

HUMAN DISEASES AND CONDITIONS

HUMAN
DISEASES AND
CONDITIONS

Second Edition

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A number of experts in the medical community provided invaluable assistance in the formulation of this encyclopedia. The advisory board performed a myriad of duties, from defining the scope of coverage to reviewing individual entries for accuracy and accessibility. To them our sincerest appreciation is extended.

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HUMAN DISEASES AND CONDITIONS

Second Edition

Volume 1
A–C

Volume 2
D–I

Volume 3
J–R

Volume 4
S–Z

Miranda Herbert Ferrara

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Please Read—Important Information

H*uman Diseases and Conditions, Second Edition*, is a health reference product designed to inform and educate readers about a wide variety of diseases and conditions, nutrition and dietary practices, treatments and drugs, as well as other issues associated with general health. Cengage Learning believes the product to be comprehensive, but not necessarily definitive. It is intended to supplement, not replace, consultation with a physician or other healthcare practitioner. While Cengage Learning has made substantial efforts to provide information that is accurate, comprehensive, and up-to-date, Cengage Learning makes no representations or warranties of any kind, including without limitation, warranties of merchantability or fitness for a particular purpose, nor does it guarantee the accuracy, comprehensiveness, or timeliness of the information contained in this product. Readers should be aware that the universe of medical knowledge is constantly growing and changing, and that differences of opinion exist among authorities. Readers are also advised to seek professional diagnosis and treatment for any medical condition, and to discuss information obtained from this product with their healthcare provider.

Today's Fish

Whenever there is a second edition of a reference work, there is the strong implication that the first edition satisfied important needs and was well received. This is certainly the case with respect to the second edition of *Human Diseases and Conditions*, but there are extraordinary circumstances which make this new work especially important.

First, healthcare has recently emerged as one of the most vital issues of our time. Every informed citizen must now have a general understanding of human diseases and conditions—their cause, diagnosis, treatment, prognosis, and economic consequences—in order to play a role in the crucial reforms that are coming to our society. This is especially true of young adults.

Second, the understanding of human diseases and conditions undergoes evermore rapid change. In the 1,343 years that followed the death of the great physician Galen (c. 130–c. 200) and the declaration of his divinity and the sanctification of his ideas, there were virtually no changes or advances to our thinking about human diseases and conditions until Andreas Vesalius (1514–1564) published his great work, *De humani corporis fabrica*, in 1543. That was in the age of anatomy, when Western medical discovery focused on human dissection. It was followed by the ages of pathology, pathophysiology, microbiology, immunology, and now molecular and regenerative medicine.

The rapid advances in science and technology, including informatics, make it imperative to update and reevaluate the fields of health and human disease frequently. This second edition is fresh and up-to-date; it emphasizes new and very practical conceptualizations like the Metabolic Syndrome and strategies to reduce the epidemics of childhood obesity, Type 2 diabetes, heart disease, and stroke. It discusses important new diseases such as avian influenza (bird flu), and conditions like Internet addiction and bullying, and contains frank discussions of subjects such as body odor, drug addiction, behavioral and school-related disorders, eating and gender difficulties, among many others.

This edition is fresh and new—it is Today's Fish.

Life and health reflect the fluxing equilibriums between organisms and the environment. That is why the most exciting aspect of human diseases and conditions is the way in which they change. When the first edition of this encyclopedia was prepared in 1999, the diagnosis of AIDS was like a death sentence and the treatment section concluded that "...Experts believe that people with AIDS eventually will die from it. ...". Now, only a few years later, AIDS is one of the most treatable chronic diseases. Leading clinical experts currently tell their patients that if they follow their treatment regimens they will not die of AIDS, and there are data to prove that. SARS was virtually unknown. HPV vaccine was not yet available for use. Similarly, the fields of genetics, epi-genetics, and molecular biology are increasingly transforming our understanding of the human condition. In the last few years we have actually begun to engineer diseases, like sickle-cell anemia, out of the human genome.

The second edition of *Human Diseases and Conditions* builds on the solid foundations of the first. It provides updated information on every subject. It includes nearly 90 new and important subjects, many of which are especially timely and of interest to our readership. And throughout there is an emphasis on the new paradigms which are now essential to our understanding and involvement in human biology and healthcare. Thus, the completely rewritten chapter on sickle-cell anemia discusses how Linus Pauling's analysis of the structure of hemoglobin S (Hb S) ushered in the age of molecular biology; how heterozygosis for the Hb S gene provides a survival advantage for individuals living in

endemic-malaria regions, which explains its high prevalence in those areas; and how preimplantation genetic diagnosis and blastocyst selection are now removing Hb S from family genomes. Similarly, new entries on genetic disorders include both generic and specific discussions of the problems and horizons for gene therapy, and entries dealing with regenerative medicine discuss the controversies, promises, and current achievements of stem cell research and their applications.

This *Second Edition* recognizes the many and increasing contributions of women to the theory and practice of medicine. The great achievements of Helen Taussig with respect to the diagnosis and treatment of congenital heart disease; Rosalyn Yalow's revolutionary development of radioimmunoassay (RIA), which advanced all areas of medicine and biology; the astounding cures of childhood leukemias by Gertrude Elion; and Rita Levi Montalchini's discovery of the growth factors that are so essential to stem cell and regenerative medicine. All of their work was developed under trying circumstances but eventually won the highest accolades in science and medicine. These facts are important for the education of young men and women and highlight current changes in medical career opportunities and research directions. The continuing struggles against race, gender, and class bias are essential to progress with regard to human diseases and conditions.

Every attempt has been made to embrace scientific complexities and to express them in authoritative yet readily available prose. By the same token, political and economic issues have not been excluded from this work. In fact, what comes through is the reality that dealing with human diseases and conditions has always been, and will ever be, at the cutting edge of human cultures and their most pressing controversies. This is the place where our values can truly be seen without the camouflage of ideology. It is increasingly difficult to doubletalk around the meaning of millions of men, women, and children being left out of timely diagnosis and treatment for the human diseases and conditions dealt with in this work. It is also clear that being driven into bankruptcy and homelessness by the excessive and unnecessary costs of a health care system that many contend is virtually unique in its waste, inefficiency, and obsolescence is something that should not be excluded from discussions of human diseases and conditions. All conscious members of society should have access to information which enlightens them to what exists, what is changing, and what the choices for improvement really are. In an age of increasing power over human diseases and conditions our society is lagging far behind with respect to inclusiveness, patient satisfaction, cost effectiveness, and healthcare outcomes. These are not controversial statements, they are the conclusions of US government agencies like the General Accountability Office (GAO) and the World Health Organization (WHO).

Let us hope that this second edition of *Human Diseases and Conditions* will provide vital information and contribute to an atmosphere within which medicine and science can flourish and young people can make informed decisions about their lives and their futures.

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About This Edition

Human Diseases and Conditions, Second Edition is the completely reviewed, revised, and expanded version of Charles Scribner's Sons' well received *Human Diseases and Conditions* (2000) and its two supplements (2001, 2003). Offering in-depth coverage of all areas of human health and disease, *Human Diseases and Conditions, Second Edition* offers current and accurate information on approximately 450 diseases and conditions. The topics covered include tropical diseases (malaria, Chagas' disease), infectious diseases (STDs, HIV/AIDS), many cancers, worrisome conditions (hives, hair loss), psychological conditions (phobias, obsessive/compulsive disorder), and human conditions (addiction, homelessness), as well as public health issues (environmental diseases, bioterrorism, vaccination) and issues of interest to the young adult audience (growth, puberty, suicide, sports injuries, eating disorders).

Originally designed for use by middle and high school students, it soon became apparent that the features of the first edition, which made it appealing to students, also made it appealing and accessible to readers of all ages. Therefore, the editors of this second edition have built on the foundation established by the first edition and its supplements.

Should this book be used to diagnose or treat medical problems? Not at all. This is a reference book. The human body is very complicated. Many medical problems have the same sorts of symptoms, and your doctor is trained to recognize the difference between those that seem alike but really are quite different. If you have medical concerns, do not try to diagnose and treat yourself (or your friends). Ask your doctor or other healthcare practitioner.

Compilation Methods

Each of the 365 entries which appeared in the first edition of *Human Diseases and Conditions* and its supplements was reviewed by a board of medical advisors who made recommendations for its updating. In addition, the board identified 85 topics that were not covered in the first edition or its supplements which they felt needed to be included in the *Second Edition*. These topics include:

- Diseases and conditions which filled out an existing area covered in the first edition, such as brain, ovarian, and thyroid cancers in the cancer field, and menopause in the area of women's health
- Newly identified diseases/conditions including Avian Influenza, Caffeine-related Disorders, Internet Addiction Disorder, Severe Acute Respiratory Syndrome (SARS)
- Conditions made popular by television advertising such as Chronic Obstructive Pulmonary Disease (COPD), Erectile Dysfunction (ED), Human Papilloma Virus (HPV)
- Genetic diseases like Familial Mediterranean Fever and Fanconi Anemia
- General interest articles such as Aging; Conjoined Twins; Gay, Lesbian, and Transgender Health; Sports Injuries
- Public Health Issues including Chemical Poisoning and Toxic Inhalation Disorders

as well as many others.

Once an entry was written or revised by a medical writer, it was reviewed again by the advisor in charge of the original review to assure the entry presented the information clearly, accurately, correctly,

and in an unbiased manner. It was then given a final vetting by a physician to guarantee that the information across entries was correct and solid. The last review was made by a copyeditor who brought the language and grammar into line across entries and made sure that the presentation of the information was consistent.

Anatomy of an Entry

Order of Entries: Entries in *Human Diseases and Conditions, Second Edition* are arranged in alphabetical order, word-by-word.

Each entry has an introductory paragraph of one sentence to three short paragraphs defining the topic with parenthetical guides to pronouncing important and possibly unfamiliar terms.

The body of the entry is defined by headings in the form of questions starting with a story of a person affected by the disease/condition. Typical headings include:

- What is the disease/condition?
- How common is the disease/condition?
- Is the disease/condition contagious?
- How do people know they have the disease/condition?
- How do doctors diagnose and treat the disease/condition (with subheads Diagnosis, Treatment, Complications if needed)?
- Can the disease/condition be prevented?

Each entry concludes with a list of resources and organizations for further information, both in print and on-line. Every effort was made to include at least two articles or books and two organizations in each entry.

Special Features

Sidebars: *Human Diseases and Conditions, Second Edition* offers two types of sidebars. The **main text sidebar** falls within the body of the entry and contains information such as historical data about the disease/condition or biographical information about people involved with the discovery of the disease/condition. The **marginal sidebar** falls in the margin and contains information such as statistics, health hints, and “fun facts.”

Photographs and Illustrations: Every attempt has been made to assure that each entry has appropriate illustrations and photographs to help the reader better understand the topic. New to *Human Diseases and Conditions, Second Edition* is a variety of charts and tables to present key facts at a glance.

Definitions: Terms that are used in an article but may be unfamiliar to readers have been starred in the text and the definition appears in the margin of the page. Definitions include diseases, medical terms, parts of the body, and other terms that may not be familiar to all readers.

Cross-references: A system of cross-references, devised by the advisory board, is in place to inform readers of related entries throughout *Human Diseases and Conditions, Second Edition*. Cross-references may appear at the end of an article as a “see also” reference or as a “blind entry” (“see” reference) in the body of the work.

Index: A comprehensive index of concepts, names, and terms enables readers to locate topics throughout *Human Diseases and Conditions, Second Edition*. Many subjects are not treated in separate entries but within the context of comprehensive entries; the index will guide readers to discussions of these subjects.

New to This Edition

In addition to increasing the number and type of resources, illustrations, and definitions, *Human Diseases and Conditions, Second Edition* contains three new compilations of information found in individual entries brought together into one convenient place. They are:

- **Bibliography:** The bibliography brings together over 800 book, periodical, and on-line resources mentioned in the *Resources* section of the entries.
- **Glossary of Terms:** All the terms defined in the margins of *Human Diseases and Conditions, Second Edition* also appear in the glossary with their definitions.
- **List of Organizations:** The 430 organizations cited in the entries have been compiled into one list. This lists the address and home page URL of the organization and has a short description of the organization if available.

Suggestions Welcome

Comments and suggestions from users of *Human Diseases and Conditions, Second Edition* on any aspect of the product as well as suggestions for a disease or condition to be included or updated in a future edition are cordially invited. Please write:

The Editor
Human Diseases and Conditions
Charles Scribner's Sons, a part of Gale, Cengage Learning
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Farmington Hills, Michigan 48331-3535

A

Abscesses

Abscesses (AB-seh-sez) are localized or walled off accumulations of pus caused by infection that can occur anywhere within the body. Furuncles (FYOOR-ung-kulz), which are also known as boils, and carbuncles (KARBUNG-kulz) are types of abscesses that involve hair follicles* and occur on the skin.*

What Are Abscesses?

An abscess develops when the body's immune system* isolates an area of body tissue that has been infected by an invading microorganism* (usually bacteria) to prevent the infection from spreading further. The body sends infection-fighting leukocytes (LOO-kuh-sites) to the infected area; leukocytes are specialized white blood cells that can destroy infectious microorganisms such as bacteria, parasites, and viruses.

As the bacteria and white blood cells clash at the site of infection, pus begins to form within the involved tissue. As the infection progresses, a wall of tissue develops surrounding the infection site, forming an abscess. A growing abscess on the skin is usually warm, red, painful, and swollen with pus.

Abscesses that grow inside the body are uncommon but can be very serious. Internal abscesses can occur anywhere within the body, but some of the more common areas where they form include surrounding the appendix* (as when someone has appendicitis, ah-pen-dih-SY-tis, an inflammation

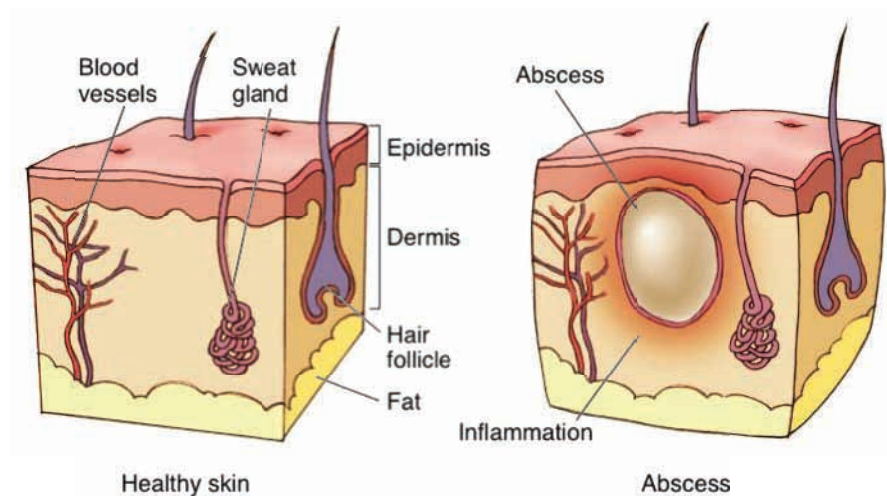
* **pus** is a thick, creamy fluid, usually yellow or ivory in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

* **hair follicles** (FAH-ih-kulz) are the skin structures from hair develops and grows.

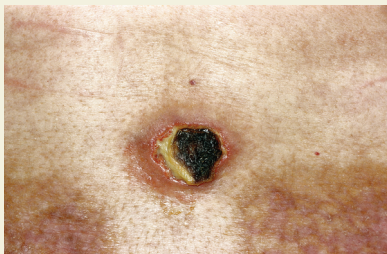
* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **microorganism** is a tiny organism that can be seen only by using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

* **appendix** (ah-PEN-diks) is the narrow, finger-shaped organ that branches off the part of the large intestine in the lower right side of the abdomen. Although the organ is not known to have any vital function, the tissue of the appendix is populated by cells of the immune system.



◀ An external abscess is an accumulation of pus that results from bacterial infection. Abscesses that form under the skin may go away on their own. Some require drainage (removal of the pus). *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



▲
A carbuncle is a deep seated infection of the skin and underlying tissue that consists of a cluster of boils. There are usually one or more openings draining pus onto the skin.

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* **tonsils** are paired clusters of lymphatic tissue in the throat that help protect the body from bacteria and viruses that enter through a person's nose or mouth.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

of the appendix), surrounding one of the tonsils* (a peritonsillar, per-ih-TON-sih-lar, abscess), and in the gums or jaw (a dental abscess). They may also form in the liver, around the spinal cord, or on or in the brain. People who have weak immune systems, such as those who need chemotherapy* for cancer or someone with diseases such as longstanding diabetes* or HIV*/AIDS*, are at more risk for developing internal abscesses.

Furuncles (boils) are a type of skin abscess most commonly found on the face, neck, armpit, groin, buttocks, and thighs. Carbuncles are larger areas of skin infection made up of several boils that have formed close together and then joined. They take longer to form and are often located on the back and the nape of the neck. Men are more likely to develop carbuncles than are women. Fever and a general feeling of illness are often associated with carbuncles.

What Causes Abscesses?

Bacteria that are commonly found on the skin, especially *Staphylococcus aureus* (stah-fih-lo-KAH-kus ARE-ree-us) and Group A β -hemolytic* *Streptococcus* (he-muh-LIH-tik strep-tuh-KAH-kus) typically cause most abscesses, furuncles, and carbuncles. People who have staphylococcus bacteria residing in their nose (called staph colonization) may be prone to developing recurrent skin abscesses.

Much of the skin's surface is covered by hair. At the base of each hair is a hair follicle, a sac-like pit in which the hair shaft develops and grows. If the skin around a hair follicle has been damaged in some way, such as with a cut or a nick on the skin from shaving, bacteria on the skin's surface can enter and start to cause an infection. This alerts the body's immune system, which walls off the area around the infected hair follicle. As the body's defenses go to work, the area fills with pus and becomes inflamed. When an area of skin contains infected, inflamed hair follicles, the condition is known as folliculitis (fuh-lih-kyoo-LYE-tis).

A boil usually starts within an area of folliculitis. The growing pus inside the boil creates pressure and swelling around the infected spot, often forming a drainage point at the surface of the skin called a head. A carbuncle typically has many small areas where pus has collected and formed heads.

Abscesses that appear inside the body, such as within the abdomen, may be caused by types of bacteria different from those that cause skin infections. For example, an abscess that forms with appendicitis may be caused by a blockage in the appendix (known as a stone). These abscesses usually contain bacteria normally found inside the intestine and in bowel movements. A liver abscess can occur when an infection in the abdomen spreads or when an infectious agent from somewhere else in the body travels through the bloodstream and is deposited in the liver.

Are Abscesses Contagious?

Abscesses are not contagious, but the bacteria that cause them can spread from person to person and can cause other types of infections. Individuals who touch a boil that is draining pus should wash their hands, and cloths

WHAT ABOUT METHICILLIN-RESISTANT STAPHYLOCOCCAL AUREUS?

While staphylococcus bacteria have long been implicated in abscess formation, a later strain that is resistant to methicillin and other antibiotics was circulating in the early 2000s. This type of infection, called community-associated methicillin-resistant Staphylococcal Aureus (MRSA), was particularly worrisome because it might be more contagious via contact than other forms of staph infections. Groups of people who have close physical contact are vulnerable to this type of infection, for example, children in daycare or other crowded school settings, people participating in contact sports, prisoners, military personnel, homeless people, homosexual men, and intravenous drug users. An abscess caused by this type of bacteria does not respond to the usual types of antibiotics, although some oral antibiotics may be effective. More serious infections due to these organisms require intravenous (IV) antibiotics. An abscess caused by MRSA will probably require incision and drainage, and in some severe cases a wide-excision of all infected tissue is required in order to rid the body of the organism and lower the risk for systemic spread of this virulent organism.

or towels that have touched an open or draining boil or carbuncle should not be shared.

How Are Abscesses Treated and Prevented?

Skin abscesses sometimes need to be drained before they can heal, although most of the time they heal on their own without medical treatment. Skin abscesses are often treated at home by applying warm compresses. The abscess usually comes to a head on its own, then begins to drain and heals soon afterward.

Boils and carbuncles that do not drain on their own should not be squeezed or lanced (cut open) to remove pus by anyone but a healthcare provider. Trying at home to puncture a boil could force the infection deeper into the skin and spread the bacteria. Skin abscesses that do not improve on their own will need to be lanced by a doctor to prevent the infection from becoming worse. The area is thoroughly cleaned before it is lanced, and antibiotics are sometimes prescribed. Most carbuncles require antibiotic treatment.

Internal abscesses are usually treated with surgical drainage and antibiotics. If a dental abscess is not treated with antibiotics it can destroy the root of a tooth, leading to the need for a root canal* procedure or the removal of the entire tooth.

Job Syndrome

The Bible includes a story in which God tests the faith and devotion of Job by allowing him to become afflicted from head to toe with painful boils. Job syndrome is named for this biblical figure's condition. People who have this rare disease experience recurring cases of severe abscesses on the skin and in the lungs, sinuses, and bones.

* **hemolytic** (he-mo-LIT-ik) refers to destruction of red blood cells with the release of hemoglobin into the bloodstream.

* **root canal** is a procedure in which a dentist cleans out the pulp of an infected tooth, removes the nerve, and then fills the cavity with a protective substance.

Keeping the area around a minor skin wound clean and dry, not sharing razors, and using antibacterial soap can help prevent skin abscesses.

▶ See also **Staphylococcal Infections** • **Streptococcal Infections**

Resources

Books and Articles

Donovan, Sandy, and Jack Desrocher. *Stay Clear! What You Should Know about Skin Care*. Minneapolis, MN: Lerner, 2009.

Organizations

American Osteopathic College of Dermatology. 1501 East Illinois Street, P.O. Box 7525, Kirksville, MO, 63501. Toll free: 800-449-2623. Web site: http://www.aocd.org/skin/dermatologic_diseases/boils.html.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/000863.htm>.

New Zealand Dermatological Society. c/o Tristram Clinic, 6 Knox Street, Hamilton, New Zealand. Web site: <http://dermnetnz.org/bacterial/boils.html>.

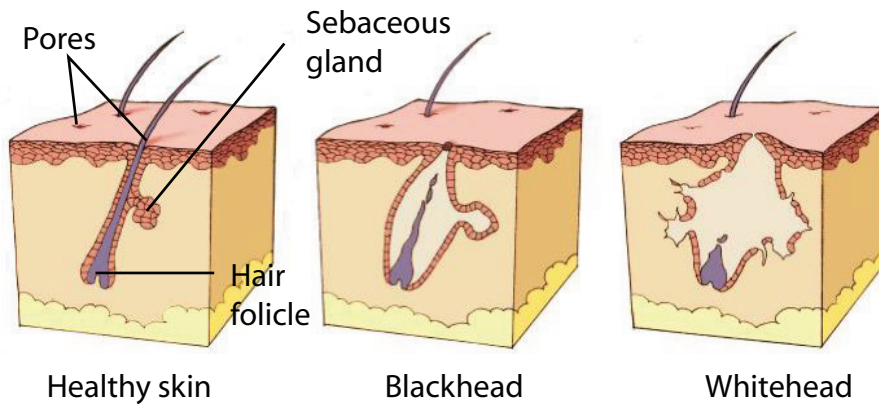
Acne

Acne (AK-nee) is a condition in which there are pimples, blackheads, whiteheads, and sometimes deeper lumps on the skin.

Jay's Story

Before he turned 13, Jay's skin was clear. Soon after the start of eighth grade, though, Jay noticed a few pimples on his face. Before long, the problem had gotten much worse. Jay's face was always broken out, and the pimples had spread to his neck, back, and chest.

Jay was willing to try almost anything to get rid of his acne. He had heard that it is caused by dirt or by eating certain foods, so he washed his face several times a day and gave up chocolate, nuts, and french fries. He also tried several acne medicines sold without a prescription. Nothing worked. Finally, Jay went to see the doctor, who prescribed a medicine. Within a few weeks, the acne started to go away. Although Jay had to



Healthy skin (left) has pores, hair follicles, and sebaceous glands that make an oily substance called “sebum.” Sebum helps keep skin and hair healthy by carrying away dead skin cells that have been shed by the follicle linings. If the cells shed too fast and stick together, they may form a plug at the surface of the skin. If the opening to the surface stays partly open, the top of the plug may darken, causing a blackhead (center). If the opening to the surface closes, the follicle may fill up and its wall may start to bulge, causing a whitehead (right). If the follicle wall bursts, the oil, cells, and bacteria spill into the skin. The result is redness, swelling, and pus. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

keep using medicine and seeing the doctor for a while, he felt that his improved appearance was well worth the trouble.

What Is Acne?

Acne is the name for pimples or comedones*: blackheads, whiteheads, and sometimes deeper lumps that occur on the skin, especially on the face, neck, chest, back, shoulders, and upper arms and legs. Almost all teenagers have at least a little acne, and some adults have the problem as well. Although acne is not a serious health threat, it affects the appearance, which in turn can affect how individuals feel about themselves. Severe acne can leave permanent scars on the skin.

Acne occurs when hair follicles (FOL-li-culs) become plugged. The follicle is a tiny shaft in the skin through which a single strand of hair grows. Follicles are connected to sebaceous (se-BAY-shus) glands, which are small structures in the skin that make an oily substance called sebum (SEE-bum). This oil helps keep the skin and hair healthy. To reach the surface of the skin, the oil drains from the glands into the follicles then leaves the follicles through tiny openings in the top of the shaft. As it leaves the follicles, the oil carries away dead skin cells shed by the follicle linings.

What Are Different Kinds of Acne?

Sometimes the cells inside the follicles shed too fast and stick together, forming a white, thick plug at the surface of the skin. If the opening to the surface stays partly open, the top of the plug may darken, causing a blackhead. If the opening to the surface closes, the follicle may fill up and its wall may start to bulge, causing a whitehead. The mixture of oil and cells inside the follicle also aids the overgrowth of bacteria. If the follicle wall bursts, the oil, cells, and bacteria spill into the skin. The result is redness, swelling, and pus*, in other words, a pimple. Ordinary acne is made up of blackheads, whiteheads, and pimples.

At times, large, pus-filled lumps called cysts (SISTS) form deeper in the skin. In this more severe form of acne, the lumps may be painful, and if they are not treated by a doctor, they may lead to permanent scars.

◀

* **comedo** (KOM-e-dones) are acne pimples. Blackheads are open comedones. Whiteheads are closed comedones. Cosmetics that are labeled non-comedogenic (non-kom-e-do-JEN-ik) are less likely to cause pimples.

* **pus** is a thick, creamy fluid, usually yellow or ivory in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

How Do Hormones Cause Acne?

Nearly all teenagers have at least an occasional pimple. The problem usually starts between the ages of 10 and 13, and it typically lasts for 5 to 10 years. Acne usually goes away on its own when people reach their early twenties. However, it can last into the twenties, thirties, and beyond. A few people get acne for the first time as adults. Acne strikes boys and girls about equally. However, boys are more likely than girls to have more severe, longer-lasting forms of acne.

During the teen years, both boys and girls go through changes in their hormones*. One group of hormones called androgens (AN-dro-jens) seems to play a role in acne. Among other factors, androgens make the sebaceous glands work harder. The more oil the glands make, the greater the chance that the follicles will become clogged. Teenage boys make ten times as much androgen as teenage girls, so it is not surprising that boys are more likely to get more severe cases of acne.

What Else Causes Acne?

Certain oily kinds of makeup and face cream can clog the openings of the skin and cause mild acne. That may mean that people who try to cover their pimples with makeup actually make the problem worse by causing new pimples. Oil-free products are labeled “non-comedogenic” (non-kom-ee-do-JEN-ik), meaning they should not cause blackheads or whiteheads, or “non-acnegenic” (non-ak-nee-JEN-ik), meaning they should not cause acne.

Several other factors can cause acne or make it worse. These include certain medicines. People who work in fast food restaurants or garages may find that their acne is made worse by the constant contact with grease, motor oil, or chemical irritants. Many girls also find that their pimples get worse around the time of their menstrual periods.

What Does Acne Look Like?

Acne is typically found where the sebaceous glands are most numerous: on the face, neck, chest, back, and shoulders. Blackheads are small round dark spots, whereas whiteheads are spots with a white center. Pimples look like small, red bumps. Some of them have a white center with a ring of redness around it. When pimples occur with no blackheads or whiteheads, they may be a sign of another skin disease or a skin reaction to medication. Cysts are large, red bumps that are often painful. They may leave deep pits and scars after healing.

It is usually easy for a doctor to recognize acne by sight. It is smart to see a doctor whenever the following is the case:

- Acne interferes with a person's life
- Acne spots are large, red, and painful
- Acne causes dark patches to appear on a dark-skinned person
- Acne scars remain when the acne spots heal
- Treatment with nonprescription medication does not work

How Is Acne Treated?

Acne treatments work by stopping new pimples from forming. They do this by cutting back on the amount of oil the sebaceous glands make, the number of bacteria that are present in the skin, or the rate at which dead skin cells are shed. It is important to give an acne treatment enough time to do its job. It may take weeks for the skin to clear up, even if a treatment is working.

Over-the-counter medications Milder cases of acne are often helped by lotions, creams, pads, and gels sold without a prescription. Many of these dry out the skin if used too frequently, however, and it is important to follow label instructions carefully.

Prescription medications A doctor may prescribe stronger medicines than those sold over the counter. These come in cream, gel, or liquid form (tretinoin), or pill form (isotretinoin). These medications carry serious side effects: skin dryness and peeling with tretinoin; and with isotretinoin, chapped lips, itchy skin, nosebleeds, irritation of the eyelids, joint and muscle pain, temporary hair loss, and rash. The doctor can offer advice on how to deal with these side effects.

Women who are pregnant or who may become pregnant during treatment should refrain from using isotretinoin as it may harm the developing fetus*.

Other treatments Doctors may prescribe topical or oral antibiotics* to help fight the overgrowth of bacteria on the skin.

The doctor may open pimples or remove blackheads and whiteheads in the office. A skilled doctor is the best one to do this. People who try to do it themselves may wind up making the acne worse and increasing the risk of scarring.

What Does Not Cause Acne?

Acne is not caused by being dirty. The black core in a blackhead is dried oil and dead skin cells, not dirt. Washing too often may actually irritate the skin and make the acne worse. In general, the following guidelines may help to prevent acne or to reduce its symptoms:

- Do not pop, squeeze, or pick at acne pimples, as this can lead to more redness, swelling, and permanent scars.
- Choose oil-free makeup and face creams labeled “non-comedogenic” or “non-acnegenic.”
- Avoid skin irritants, such as grease, oil, and rough clothes and sports equipment.
- Wash the face gently twice a day with a mild soap, then pat it dry.
- Shampoo hair regularly.
- For men who shave, shave as lightly as possible to avoid nicking any pimples.



▲ Acne is characterized by blackheads, whiteheads, and pustular nodules.

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* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

Acne is also not caused by the foods a person eats. Studies have shown that a strict diet alone will not clear up the skin. However, some people are still convinced that certain foods such as chocolate or french fries make their acne worse. It certainly cannot hurt to cut back on junk food. A healthier diet is always a plus, whether it has an effect on acne.

▶ See also **Cyst • Skin Conditions**

Resources

Books and Articles

Day, Doris J. *100 Questions & Answers about Acne*. Sudbury, MA: Jones and Bartlett, 2005.

Fried, Richard G. *Healing Adult Acne: Your Guide to Clear Skin & Self-Confidence*. Oakland, CA: New Harbinger, 2005.

Goodheart, Herbert P. *Acne for Dummies*. Indianapolis, IN: Wiley, 2006.

Organizations

American Academy of Dermatology. P.O. Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: http://www.aad.org/public/publications/pamphlets/common_acne.html.

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://familydoctor.org/online/famdocen/home/common/skin/disorders/001.html>.

American Osteopathic College of Dermatology. 1501 East Illinois Street, P.O. Box 7525, Kirksville, MO, 63501. Toll free: 800-449-2623. Web site: http://www.aocd.org/skin/dermatologic_diseases/acne.html.

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-226-4267. Web site: http://www.niams.nih.gov/Health_Info/Acne.

Acquired Immune Deficiency Syndrome/Acquired Immunodeficiency Syndrome See *AIDS and HIV Infection*.

Acromegaly See *Growth and Growth Disorders*.

Addiction

Addiction (a-DIK-shun) refers to the abuse of a substance, such as alcohol or another drug, to the point at which a person develops a physical or psychological need for it. The term also may be used to describe a behavior that is out of control, such as gambling or spending too much time on the Internet.*

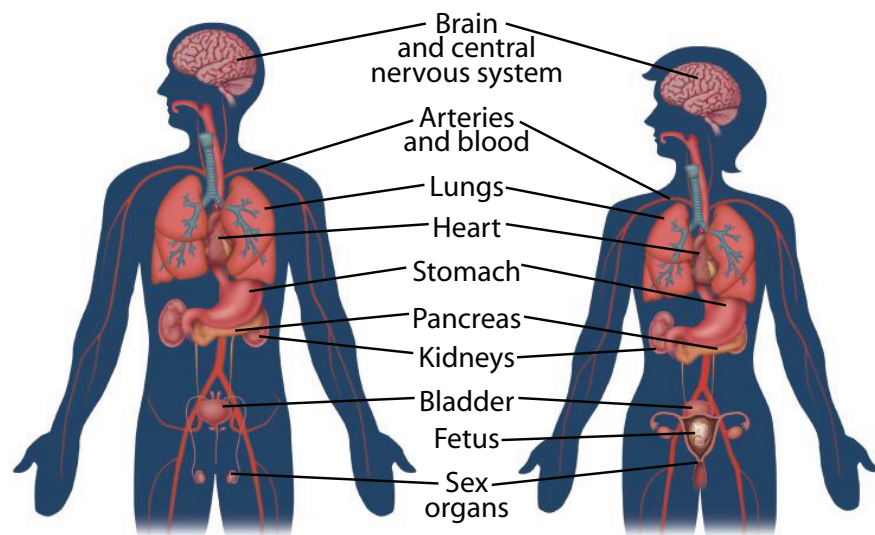
Josh's Story

When friends first told Josh that his drinking and drug use were out of control, he ignored them. He liked to party, he said, but he could stop anytime he wanted. He did not stop, though, no matter how much his grades fell and his soccer game suffered. He still did not stop even after he was kicked off the soccer team and lost many of his friends. Eventually, Josh had to admit that his use of alcohol and drugs had gotten out of control. He had developed an addiction, he now said, and he needed help to fight it.

What Is Drug Addiction?

People who have an addiction are commonly said to be “hooked” on a substance or behavior. It is an apt choice of word, since addicts often feel as if they are dangling like a fish on a hook and that they cannot break free. Fortunately, this is not true. Treatment can help people overcome addiction and regain control of their lives.

Psychological dependence Some people feel as if they have lost control of their drinking or drug use, yet they do not show signs of tolerance* or withdrawal. While these people may not be physically hooked on a substance, they can still have a strong psychological dependence on it.



* **psychological** (SI-ko-LOJ-i-kal) refers to mental processes, including thoughts, feelings, and emotions.

* **tolerance** (TALL-uh-runce) a condition in which a person needs more of a drug to feel the original effects of the drug.

◀ Addiction affects many different parts of the body. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

- * **amphetamines** (am-FET-a-meenz) are stimulants, drugs that produce a temporary feeling of alertness, energy, and euphoria.
- * **cocaine** (ko-KAYN) is a stimulant, a drug that produces a temporary feeling of alertness, energy, and euphoria.
- * **LSD** short for lysergic acid diethylamide (ly-SER-jik A-sid dy-e-thel-AM-eyed), is a hallucinogen, a drug that distorts a person's view of reality and causes hallucinations.
- * **PCP** short for phencyclidine (fen-SY-kle-deen), is a hallucinogen, a drug that distorts a person's view of reality.
- * **withdrawal** a group of symptoms that occurs when a drug that causes physical or psychological dependence is regularly used for a long time and then suddenly discontinued or decreased in dosage.

FROM USE TO MISUSE TO ABUSE TO ADDICTION

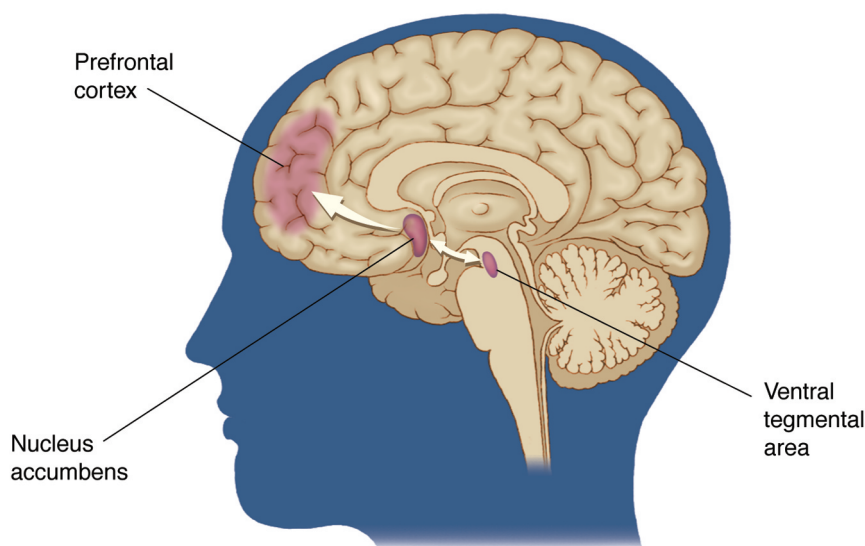
Alcohol or drug use by teenagers typically moves through four stages as it goes from occasional use to addiction. The stages are:

- **Occasional use:** Teenagers at this stage typically use beer, marijuana, or inhalants on weekends with their friends. There are few obvious changes in their behavior during the week.
- **Regular misuse:** Teenagers at this stage actively seek the high they get from drinking or using drugs. They may try stimulants (amphetamines* or cocaine*) or hallucinogens (LSD* or PCP*), and they may use drugs four or five times per week, even when they are alone. Grades start to slip, activities fall by the wayside, and old friends are replaced with new ones who also use alcohol or drugs.
- **Frequent abuse:** Teenagers at this stage can have mood swings that go from extreme highs to such lows that suicide becomes a risk. Many start to sell drugs to support their habit. As the drug use continues, lying, fighting, stealing, and school failure become on-going problems.
- **Addiction:** Teenagers at this stage may need alcohol or drugs every day to fend off withdrawal*. They will use whatever drug is handy and do whatever it takes to get high. Drug use is all they think about, and they may feel as if they have lost control. Guilt, shame, and depression are common emotions, and overdoses and medical problems may occur.

Psychological dependence is present when individuals are convinced they cannot manage or enjoy themselves without using. The substance, they believe, helps them cope. Like people with a physical dependence, these individuals feel an intense craving, which leads them to believe that using is necessary.

Physical dependence People with an addiction to alcohol or another drug develop a physical dependence on the substance, which is a strong need to use it no matter how bad the consequences may be. One sign of physical dependence is called tolerance. When individuals develop tolerance for a certain substance, they need more and more of it to get the same effect they originally got with a small amount. If individuals keep using the same amount of the substance, after a while they notice that it does not have the original effect anymore.

Another sign of physical dependence is withdrawal, which means that people who are hooked on a substance can have physical symptoms, including feeling sick if they stop using it. The symptoms are so unpleasant that people may be driven to start using the substance again just so



Addiction is believed to change the brain's pleasure circuits and pathways. A complex cascade of signals within the brain creates the craving that characterizes addiction. Thus, an addiction to a substance may be both psychological and physiological, as the body creates demands that are out of the person's control. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



they can feel better in the present. Withdrawal discomfort explains why addicted individuals come back for more of a substance, even after they realize that they have a serious problem.

People who are dependent on alcohol or other drugs, either psychologically or physically, often spend much of their time finding ways of getting the substance, using it, hiding it, and recovering from its ill effects. Friendships, school, work, sports, and other activities all are negatively affected as a result. As the problems pile up, people may want desperately to give up the substance, yet they find it very hard to do so despite repeated efforts to kick the habit. Often, users will not see the connection between drug use and life problems. They think that the issues in their lives justify their drug and alcohol use and deny that their substance abuse is the underlying problem causing those issues.

What Causes Drug Addiction?

Addiction usually begins with a conscious choice to drink or use drugs. It begins with a small exposure to a drug and repeated exposure to that drug. People often turn to alcohol or other drugs to avoid whatever is bothering them. For teenagers, this may mean pressure from friends, stress at home, or problems at school. Teenagers may also assume that drinking or using other drugs will help them fit in, let them overcome their shyness at parties, or make them look more grown up. Some just like the feeling of being high. In the long run, though, these individuals feel worse. The more they drink and use drugs, the more problems arise, and the harder it is to stop. By this point, however, people may feel as if they no longer have a choice, because the urge to use alcohol or drugs has become so powerful.

To understand how alcohol and drugs can gain such a strong hold on people, it helps to understand how these substances act inside the body. Once a substance is taken in through drinking, smoking, injecting, or

The Tiniest Addicts

Babies who are born addicted to substances their mothers used during pregnancy go through drug withdrawal after birth. Babies born addicted to heroin, for example, sneeze, hiccup, twitch, and cry. They also may have such symptoms as restlessness, shakiness, trouble sleeping and eating, a stuffy nose, vomiting, diarrhea, a high-pitched cry, fever, irregular breathing, and seizures. These symptoms usually start within a few days after birth, and some can last for three months or more. As they develop, these children can experience behavioral problems, learning difficulties, mental retardation, and retarded growth.

- * **heroin** is a narcotic, an addictive painkiller that produces a high, or a euphoric effect. Euphoria (yoo-FOR-ee-a) is an abnormal, exaggerated feeling of well-being.
- * **inhalants** (in-HAY-lunts) are substances that a person can sniff, or inhale, to get high.
- * **marijuana** (mar-a-WA-na) is a mixture of dried, shredded flowers and leaves from the hemp plant that a person can smoke or eat to get high.
- * **morphine** (MOR-feen) is a narcotic, an addictive painkiller that produces a high.
- * **sedatives** (SAID-uh-tivs) are drugs that produce a calming effect or sleepiness.

inhaling, it travels through the bloodstream to the brain, which has its own built-in reward mechanism. When people engage in actions that are important for survival, such as eating, special nerve cells in the brain release chemicals that make people feel pleasure. In this way, the brain's response conditions people to want to repeat these actions in order to feel pleasure.

Substances that are addictive affect the brain's reward system. Instead of teaching people to repeat survival behaviors, though, they "teach" them to take more drugs. The way this happens depends on the substance that is being used. Some drugs, such as heroin* or LSD, mimic the effects of a natural brain chemical. Others, such as PCP, block the sending of messages between nerve cells. Still others, such as cocaine, interfere with the molecules that carry brain chemicals back to the nerve cells that released them. Finally, some drugs cause brain chemicals to be released in larger amounts than normal, such as methamphetamine, a type of amphetamine, also known as "speed." At first, drug use may seem to be fun, because it leads to feelings of pleasure or relaxation. Over time, though, drug use gradually changes the brain so that people need to take drugs just to feel normal.

Who Is at Risk of Addiction?

Addicts come in all shapes, sizes, and ages. The homeless man sleeping on the street may have an addiction, but so may the captain of the high school soccer team. Any person who abuses alcohol or other drugs is at risk of becoming addicted. For some people, however, the risk is especially high. For example, problems with drinking and drug use, just like heart disease or cancer, often run in families. Children whose parents are addicted to alcohol may be more likely than other people to have an alcohol or drug problem themselves.

People who have certain mental disorders also have a higher than average risk of addiction. This is not surprising, because it is thought that many mental disorders are caused in part by an imbalance in the same kinds of brain chemicals that drugs affect. People who suffer from depression, for example, may find that a certain drug lifts their mood for a while. The "self-medication" theory of addiction asserts that people learn to cope with a particular mood by taking a drug, in a misplaced effort to relieve their mental pain.

What Are Some Addictive Drugs?

People can become addicted to a wide range of substances, including alcohol, amphetamines, cocaine, heroin, inhalants*, LSD, marijuana*, morphine*, tobacco, PCP, and sedatives*, just to name a few commonly abused drugs.

Marijuana addiction Some people believe that marijuana use is relatively safe, because it does not lead to addiction. However, regular marijuana users may become psychologically dependent on the drug. Some longtime, heavy users also can experience mild signs of physical dependence, including tolerance and withdrawal. Some studies suggest that marijuana affects the brain's reward system in much the same way as other addictive drugs.

Alcohol addiction Alcoholism (AL-ko-hall-i-zm) is the common name for an addiction to alcohol. Some people with alcoholism develop a tolerance that lets them drink large amounts of alcohol without seeming drunk or passing out. Others have severe withdrawal symptoms if they stop drinking. Delirium tremens (de-LEER-ee-um TRE-munz) is the name given to the most severe withdrawal symptoms seen in people who have alcoholism. These symptoms include confusion, disordered thoughts, and hallucinations*.

Tobacco addiction Cigarette smoking is a difficult habit to break, because tobacco contains nicotine, a highly addictive substance. Smokers can build up a tolerance for nicotine, as shown by the fact that most smokers increase the number of cigarettes they smoke as they continue to use tobacco. They also go through withdrawal when they are unable to smoke, which explains why many smokers rush to light up as soon as they leave a place where smoking is not allowed.

Caffeine addiction Caffeine (ka-FEEN), a substance found in coffee, tea, colas, and many nonprescription medicines, is a widely used mind-altering chemical. It is no accident that coffee, a potent source of caffeine, is the favorite wake-up drink in so many homes. People often use caffeine for the temporary surge of energy it produces, much like the “buzz” that comes from some other drugs. Owing to tolerance, however, it eventually takes more and more caffeine to get this feeling. When daily coffee drinkers stop using caffeine, they may have withdrawal symptoms, such as headaches, fatigue, and irritability.

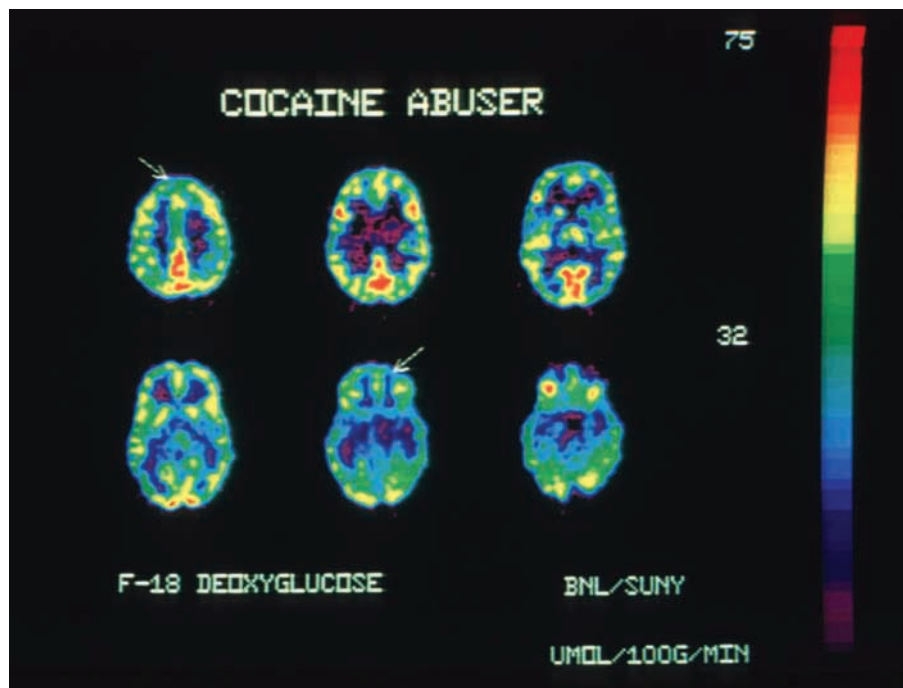
What Is an Addictive Disorder?

People may also develop harmful behavior patterns that share many of the same traits as dependence on alcohol or other drugs. Such behaviors sometimes are referred to as addictions although the abuse of a substance is not involved. Among the types of behavior that can be taken to an unhealthy extreme are gambling, sexual activity, and Internet use. When people say they have an addiction to gambling, for example, they mean that they have trouble controlling their desire to gamble, even when they experience harmful consequences, such as losing a lot of money.

Experts disagree about whether this kind of out-of-control behavior should be termed an addiction. Many doctors prefer to call it an impulse control disorder. People with an impulse control disorder are unable to curb their urge to do something that is harmful to themselves or others, even though they may try to resist and feel guilty for failing to do so. In everyday conversation, though, people often refer to excessive gambling, promiscuous and risky sexual activity, and Internet use as addictions, because people with these problems act much like people who are addicted to alcohol or other drugs. Rather than responding to outside chemicals, however, such people may be responding in part to natural chemicals released inside the brain. Exciting activities, such as gambling and certain risky sexual behavior, can trigger the release of brain chemicals

* **hallucinations** (ha-LOO-sin-AY-shuns) occur when a person sees or hears things that are not really there. Hallucinations can result from nervous system abnormalities, mental disorders, or the use of certain drugs.

People who use cocaine often feel smart and powerful. Actually, a brain impaired by cocaine use is less active than a healthy brain. These positron emission tomography (PET) scans show areas of high brain activity in red and yellow. Note that brain activity is reduced in the cocaine user, especially in the frontal lobes (arrows) where ideas, thoughts, plans, and memories are created. *Pascal Goetgheluck/Photo Researchers, Inc.*



* **pornography** (por-NAH-gra-fee) refers to any material, such as magazines or videos, that shows sexual behavior and is meant to cause sexual excitement.

that have an arousing effect. This is similar to the effect that people get from taking cocaine or amphetamines.

Gambling addiction Gambling addiction, also sometimes called pathological (pa-tha-LAH-ji-kal) gambling, refers to out-of-control gambling with harmful consequences. Like people addicted to substances, gambling addicts may need to risk ever-increasing amounts of money to feel the same excitement they got from gambling a small amount the first time. They may also become restless or cranky if they try to cut down or stop gambling, which makes it hard for them to quit. The continued gambling causes trouble at home, school, or work. Yet gambling addicts use their habit as a way to escape problems, much the way someone else might use alcohol or drugs as a form of escape. They may find that much of their time is spent thinking about their next bet or scheming to get more money. They also may start lying to friends and family to hide how much they are gambling, or they may need to borrow money to cover their losses. As their financial situation gets worse, they may even turn to stealing. Despite increasing problems, such people find it nearly impossible to stop gambling.

Sexual addiction Sexual feelings and desires are normal, but some people take these natural feelings to an unhealthy extreme, to the point where they are unable to control their sexual behavior. Some people might spend hour after hour looking at pornography*, whereas others might have casual sex with partner after partner. In either case, there can be serious negative consequences. People who spend too much time looking at

WITHOUT DRUGS = WITHDRAWAL

When long-term or heavy drug use suddenly stops, people experience a number of unpleasant and sometimes dangerous symptoms. These symptoms vary, depending on the substance involved. Some addictive substances and the common withdrawal symptoms that follow their abuse are:

- **Alcohol and sedatives:** shaking hands, upset stomach, vomiting, anxiety, sweating, rapid heartbeat, restlessness, trouble sleeping, seizures, and hallucinations
- **Amphetamines and cocaine:** bad mood, tiredness, vivid nightmares, increased appetite, and sleeping too much or too little
- **Caffeine:** tiredness, sleepiness, depression, anxiety, upset stomach, vomiting, and headache
- **Heroin and morphine:** bad mood, upset stomach, vomiting, muscle aches, runny nose or eyes, sweating, diarrhea, yawning, fever, and trouble sleeping
- **Nicotine:** bad mood, depression, trouble sleeping, crankiness, anger, anxiety, short attention span, restlessness, slower heartbeat, increased appetite, and weight gain

sexual pictures or videos may lose friends or drop out of other activities. Those who have numerous sex partners risk an unwanted pregnancy or a sexually transmitted disease (an infection, such as herpes or HIV, that can be passed from person to person by sexual contact).

Internet addiction A problem of the computer age is seen among people who are unable to control their online behavior. Some people feel driven to “surf” websites or play computer games for hours on end, to the point where they lose interest in offline activities. Others spend so much time “chatting” with online buddies that they have no time for real-world friends. Still others who already have trouble controlling their desire to gamble or look at pornography spend a lot of time at websites that cater to their pre-occupations. Like other drug abuse, Internet addiction isolates people and erodes their face-to-face relationships with family members and friends.

What Are the Signs of a Drug Addiction?

It is not easy for others to tell when individuals whom they know have an alcohol or drug addiction, because addicted people work hard to hide the addiction. Addicts themselves may have difficulty recognizing the signs of their addiction. Nonetheless, certain signs do suggest that something is wrong. Typical warning signs in young people include:

- Getting drunk or high on a regular basis
- Having to use more alcohol or drugs to get the same effect

- Wanting to quit but being unable to do so
- Lying about or hiding the alcohol or drug use
- Avoiding friends in order to get drunk or high
- Giving up responsibilities and activities, such as homework or sports
- Pressing others to drink or use drugs
- Taking risks, including having unsafe sex
- Driving under the influence of alcohol or drugs
- Getting into trouble with the law
- Being kicked out of school for a reason related to alcohol or drugs
- Thinking that the only way to have fun is to drink or use drugs
- Being unable later to remember actions while drunk or high
- Feeling run-down, hopeless, or depressed

What Are the Signs of an Addictive Disorder?

People with an addictive disorder may act much like those with alcohol or drug addiction. Typical warning signs include:

- Taking part in the behavior more often or intensely than intended
- Having to increase the behavior to get the same effect
- Wanting to quit but being unable to do so
- Feeling restless or cranky if the behavior stops
- Continuing the behavior despite knowing that it causes real problems
- Giving up other responsibilities and activities, such as homework or sports
- Thinking about or planning for the behavior all the time
- Spending a lot of time on the behavior and its aftereffects

How Is an Addiction Diagnosed and Treated?

An addiction is a tough problem to beat, but it can be done. The first step is to seek professional help. To make a diagnosis, a physician or mental health professional, such as a psychologist, social worker, or counselor, asks the addicted person about past and present alcohol and drug use. If possible, the doctor or mental health professional will also talk to the person's family or friends. In addition, a physician can perform a full medical checkup and may order tests to check for diseases that are more common among addicts. For example, a person who injects drugs might be tested for HIV infection, which can be contracted by sharing needles with an infected person.

Once a diagnosis has been made, there are several treatment options. Medications can help control drug cravings and relieve withdrawal symptoms. These are not the same kinds of drugs that are involved in the addiction but rather medications that help lessen the addiction problem. Talk therapy can help people with addictions understand their own behavior, develop improved self-esteem, and cope better with stress. For most people, a combination of medication and talk therapy

TWELVE-STEP PROGRAMS

Founded in Akron, Ohio, in 1935, Alcoholics Anonymous (AA) is a self-help group with a 12-step program that addicts work through to become free of their addiction. AA had grown to nearly 2 million members in more than 99,000 groups worldwide as of 2009. Not surprisingly, dozens of other self-help groups have copied its model.

A generic version of the 12 steps follows.

1. We admitted we were powerless over our addiction—that our lives had become unmanageable
2. Came to believe that a Power greater than ourselves could restore us to sanity
3. Made a decision to turn our will and our lives over to the care of God as we understood God
4. Made a searching and fearless moral inventory of ourselves
5. Admitted to God, to ourselves and to another human being the exact nature of our wrongs
6. Were entirely ready to have God remove all these defects of character
7. Humbly asked God to remove our shortcomings
8. Made a list of all persons we had harmed, and became willing to make amends to them all
9. Made direct amends to such people wherever possible, except when to do so would injure them or others
10. Continued to take personal inventory and when we were wrong promptly admitted it
11. Sought through prayer and meditation to improve our conscious contact with God as we understood God, praying only for knowledge of God's will for us and the power to carry that out
12. Having had a spiritual awakening as the result of these steps, we tried to carry this message to other addicts, and to practice these principles in all our affairs

works best. Talk therapy can be done one-on-one with a therapist or in a group.

Many people do quite well being treated at a clinic while living at home, but others may need to spend a short time in a hospital or other controlled setting. These may be appropriate for individuals who have other mental disorders, are not motivated to change, have friends who still use alcohol or drugs, or have failed in past treatment efforts. Peer group self-help programs, such as Alcoholics Anonymous or Narcotics Anonymous, are cornerstones of treatment for addiction problems.

Medications Some medications block the effects of addictive drugs and relieve withdrawal symptoms. For example, methadone (METH-a-don) is a medication used to treat heroin withdrawal, whereas naltrexone (nal-TREK-zone) blocks the effects of heroin and related drugs. Other medications discourage the use of addictive drugs. For example, disulfiram (dy-SUL-fi-ram) works against alcohol use by causing severe nausea and other unpleasant symptoms when a person who is using it drinks alcohol.

Various forms of therapy Several kinds of talk therapy (psychotherapy) are used to treat addiction. Cognitive (COG-ni-tiv) therapy targets the faulty thinking patterns that lead to alcohol and drug use. For example, people who think that alcohol protects them from pain may be helped to recognize the pain alcohol has caused them (such as loss of friends, work, and self-esteem, along with physical pain such as hangovers). People who use drinking as the only way to cope with problems may be helped to identify other ways to cope with problems. They are then helped to reconsider their old beliefs that alcohol is the only way to cope or that it protects them from pain. By discovering that old beliefs are false, individuals can decide what beliefs are more accurate. In this way, with time and effort, thinking patterns and false beliefs can change.

Behavioral (bee-HAV-yor-al) therapy takes aim at negative forms of behavior, often by using a system of rewards and punishments to replace harmful behaviors with more positive ones. A teenager, for example, might get movie tickets for having a drug-free urine sample or lose the privilege of driving the car as a result of a relapse. Behavioral therapy may also focus on identifying behaviors that keep a drug or alcohol problem in place (such as going to bars for recreation or spending time with friends who drink) and choosing behaviors that help beat the problem (such as going to the gym instead of a bar).

Family therapy works on problems at home that may play a role in alcohol or drug abuse, such as conflict between family members. Family members may be taught to communicate better or to solve problems more effectively.

Self-help groups Self-help groups can be helpful to people who are trying to deal with an addiction and to their family members. Many are 12-step groups, patterned on the 12 steps that are the guiding principles of Alcoholics Anonymous. Those who attend group meetings receive personal support from peers who are fighting the same addiction and trying to solve their problems responsibly.

A partial list of self-help groups follows:

- Chemically Dependent Anonymous, P.O. Box 4425, Annapolis, MD 21403. Telephone: 800-CDA-HOPE. <http://www.cdaweb.org>
- Cocaine Anonymous, 3740 Overland Avenue, Suite C, Los Angeles, CA 90034-6337. Telephone: 310-559-5833. <http://www.ca.org>

- Crystal Meth Anonymous, 8205 Santa Monica Blvd., PMB114, West Hollywood, CA 90046-5977. Telephone: 213-488-4455. <http://www.crystalmeth.org>
- Debtors Anonymous, P.O. Box 920888, Needham, MA 02492-0009. Telephone: 781-453-2743. <http://www.debtorsanonymous.org>
- Emotions Anonymous, P.O. Box 4245, St. Paul, MN 55104-0245. Telephone: 651-647-9712. <http://www.emotionsanonymous.org>
- Food Addicts in Recovery Anonymous, 6 Pleasant Street, Suite 402, Malden, MA 02148. Telephone: 781-321-9118. <http://www.foodaddicts.org>
- Gamblers Anonymous, P.O. Box 17173, Los Angeles, CA 90017. Telephone: 213-386-8789. <http://www.gamblersanonymous.org>
- Marijuana Anonymous, P.O. Box 2912, Van Nuys, CA 91404. Telephone: 800-766-6779. <http://www.marijuana-anonymous.org>
- Narcotics Anonymous, P.O. Box 9999, Van Nuys, CA 91409. Telephone: 818-773-9999. <http://www.na.org>
- Nicotine Anonymous, 419 Main Street, PMB370, Huntington Beach, CA 92648. Telephone: 866-536-4359. <http://www.nicotine-anonymous.org>
- Overeaters Anonymous, 6075 Zenith Court Northeast, Rio Rancho, NM 87124. Telephone: 505-891-2664. <http://www.overtakersanonymous.org>
- Sexaholics Anonymous, P.O. Box 111910, Nashville, TN 37222. Telephone: 615-331-6230. <http://www.sa.org>.

▶ See also **Alcoholism • Substance Abuse**

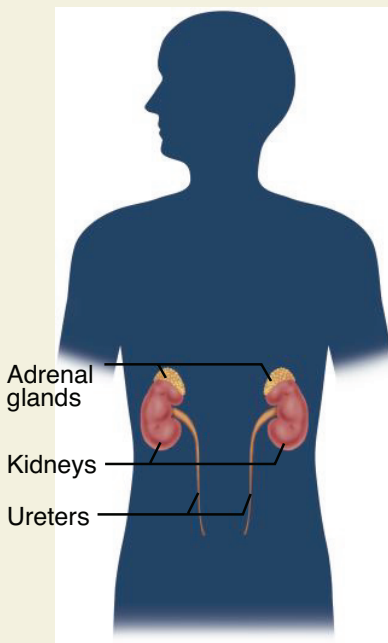
Resources

Books and Articles

- Hoffman, John, and Susan Froemke, eds. *Addiction: Why Can't They Just Stop?* New York: Rodale Books, 2007.
- Klosterman, Lorrie. *Drug Dependence to Treatment*. New York: Marshall Cavendish Benchmark, 2008.
- Pletcher, Claudine, and Sally Bartolameolli. *Relationships from Addiction to Authenticity*. Deerfield Beach, FL: Health Communications, 2008.

Organizations

- Alcoholics Anonymous.** Grand Central Station, P.O. Box 459, New York, NY, 10163. Telephone: 212-870-3400. Web site: <http://www.aa.org>.



▲
The adrenal glands are located above each of the two kidneys. When people have Addison's disease, the adrenal glands do not produce enough of the hormones cortisol and aldosterone. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

National Clearinghouse for Alcohol and Drug Information. P.O. Box 2345, Rockville, MD, 20847-2345. Toll free: 800-729-6686. Web site: <http://www.health.org>.

National Council on Alcoholism and Drug Dependence. 20 Exchange Place, Suite 2902, New York, NY, 10005. Toll free: 800-NCA-CALL. Web site: <http://www.ncadd.org>.

National Institute on Alcohol Abuse and Alcoholism. 5635 Fishers Lane, MSC 9304, Bethesda, MD, 20892-9304. Telephone: 301-443-3860. Web site: <http://www.niaaa.nih.gov>.

National Institute on Drug Abuse. 6001 Executive Boulevard, Room 5213, Bethesda, MD, 20892-9651. Telephone: 301-443-1124. Web site: <http://www.drugabuse.gov>.

Addison's Disease

Addison's disease is a chronic condition that results when the adrenal cortex, the outer layer of the adrenal glands, is damaged, destroyed, or otherwise functioning incorrectly, and the glands are unable to produce enough of certain important hormones. This condition can lead to fatigue, low blood pressure, loss of appetite, and darkening of the skin. While Addison's disease is highly treatable with daily oral medication, it can be fatal if care is inadequate or lacking.

JFK's Story

Many people knew that U.S. president John F. Kennedy (1917–1963) suffered from back pain most of his life. Only after he died from an assassin's bullet in 1963, however, did the public learn that the president also had Addison's disease, a rare condition that results when the body fails to produce enough of certain hormones*.

What Is Addison's Disease?

The adrenal glands are thin triangular groups of cells about the size of an adult thumb. One adrenal gland is located above each of the two kidneys. Among other functions, the glands release hormones known as cortisol and aldosterone. In people with Addison's disease, the adrenal cortex is damaged or destroyed, and the glands no longer release enough cortisol and aldosterone to keep the body working normally.

Cortisol and aldosterone Cortisol helps the body respond to stresses such as diseases and infections. It also helps the body use sugars, proteins, carbohydrates, and other substances in food for energy. Aldosterone helps

signal the kidneys to regulate the amount of salt and water retained in the body, which is important because, without the proper concentrations of salt and water, blood pressure can drop to dangerously low levels.

Autoimmunity Normally, the immune system releases antibodies to fight foreign substances in the body, such as viruses. The cause in about 70 percent of Addison's disease cases is a faulty immune system that turns against the body—a situation known as autoimmunity—and targets the adrenal cortex. Specifically, the antibodies and cells of the immune system destroy the adrenal cortex and cause the glands to release inadequate amounts of cortisol and aldosterone. As of 2009, scientists were not sure why this response occurs.

Other causes The disease also can result from conditions that affect the pituitary gland, which is located at the base of the brain. Normally, this gland secretes a hormone called adrenocorticotropin, which stimulates the production of cortisol in the adrenal glands. When the pituitary is compromised, cortisol levels can drop and cause Addison's disease. In this case, levels of aldosterone are not affected.

A similar condition can occur in patients who have been medicated with daily high doses of cortisol-like drugs usually for a serious disorder involving the immune system. In these patients, the sudden cessation of the medication, or a sudden increase in stress, such as major surgery or a serious infection, can produce symptoms and threats to health that are similar to many of those associated with Addison's disease. These patients should always wear an identification bracelet indicating their drug usage and carry with them a supply of extra medication to meet any needs that arise.

Incidence Addison's disease is rare in the early 21st century. It strikes only about one of every 100,000 persons.

What Are Those Puzzling Feelings?

The first signs of Addison's disease can be puzzling to patients and their doctors. The lack of hormones in the body causes individuals to feel tired and weak. Patients also can feel dizzy due to low blood pressure. Appetite



▲ President John F. Kennedy at his inauguration January 20, 1961. The public did not learn until after his death that President Kennedy had Addison's disease. *Arnold Sachs/Hutton Archive/Getty Images.*

THOMAS ADDISON

The 19th-century British physician Thomas Addison (1793–1860) was the first to connect the symptoms of Addison's disease to problems with the adrenal glands. At that time, the disease was more common because tuberculosis was widespread, and people with tuberculosis may develop Addison's disease if the infection involves and destroys the adrenal glands.

Autoimmunity

Addison's disease is one of many diseases that are considered autoimmune disorders. Normally, the immune system protects the body from foreign substances, such as viruses. Sometimes, however, it attacks the body's own cells, tissues, and/or organs, causing a wide variety of medical conditions. AIDS, lupus, type 1 diabetes mellitus, and rheumatoid arthritis are just a few of the more than 80 known autoimmune disorders. Together, autoimmune diseases affect an estimated 5 to 7 percent of the human population.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

drops, and they start to lose weight from not eating as much. Because salt levels are out of balance in the body, people with Addison's might also feel hungry for salty foods, such as potato chips.

Sometimes people get sick to their stomachs and vomit, and they can develop dark areas on the skin, as if they are tanning. They also can seem unreasonably upset in response to certain circumstances or become depressed.

Addison's usually develops slowly over many years. The symptoms might be noticed but ignored or explained away as the result of working too hard or not exercising enough. About 25 percent of people with Addison's disease do not seek medical help until an accident or other illness triggers a sudden worsening of their symptoms. Without medical help, the sudden worsening can be fatal.

How Do Doctors Diagnose and Treat Addison's Disease?

Generally, doctors first suspect Addison's disease following a careful review of a given patient's medical history and symptoms, which may be as innocuous as darkened patches of skin or a desire for salt. Various tests can be used to check for the proper levels of the hormones involved in Addison's disease. In addition, doctors can use an abdominal x-ray or other diagnostic tests to obtain an image of the adrenal glands to see if they look damaged or if they reveal calcium deposits that are a sign of tuberculosis. If necessary, they may also employ another tool, called a computerized tomography* scan, to look at the pituitary gland.

People with Addison's disease need to take prescription hormones to do the work of the missing cortisol and, if necessary, aldosterone. Most of the time, taking the prescribed hormones allows people with Addison's to avoid the disease's symptoms.

Individuals might experience a return of severe symptoms, such as low blood pressure or elevated potassium levels, if they become ill with another condition. Because these symptoms can be fatal, doctors recommend that people with Addison's wear a medical identification bracelet that explains their condition. The bracelet is especially helpful if the individual suddenly becomes sick and is unable to communicate with those trying to help.

With treatment, however, people with Addison's disease can live as long and as well as people without the disease typically do.

▶ See also **Metabolic Disease • Skin Conditions • Tuberculosis**

Resources

Organizations

American Autoimmune Related Diseases Association. 22100 Gratiot Avenue, Eastpointe, MI, 48021. Telephone: 586-776-3900. Web site: <http://www.aarda.org>.

National Adrenal Diseases Foundation. 505 Northern Boulevard, Great Neck, NY, 11021. Telephone: 516-487-4992. Web site: <http://www.nadf.us>.

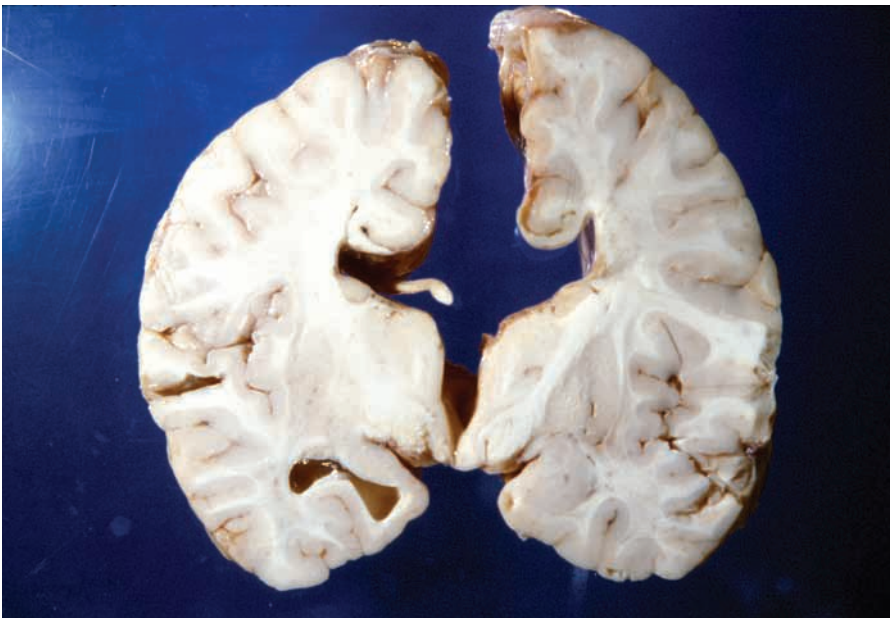
Penn State Milton S. Hershey Medical Center. 500 University Drive, Hershey, PA, 17033. Toll free: 800-243-1455. Web site: <http://www.hmc.psu.edu/healthinfo/a/addisons.htm>.

ADHD *See Attention Deficit Hyperactivity Disorder (ADHD).*

African Sleeping Sickness *See Trypanosomiasis.*

Agenesis of the Corpus Callosum

Agenesis of the corpus callosum is a medical term used to describe the partial or complete absence of the corpus callosum during the development of a fetus. Because the corpus callosum fails to develop normally, the two hemispheres of the brain are functionally disconnected resulting in a wide spectrum of medical consequences.



The disconnected hemispheres of a brain affected with agenesis of the corpus callosum. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **white matter** a group of nerve fibers insulated with a material known as myelin that affects the speed of nerve impulse transmissions and has a white appearance

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **chromosomes** (KRO-mo-somz) are threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.

* **prenatal** (pre-NAY-tal) means existing or occurring before birth, with reference to the fetus.

* **insomnia** abnormal inability to get adequate sleep.

What Is Agenesis of the Corpus Callosum?

The corpus callosum is a bundle of nerve fibers that connect the right and left hemispheres of the brain. It is made up of 200 to 300 million fibers of the type known as white matter*, which is a group of nerve fibers covered in a substance called myelin that affects the speed of nerve impulse transmission. The corpus callosum is located in a band right down the midline of the brain. Its function affects the sensory systems, motor function (movement), learning, memory, and thought processes. Different parts of the band have an effect on specific functions.

Agenesis of the corpus callosum (ACC) is a medical term used to describe the partial or complete absence of the corpus callosum during the development of a fetus*. Sometimes the terms hypogenesis or dysgenesis are used instead of agenesis, specifically when the corpus callosum is only partially absent or malformed, respectively. Because the corpus callosum failed to develop normally, the two hemispheres of the brain are functionally disconnected. The varying degrees of agenesis lead to a wide spectrum of medical consequences. The occurrence of ACC is often associated with other physical abnormalities. The frequency of ACC in the United States is low at 0.7 to 5.3 percent.

Causes of Agenesis of the Corpus Callosum

The corpus callosum develops in the fetus around the 10th and 11th week of pregnancy. If fetal development is disrupted during this period, the corpus callosum may be negatively affected. The exact cause of ACC is unknown, but multiple factors may be involved. ACC may be caused by errors in the chromosomes* or the inheritance of some unknown genetic factor. Disruption of corpus callosum development may also be due to prenatal* infections, injuries, or exposure to toxins. The corpus callosum may be kept from forming properly when blocked by cysts that form in the developing brain.

Signs and Symptoms of Agenesis of the Corpus Callosum

Abnormalities of the corpus callosum can occur as in isolation. However, abnormalities in corpus callosum development often occur with other medical problems. The number or type of medical complications an individual has in association with the degree of corpus callosum agenesis determines what the individual's symptoms are. There are some medical signs that appear in most people with ACC, in various degrees of severity. The range can be from slight to seriously disabling.

Physical and structural defects Many individuals with ACC may have the following problems: vision defects such as nearsightedness or difficulty with depth perception; difficulty feeding as a baby, gastric reflux problems, or problems chewing and swallowing; low muscle tone and weakness; sleep problems such as insomnia* or bed-wetting; abnormal facial features; seizures; hearing defects; chronic constipation; low perception of

pain. Less often seen are heart problems, defects in the skeletal system, or genetic conditions.

Developmental defects Many children with ACC do not develop normally or reach standard developmental milestones in the expected time. Milestones associated with movement are known as motor milestones. They may be delayed in ACC and include general coordination, walking, and riding a bike. Other potentially delayed developmental abilities include speech and toilet training.

Behavioral defects Children with ACC tend to have a lack of self-awareness and consequently tend to be socially immature. They may have difficulty interpreting and responding appropriately to other people. These children may have increasing social difficulty with age, due to the increasingly complex nature of social interactions. Children with ACC may be hyperactive and have difficulty paying attention for long periods of time. Obsessive compulsive behaviors and timidity may also be seen.

Cognitive defects Cognitive* defects are problems with communication, thought processes, language usage, and judgment. Individuals with ACC may have explicit mental retardation*, or they may seem to have normal intelligence if the ACC is partial and an isolated medical incident. However, even those with seemingly normal intelligence are thought to have some form of more subtle cognitive difficulties. Individuals with ACC may have difficulty interpreting people's facial expressions or verbal cues. Tasks requiring problem-solving skills such as finances or scheduling events may prove difficult. Unfortunately, individuals with ACC are often not aware of their limitations and may attempt to perform tasks beyond their abilities, with poor awareness of the consequences. Abstract language concepts such as the use of slang or sarcasm may not be understood by people with ACC. Confabulation*, making up information that is not true while convincing oneself that it is true may also occur in ACC.

How Is Agenesis of the Corpus Callosum Diagnosed?

ACC can be diagnosed using medical tools that perform brain scans. Brain scans can be performed using a variety of techniques that provide an image of the brain for physicians to analyze and search for missing structures. Prenatal ultrasound* or MRIs* may be performed to look for a defective corpus callosum. CT scans* are also used to view the structures of the brain, but MRIs provide the most detailed information.

Treatment and Prognosis of Agenesis of the Corpus Callosum

No medical treatment as of the early 2000s was available to rectify the defective development involved in ACC. Some treatment may be available to relieve symptoms associated with ACC, such as constipation or seizures.

* **cognitive** associated with thinking, learning, perception, awareness, and judgment

* **mental retardation** is a condition in which people have below average intelligence that limits their ability to function normally.

* **confabulation** filling in gaps in memory by making up or fabricating facts. The gaps occur because the memory function is impaired.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **MRIs** a procedure in which magnetic resonance imaging is used.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

However, behavioral therapies, educational programs, and support groups may assist an individual with ACC in leading a more satisfying life.

The prognosis for ACC varies with the type and degree of corpus callosum abnormality and associated medical conditions. The corpus callosum cannot regenerate or degenerate, meaning that once formed it cannot regrow or continue to deteriorate. Some individuals with ACC may seem to have average intelligence and lead normal lives, but they cope at least with slight deficiencies in cognition in contrast to individuals without ACC.

Resources

Organizations

Agensis of the Corpus Callosum/ACC Network. University of Maine, 5749 Merrill Hall, Room 118, Orono, ME, 04469-5749. Telephone: 207-581-3119. Web site: <http://www.umaine.edu/edhd/research/accnetwork.htm>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Web site: <http://www.ninds.nih.gov/disorders/agenesis/agenesis.htm>.

National Organization for Disorders of the Corpus Callosum. 18032-C Lemon Drive, Yorba Linda, CA, 92886. Telephone: 714-747-0063. Web site: <http://www.nodcc.org/index.php>.

National Organization for Rare Disorders. 55 Kenosia Avenue, P.O. Box 1968, Danbury, CT, 06813-1968. Toll free: 800-999-6673. Web site: http://www.rarediseases.org/search/rdbdetail_abstract.html?disname=Agensis%20of%20Corpus%20Callosum.

Aging

Aging is the accumulation of changes in a living organism over time. Most organisms have a predictable pattern of development and an easily established life expectancy. However, with humans, the patterns of development and life expectancy itself have been throughout the ages subject to a wide range of threatening environmental and social conditions that came under some control only in the 19th and 20th centuries. Disease has always been one of the greatest environmental threats. Military action, slavery, and other forms of physical cruelty affect life expectancy. As disease is eradicated, diet is improved and the social threats are ameliorated, human life expectancy tends to increase proportionately. Nevertheless, new environmental and social threats continue to evolve. Diseases such as AIDS, Ebola virus, avian flu, and epidemic metabolic syndrome, along with climate change*



The faces of aging from child to senior.
 Frank Schwere /Stone+/Getty Images.



and habitat reduction forcing hostilities over diminishing resources, are 21st-century threats to human life expectancy. In the early 2000s, the refusal of nuclear powers, including the United States, to seriously limit the deployment of nuclear weapons while continuing to use military force to exercise global strategies in the interest of their perceived needs represents another real threat to human longevity.

Jerry and Saba at 32

Since grade school, Jerry was always the best athlete among his peers. Even in his mid-20s, when most of his friends gave up the weekly softball game, he was still the best pitcher, best hitter, and best runner. Now at

- * **prenatal** (pre-NAY-tal) means existing or occurring before birth, with reference to the fetus.
- * **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.

age 32, he is losing his love for the game. Not only are the younger players better athletes, but he is having difficulty in coming close to his best game. In previous years, he was always getting better at the game, but now he realizes that he cannot take age-related improvement for granted. He recognizes that his wife Saba is beginning to gain weight even as she makes effort to retain her figure. But she looks much younger than her younger sister, who smoked for many years and now has dry skin and the beginnings of wrinkles. Saba's work requires her to update her skills through yearly training exams. During these trainings she realizes that her memory skills are not as strong as they used to be, yet she still is able to do very well on the training assessment. Jerry and Saba enjoy the company of their friends, but now their reciprocal relationship as a married couple has replaced outside friendships and the importance those once held in their lives. On the threshold of middle-age, Jerry and Saba are experiencing the changes that come with more advanced aging.

Humans accumulate change in three different domains: biological, psychological, and social. As people grow older, their bodies first grow stronger and then begin to deteriorate. Their psychological characteristics also change over time as they exhibit shifting personality traits and use different intellectual abilities. Aging in the social domain is marked by the changing expectations that others have of people as they age.

Aging and Child Development

Biologically, aging begins with prenatal* development. The fetal period is the time when the developing fetus* gradually becomes a viable human being that will be able to survive outside of the uterus*. The accumulated successes of the prenatal period make it likely that a healthy infant will be delivered and will grow in strength, mass, and physical ability for the next 25 to 30 years.

The first years of life are important for growth and the development of vital functions. The changes that mark the first two years are rapid, and they are of such importance that any delay in any area of growth or development can be detrimental. The pediatricians who care for the newborn encourage regular monthly check-ups to make sure that the baby's growth and attainment of developmental milestones are normal. Because the baby changes so much from week to week, aging in infancy is measured in months (as compared to years in older children and adults). Some childhood behavioral assessments, such as the Revised Gesell Developmental Schedules, use months as the benchmarks for children under five years of age. The developers of these schedules note the maturational changes in abilities and behaviors that occur each month in the first five years.

Changes in a child's psychological profile are first noted in the initial months of a child's life. As the physical senses become more acute and the perceptions of sensory stimuli become more accurate, the child begins to make better sense of the world. One milestone taking place at around eight months is the development of depth perception. A baby needs

about one month of crawling experience to understand that the world is three-dimensional. A seven-month-old baby who has just started crawling will take some risks with stairs or other possibilities for a tumble that an eight-month-old is likely to avoid. Around 15 months, the baby develops some self-awareness, as noted by the baby's recognizing that the image in the mirror is a reflection of self. Communication skills begin long before the first words, with cries, gestures, and babbling. After two years of age, the baby makes rapid strides with respect to language proficiency.

The social expectation in infancy is the bonding between the baby and the primary caregiver who is usually the mother. This bonding, known as attachment, is very important for the child's psychosocial development. It begins with the mother's responding to the infant's needs in a way that assures the infant that life is meaningful and that the world is predictable.

Childhood, as a period of aging, extends from age two until puberty*. During this time the child grows continuously. Before the growth spurt associated with puberty, an average child will achieve about 85 percent of adult height. During childhood, the child becomes more adept at gross motor skills (such as those used in sports) and fine motor skills (such as those used in drawing or writing).

Psychologically, childhood is the time during which a person begins to develop self-reliance. The child also recognizes similarities and differences between self and others and begins to develop a self-concept. New mental abilities enable the child to learn what is taught at school and in other social settings. What is taught and what is seen as important to the child's development and education are culturally and environmentally determined.

In the social domain, children begin spending time outside the home and, therefore, have to learn to make friends. As they grow, their concept of friendship evolves. Preschool children accept any playmate as a friend, but as children grow older, they become selective. They also have to learn rules of society. As children generally like to experiment with new surroundings and new opportunities, they inevitably come to realize that their actions and choices have consequences.

Adolescence is a time of rapid change in all three domains. Physically, the adolescent is changing from a child to an adult. The onset of puberty, accompanied by a growth spurt (coming a little earlier for girls than for boys), is the time at which the physical body first becomes capable of sexual reproduction. In addition to changes in reproductive organs and reproductive functions, the secondary sexual characteristics, the traits that distinguish the two sexes, begin to appear.

In the psychological domain, there is exploration of all kinds, as the adolescent works to develop a sense of identity. It is important that adolescents have positive exploratory experiences, and the hoped-for outcome is that they have acquired a vocational goal, individual values, and a mature personality. Adolescents are aided in this exploration by their more advanced

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

* **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

and more sophisticated cognitive abilities. In comparison to children, adolescents are more capable of abstract thinking. For the first time in life, they think about the future in a serious way. Young people at the threshold of adult life are likely to be idealistic.

Socially, adolescents try to break away from the influence of their parents. Peers become more important as adolescents tend to value their perceptions and want their opinions and reactions. Adolescents are required to maneuver in increasingly difficult environments. Their social life can be especially rewarding at this time. However, it also can be difficult and fraught with anxieties and conflict.

Aging after Young Adulthood

After adolescence, the physical body continues to grow stronger, reaching a peak or plateau between 25 and 30 years of age. Starting in one's thirties, the slow degeneration of the physical body that is part of the aging process begins. While adults gradually lose physical abilities, overall mental abilities tend to increase through middle age. In general, overall mental abilities do not diminish until the age of 65, the common age for retirement. Whether the reduction in overall mental abilities owes more to physical changes in the brain or to reduced mental exercise was still debated as of 2009. The social effects of aging are often seen in how adults draw satisfaction from their unique experiences rather than from novelty and excitement, which the young often crave and regard as essential.

Many people like to think they can minimize the decline in physical ability by maintaining a positive mental outlook. However, professional athletes, for example, cannot deny that in middle age there is a sharp decline in physical ability, agility, and endurance when compared to their earlier peak performance. At the same time, there are middle-aged athletes who perform better than younger people who have not made a habit of daily exercise. Exercise and health patterns throughout life play an important role in the maintenance of physical vigor in the years after the late 20s. After age 35, female reproduction capability decreases more sharply, but men of comparable age do not have an equivalent decline in their likelihood of becoming fathers. However, there is a distinct decline in the number and quality of their sperm cells. Around the age of 50, women enter menopause, which marks the end of their childbearing years.

While middle-aged people who maintain their health may reduce the impact of age-related physical degeneration, the decline in sensory acuity is unavoidable. Vision decline is slow between the ages of 30 and 70 years of age, but after 70 it is more rapid. There is a similar trend for the sense of smell where there is virtually no decline in middle age but a sharp decline in the late 60s. Hearing has a steady decline every ten years from age 30 to 60 when the decline becomes steeper. The body begins responding less effectively to stress. The risk of many diseases starts to increase.

In the elderly, there is a higher incidence of dementia*. In many elderly people, dementia is attributable to brain injury. The dementia may

represent the accumulated effects of alcoholism, the presence of mini-strokes, or a brain tumor*. A common form of dementia is Alzheimer's (ALTS-hy-merz) disease*.

From middle age onward, human neural processing starts slowing down, and in particular, people's reaction time, perceptual accuracy, and ability to perform memory tasks. Brain size changes with age, so that an 80-year-old's brain is on average about 10 percent smaller than it was at age 20. The areas of the brain most affected by this loss are the ones associated with memory. However, it appears that being mentally active can counter this trend as it is likely that mental activity encourages the growth of new neurons and synaptic connections. There is evidence that maintaining a physical exercise regimen throughout one's life, just as it contributes to one's physical agility, contributes to one's mental agility later in life.

One popular assumption in the United States is that growing older is negative and that it is associated with increased difficulties and decreased intelligence. Conclusive evidence for reduced overall intelligence as part of the aging process has not been established. When a group of people take an intelligence test at the same time, the younger test-takers tend to do better than the older ones, which suggests an inverse relationship between age and test-taking ability. This would seem to suggest that as people age, they tend to lose intellectual capabilities. However, in longitudinal studies, where the same people are given intelligence tests many times over a long period of time, there is no decrease in intelligence. In fact, there appears to be an increase in intellectual functioning in middle age, which only starts to decline at around age 65.

There is some decline in the ability to perform memory tasks for older people, particularly in recall tasks. If an older person and a younger person are asked to repeat the name of someone they both just met, the older person is less likely to remember than a younger person is. However, in recognition tasks, there is little difference between old and young. Therefore, if the older and younger persons are given a list of names and asked which one was the name of the person just met, they are equally likely to recognize the name. What has been called crystallized memory stays strong throughout the life of a healthy person. This memory involves recalling facts and knowledge accumulated over the years. However, fluid memory declines with age. This kind of memory pertains to quick decision-making and logic tasks. This decline is slowed, however, in people who practice logic problems regularly.

With regard to the social aspect of midlife aging, one misconception needs dispelling: the midlife crisis. Many people expect that middle age will be a period of bigger problems and less satisfaction. However, there is no scientific justification for such an expectation. On average, there is no increased emotional instability in midlife. Also, there is no decrease in the measure of life satisfaction associated with middle age and old age.

According to the psychologist Erik Erikson (1902–1994), much psychosocial development continues in adulthood and late life. Typically,

Alzheimer's disease

Alzheimer's disease is a progressive degenerative (progressively worsening or becoming more impaired) condition characterized by decreasing memory and brain functions and the gradual loss of identity and life memories. The cause of Alzheimer's disease was not fully understood as of 2009; however, there seemed to be a strong genetic component in the early-onset form of the illness, but a smaller genetic influence in the normal or late-onset form. It was theorized that those who are at risk for Alzheimer's disease (based on family histories) are able to delay the onset of the disease through mental exercises.

* **tumor** (TOO-mor) is an abnormal growth of body tissue that has no known cause or physiologic purpose. A tumor may or may not be cancerous.

* **Alzheimer's (ALTS-hy-merz) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

CURRENT RESEARCH IN HUMAN AGING

Each species has a predictable life expectancy, and there is a definite relationship between genes* and lifespan. Researchers at the National Institute of Aging identified individual fruit flies with a "longevity gene," and through selective breeding doubled the lifespan of the fruit fly in their laboratory. This experiment led many to hope that a similar gene that exerts control over the rate of the aging process may be found in humans to help regulate the rate of the aging process.

Some gerontologists (medical doctors researching the causes and effects of aging) believe that aging should be regarded as a "treatable" condition. While it is impossible to prevent aging altogether, these professionals work to delay the effects of aging for as long as possible. The goal is to increase the productive lifespan of humans and not to merely stretch out their number of years.

young adults are focused on finding a mate; middle-aged adults, on leaving something behind for future generations; and people in late life, on seeking validation that their lives have been meaningful. Those who marry and have children eventually experience an empty nest, when the children grow up and begin separate lives of their own. For many people, this transition is happy, as a new milestone is being passed.

Death is the ultimate effect of aging. People tend to accept death in different ways based on their personal, religious, and cultural views. Grief is an individual experience; there is no model for grief that all individuals follow.

Aging Populations in Modern Times

While more people enjoy longer, more productive lives in the 21st century, there are problems associated with an aging population. Due to better living conditions, better medical treatments, and more nutritious eating habits in modern times than in previous ages, the elderly populations of many countries are increasing. At the same time, the birth rates for many of these countries are decreasing. For the first time in human history, in the United States and elsewhere as of the early 2000s, the population of people over age 65 is greater than the population of children under the age of five. It was anticipated that as middle-aged persons begin to retire there will not be enough younger workers to take their places. Many national social insurance systems, including the U.S. Social Security system, rely on a relatively large working population to support a relatively small retirement generation. The trend at the beginning of the 21st century suggests the advent of a challenge to these systems. One benefit of better health among the elderly is that workers may postpone retirement for many years. However, the elderly will continue to need more health care,

and this burden on the healthcare systems of affected nations will increase as the elderly live longer. As of 2009, many industrialized nations were working on restructuring their healthcare and retirement systems to meet anticipated increased demand.

▶ See also **Alzheimer's Disease**

Resources

Books and Articles

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Creagan, Edward, ed. *The Mayo Clinic Plan for Healthy Aging*. Rochester, MN: Mayo Clinic, 2006.

Sauvain-Dugerdil, Claudine, Henri Léridon, and Nicholas Mascie-Taylor, eds. *Human Clocks: The Bio-Cultural Meanings of Age*. Bern: Peter Lang, 2006.

Swarts, Katherine, ed. *The Aging Population*. Detroit, MI: Greenhaven Press, 2009.

Organizations

American Association of Retired Persons. 601 E Street NW, Washington, DC, 20049. Toll free: 888-687-2277. Web site: <http://www.aarp.org>.

National Institute on Aging. 31 Center Drive, MSC 2292, Building 31, Room 5C27, Bethesda, MD, 20892. Telephone: 301-496-1752. Web site: <http://www.nia.nih.gov>.

Agoraphobia

Agoraphobia (a-go-ra-FO-bee-a) is an anxiety disorder that involves intense fear of having a panic attack and avoidance of situations that a person fears may trigger a panic attack, such as leaving the home or being in a crowd. The effort to avoid such situations may greatly limit a person's activities.*

What Is Agoraphobia?

In Greek, the word agoraphobia means “fear of the marketplace.” In English, the term is used to describe a disabling disorder that often leads people to fear being in crowds; standing in lines; going to shopping malls; or riding in cars, buses, or subways. In its most extreme form, the disorder can make people afraid of traveling beyond their neighborhoods or even stepping outside their homes. Put simply, agoraphobia is a fear of fear.

* **panic attack** is a period of intense fear or discomfort with a feeling of doom and a desire to escape. The person may shake, sweat, be short of breath, and experience chest pain.

CHARLES DARWIN, AGORAPHOBIC

Charles Darwin (1809–1882), who developed the theory of evolution, is one of the best-known figures in the history of modern science. Many people do not know, however, that Darwin suffered throughout adulthood from an array of physical symptoms that greatly limited his social activities and later caused many physicians to speculate about what might have been the problem. Thomas Barloon and Russell Noyes, Jr., writing in the *Journal of the American Medical Association*, suggested that Darwin may have suffered from agoraphobia. This interpretation would partly explain Darwin's secluded lifestyle and his resistance to meeting people and speaking before groups.

Agoraphobia refers to an intense, unreasonable, and long-lasting fear (a phobia) of panic attacks and avoidance of situations in which a panic attack might arise. A panic attack is a sudden surge of overwhelming terror that occurs unexpectedly and without logical reason. The person is actually in no real danger. Although it is harmless, a panic attack can cause upsetting psychological symptoms, such as a feeling of unrealness and a fear of losing control, as well as unpleasant physical symptoms, such as a racing heart, sweating, trembling, shortness of breath, chest pain, upset stomach, and dizziness. People with agoraphobia have experienced panic attacks and are fearful about experiencing more attacks.

People with agoraphobia may limit themselves to being in places they think of as safe. Any movement beyond this safety zone leads to mounting worry and nervousness. They may worry about whether they could escape quickly from a certain place if they should begin to have a panic attack there. People with agoraphobia often avoid being on busy streets or in crowded classes or stores for fear that they might feel trapped if they start to have a panic attack. Gradually, fewer and fewer places feel “safe.” Some people reach the point where they are too frightened to leave their homes. Others still go out, but doing so causes great distress, and they may insist that family members or friends go with them. Such self-imposed limits can make it difficult for people to get on with their lives at school and work.

What Causes Agoraphobia?

Typically people with agoraphobia experience the disorder after first having one or more panic attacks. Panic attacks usually strike unexpectedly, making it difficult for people to predict which situations will trigger them. This lack of predictability prompts people to worry about when the next attack will occur. It also conditions them to fear situations in which attacks have happened, even if this fear is unreasonable. As a result, people may begin avoiding such situations. Over time, avoidance actually can reinforce the person's phobia, making the condition worse.

What Are the Symptoms of Agoraphobia?

Agoraphobia typically starts between the ages of 18 and 35. Two-thirds of those affected are women. Most people with agoraphobia also have panic disorder, which means that they have repeated, unexpected panic attacks. A few do not have full-blown attacks, but they have similar symptoms of panic. Individuals with agoraphobia may catastrophize (imagine the worst) about what could happen to them if they left home. For example, they may be afraid to leave home because they fear becoming dizzy, fainting, and then being left helpless on the ground. Without treatment, agoraphobia can cause misery for years.

How Is Agoraphobia Treated?

About one-third to one-half of people with panic disorder eventually go on to have agoraphobia. Treatment of panic disorder can help prevent agoraphobia. Once agoraphobia has set in, people still may be helped by the same kinds of medications and therapy used to treat panic disorder. People with agoraphobia may be helped by exposure therapy (a type of behavior therapy*), in which they gradually are put in situations that frighten them until the fear begins to fade. Some therapists go to people's homes for the first few sessions because individuals with agoraphobia may not feel able to get to a therapist's office. Therapists who do exposure therapy also teach coping skills to help with anxiety. Exposure therapy may involve taking patients on short trips to shopping malls or other places that the patients have been avoiding. As people begin to spend more and more time in feared situations, using coping skills instead of avoidance, they may learn that they can handle their feelings after all.

▶ See also **Anxiety and Anxiety Disorders • Panic Disorder**

Resources

Books and Articles

Chope, Robert C. *Shared Confinement: Healing Options for You and the Agoraphobic in Your Life*. Oakland, CA: New Harbinger, 2001.

Organizations

Anxiety Disorders Association of America. 8730 Georgia Avenue, Suite 600, Silver Spring, MD, 20910. Telephone: 240-485-1001. Web site: <http://www.adaa.org>.

Anxiety Disorders Health Information Program, National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov/healthinformation/anxietymenu.cfm>.

* **behavior therapy** is a type of counseling that works to help people change their actions.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.

AIDS, and the infections that occur in the disorder, can affect many parts of the body. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

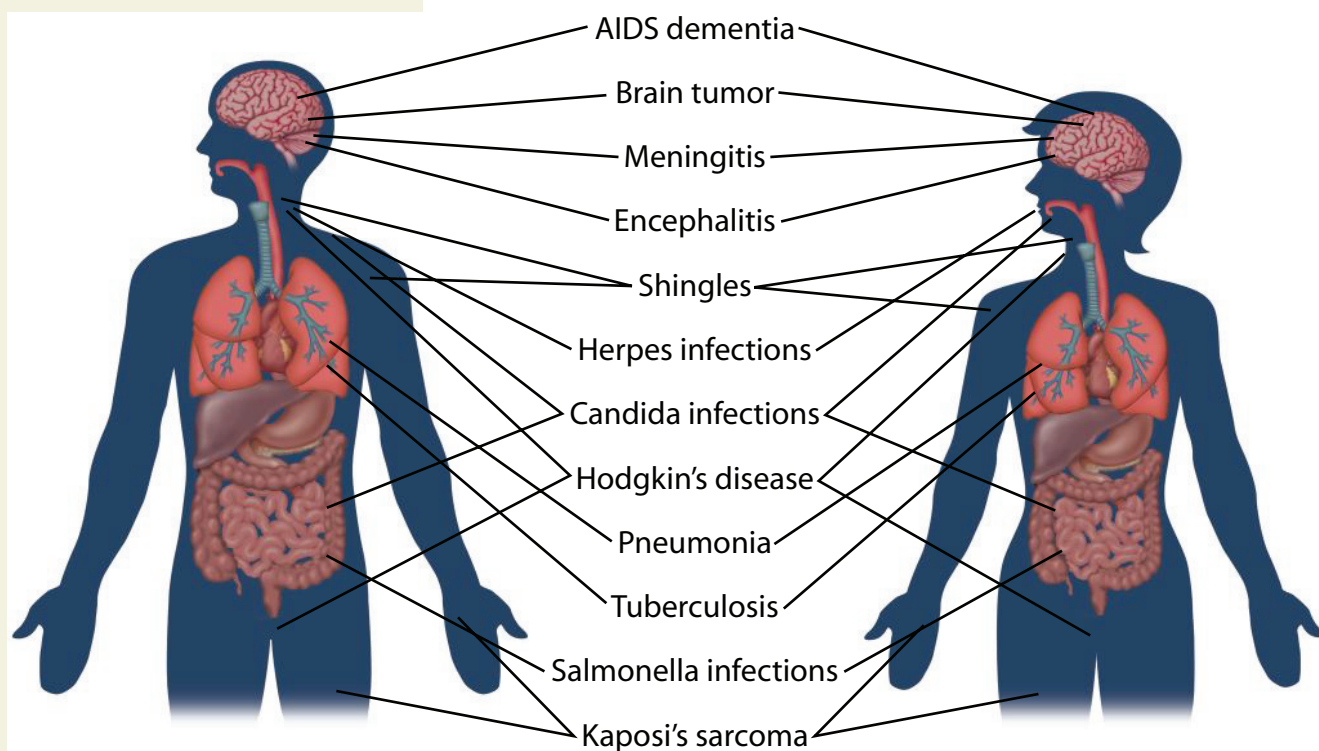
National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/panicdisorder.html>.

AIDS and HIV Infection

AIDS—acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome—is the condition caused by infection with HIV, the human immunodeficiency virus. HIV attacks the body’s immune system, leaving one susceptible to life-threatening illnesses. Spread primarily through unprotected sexual activity or needles contaminated with infected blood, HIV/AIDS had become a worldwide epidemic* by the end of the 20th century.*

Carl’s Family: How Could This Happen?

Carl could not have been more shocked when his mother informed him that she was HIV-positive. After all, she worked full time, kept house, volunteered at church, and was raising Carl alone. Ever since Carl’s father had died of brain cancer, she had not even been out on a date. And she



was the last person in the world he could imagine shooting up drugs. How could she have contracted HIV? But Carl had not been told the whole story of his father's death. Yes, it had been cancer, but it was a type of cancer—lymphoma of the brain—that strikes HIV-infected people. Carl's father had died of AIDS.

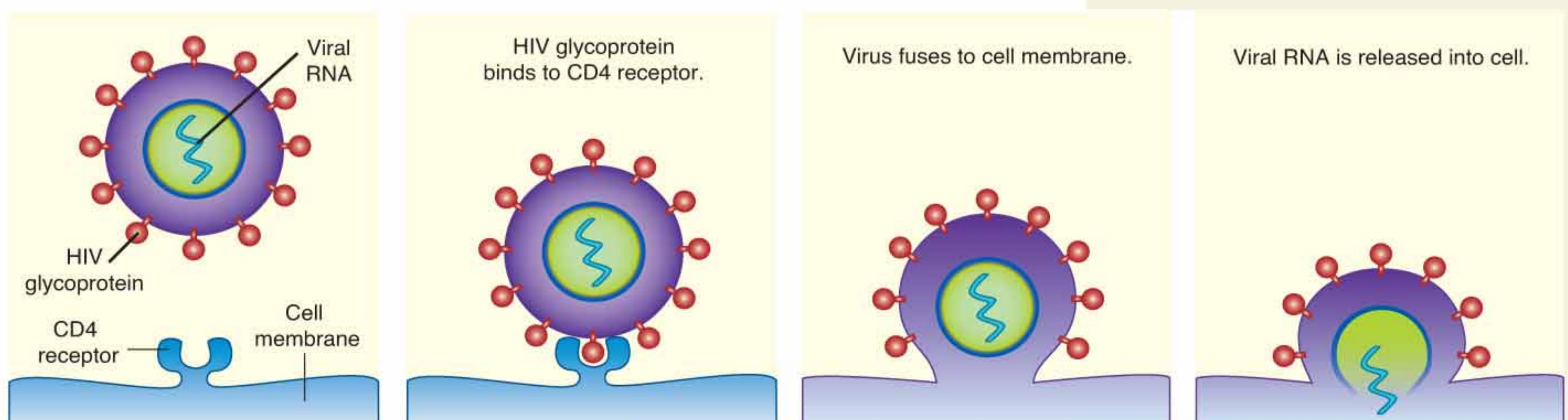
"I didn't know it until your father got sick," Carl's mother told him, "but when he was your age, he and his friends injected cocaine and heroin. He stopped after a couple of years and got his life together. By the time we met, he believed that was all behind him. He didn't realize he carried HIV until he became sick." By that time he had infected Carl's mother. Carl was lucky: His mother had not passed the virus on to him when he was born. But Carl did not feel lucky. His mother now took five different medicines—19 pills every day—to prevent her from developing full-blown AIDS. Sometimes the drugs made her sick. They cost about \$15,000 per year, and she will have to take them for the rest of her life. But she will stay alive, and unlike millions of children in Africa, Carl will not be orphaned by AIDS.

What Is HIV/AIDS?

HIV HIV is a retrovirus that attacks the human immune system by disabling and destroying a type of white blood cell called a CD4-positive (CD4+) T-cell or T-lymphocyte (Tee-LIM-fo-site), sometimes called a T-helper cell. CD4+ T-cells play a central role in the immune response. HIV enters CD4+ cells and uses the cell's machinery and energy to make new HIV particles. When HIV destroys CD4+ cells more rapidly than the body can replace them, the immune system becomes less effective at fighting cancers and infections caused by bacteria, viruses, parasites, and fungi, and AIDS develops. HIV can also attack some organs directly, including the brain, kidneys, and heart.

There are two major types of HIV. HIV-1 is the cause of the current epidemic. Different subtypes of HIV-1 occur in different parts of the world. HIV-2 is found in parts of West Africa and causes a milder form of AIDS.

HIV attacks T-helper cells, or CD4+ cells, by fitting itself into the cell like a key in a lock. Once it has invaded, it can use its own RNA as a template to make copies of itself, multiplying and traveling through the body. This process destroys the body's own T cells over time; as the T-cell count falls, the body's resistance to germs and disease declines. *Illustration by Molly A. Moore Blessington. Reproduced by permission of Gale, a part of Cengage Learning.*



* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **enzyme** (EN-zime) is a protein that helps speed up a chemical reaction in cells or organisms.

* **opportunistic infections** are infections caused by infectious agents that usually do not produce disease in people with healthy immune systems but can cause widespread and severe illness in patients with weak or faulty immune systems.

HIV can mutate (change its genetic characteristics) with amazing speed, so that a single individual may be infected with different strains of the virus. Furthermore, HIV can quickly become resistant to antiretroviral medications (ARVs), rendering them ineffective. These are among the reasons that no vaccine or cure for HIV had been found as of the early 2000s.

AIDS It can take 5 to 15 years for HIV infection to develop into full-blown AIDS. During most of this period, people usually look and feel healthy. Unless they have been tested for HIV, they may not know that they are infected. However, if their condition is left untreated, most people with HIV eventually develop AIDS.

AIDS occurs when HIV has destroyed so many CD4+ cells that a person's T-cell count falls below a critical level, and the immune system can no longer fight off common infections. Many of these are opportunistic infections* (OIs) that rarely occur in people with healthy immune systems but which can be life-threatening in AIDS patients. People with AIDS often repeatedly contract the same OI. AIDS patients are also more likely to develop certain cancers.

WHAT IS A RETROVIRUS?

Viruses are tiny particles, much smaller than bacteria. They are made up mostly of genes*—either DNA (deoxyribonucleic acid) or RNA (ribonucleic acid)—that code for a few proteins. Retroviruses such as HIV have RNA as their genetic material, which means that they reproduce themselves in a backward or “retro” manner.

When HIV enters the human bloodstream, it attaches to receptors on the surface of the CD4+ lymphocyte. It fuses with the cell membrane and injects its RNA into the cell. With the help of an HIV enzyme* called reverse transcriptase (RT), the HIV RNA is copied into DNA. Drugs called RT inhibitors prevent this copying of the viral RNA. The HIV enzyme called integrase inserts the HIV DNA in the host cell's genes, where it may remain hidden for some time.

When the CD4+ cell is activated by the immune system, cellular enzymes make RNA “copies” of the HIV DNA and long chains of HIV proteins. An HIV enzyme called a protease (PRO-tee-ace) cuts the large viral proteins into smaller pieces for making new HIV particles. Drugs known as protease inhibitors interfere with this cutting of the viral proteins.

New HIV particles are released from the lymphocyte and travel through the body, destroying other CD4+ cells. HIV reproduces itself very rapidly and several billion new viral particles may be produced every day. In addition, the HIV RT makes many mistakes, which results in different strains or variants of HIV in a single individual.

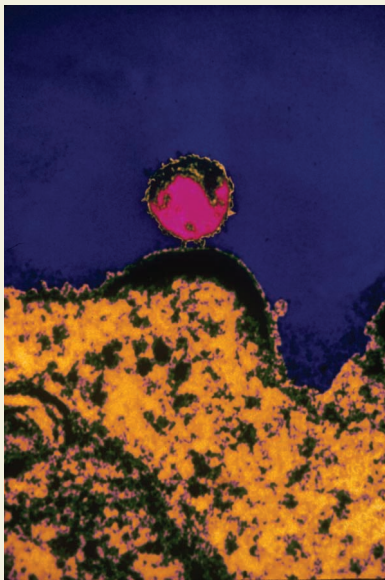
OPPORTUNISTIC INFECTIONS

Opportunistic infections (OIs) associated with AIDS can be caused by viruses, bacteria, parasites, or fungi, and they can affect every system in the body:

- Tuberculosis (TB), caused by the bacterium *Mycobacterium tuberculosis*, is a very common OI. TB is 100 times more likely to cause illness in an HIV-infected person than in a healthy person. Worldwide, TB kills as many as one in three people with AIDS. Of particular concern is the rapidly increasing incidence of multi-drug-resistant TB (MDR-TB), which is very hard to treat.
- *Pneumocystis* (nu-mo-SIS-tis) pneumonia (PCP) is a very common life-threatening complication of AIDS. It is a fungal infection of the lungs that can spread to the liver, spleen, and bone marrow.
- Oral hairy leukoplakia is caused by the Epstein-Barr virus. Often the first OI to appear in HIV-infected men, it is characterized by white lesions on the tongue.
- *Herpes simplex* virus infections, including genital herpes, are common AIDS-related OIs.
- Cytomegalovirus (syeh-tuh-meh-guh-lo-VY-rus) (CMV) is a herpes virus that is very common in people with low T-cell counts. CMV can attack almost any organ and can cause blindness in AIDS patients.
- Human papillomavirus (HPV) can cause genital warts or cervical cancer.
- Disseminated *Mycobacterium avium* complex are bacteria found in food, water, and soil. Although they are usually harmless in healthy people, they can cause fever, night sweats, diarrhea (dye-uh-REE-uh), weight loss, and lung disease in people with HIV/AIDS.
- Salmonella or common food poisoning is an OI in AIDS patients.
- Bacillary angiomatosis or “cat scratch disease” is a bacterial OI contracted by AIDS patients from cats.
- Histoplasmosis (his-toh-plaz-MO-sis) is a fungal infection that normally does not require treatment. In some areas of the United States, especially in the South and Southwest, almost 80 percent of the population tests positive for histoplasmosis. However, in people with AIDS histoplasmosis can spread from the lungs throughout the body, causing rash, skin sores, nausea and vomiting, and joint pain, and requiring ongoing treatment.
- Cryptosporidiosis (krip-toh-spo-rid-e-O-sis) and isosporiasis (eye-so-spuh-RYE-uh-sis) are gastrointestinal conditions caused by parasites.
- Cryptococcal meningitis (krip-toh-KAH-kul meh-nin-JY-tis), caused by a yeast-like soil fungus, is an infection of the membranes lining the brain and spinal cord. It can lead to coma and death in people with AIDS.
- Cerebral toxoplasmosis (suh-REE-brul tox-oplaz-MO-sis) can destroy parts of the brain and often paralyzes one side of the body.
- Progressive multifocal leukoencephalopathy (loo-co-en-SEF-fal-op-a-thee) is caused by a virus that infects brain cells in late-stage AIDS and is usually fatal.

How Common Is HIV/AIDS?

Although effective measures for preventing HIV infection have been known since the early 1980s, HIV/AIDS continued in the early 2000s to spread throughout the world. Education about the disease and its prevention has played a crucial role in slowing the epidemic. However, changing human behavior to prevent HIV infection proved to be a more intractable problem. New treatments for slowing or preventing the onset



▲ A single HIV virus, seen under an electron microscope, escaping from the body cell (CD4 lymphocyte) that it had invaded. ©NIAID/NIH/Peter Arnold, Inc.

How Did the AIDS Epidemic Begin?

AIDS was first described in the United States in 1981, when gay men in California and New York began developing unusual infections and cancers, similar to illnesses in children born with weak immune systems. However, as early as 1978 cases of what would later be called AIDS were showing up in gay men in the United States and Sweden and in heterosexuals in Tanzania and Haiti. In Africa and the Caribbean, AIDS appeared to be spread primarily through heterosexual contact and sometimes babies were born with it. AIDS also seemed to strike people who had received blood transfusions and drug addicts who shared needles. HIV was identified as the causative agent of AIDS in 1983, the same year that the Centers for Disease Control and

of AIDS in HIV-infected people led to some complacency about HIV/AIDS prevention.

The United States Between 1981 and 2006 there were 982,498 diagnosed cases of AIDS in the United States and 545,805 deaths; thus, by 2006 there were 436,693 Americans living with AIDS. The CDC estimates that there were approximately 56,300 new HIV infections in the United States in 2006. This rate is higher than previous estimates, not because the number of new infections increased but because the technology for tracking new infections improved. The CDC suspected that the number of new HIV infections in the United States remained relatively stable between the late 1990s and the early 2000s.

In the United States, in the early 2000s, gay and bisexual* men remained the population that was most severely affected by HIV/AIDS. Although men accounted for 73 percent of new infections in 2006, women of color infected through heterosexual activity constituted the fastest-growing group of HIV-infected Americans. Young people between the ages of 13 and 29 accounted for more new infections than any other age group. The CDC estimated that new infections in 2006 were contracted in the following ways:

- 53 percent resulted from male-to-male sexual contact
- 31 percent resulted from high-risk heterosexual contact
- 12 percent resulted from injected drug use.

As of the early 2000s African Americans were disproportionately and more severely affected by HIV/AIDS than any other racial or ethnic group in the United States. Blacks accounted for almost half of all Americans living with HIV/AIDS, and they did not survive as long as patients in other racial and ethnic groups. In 2006 black men accounted for 41 percent of all male Americans living with HIV/AIDS, and black women accounted for 64 percent of all female Americans with HIV/AIDS. Blacks accounted for 45 percent of new infections in 2006, seven times the rate among white Americans. Hispanic Americans had three times the rate of new HIV infections as white Americans.

The HIV/AIDS Epidemic Worldwide The HIV/AIDS epidemic is far worse in other parts of the world than in the United States. In 2007 an estimated 2.1 million people died of AIDS-related causes and another 2.5 million became infected with HIV. Globally about 33.2 million people were living with HIV/AIDS in 2007, up from fewer than 10 million in 1990. More than 20 million of these people were in sub-Saharan Africa where, in 2007, 6 percent of the population between the ages of 15 and 49 was infected with HIV. In 2007 sub-Saharan Africans accounted for 67 percent of all people living with HIV and 72 percent of all AIDS deaths. By 2007 more than 12 million children in sub-Saharan Africa had been orphaned by AIDS. Worldwide 50 percent of adults with HIV are female, the vast majority having contracted the infection through heterosexual relations.

The number of new HIV infections worldwide declined from 3 million in 2001 to 2.7 million in 2007. Although the epidemic had stabilized or begun to decline in most sub-Saharan countries, in many countries outside Africa, HIV infection was on the rise.

Two million children under age 15 were living with HIV in 2007, almost 90 percent of them in sub-Saharan Africa. An estimated 370,000 children under age 15 became infected in 2007. However, new HIV infections and AIDS deaths among children declined between 2002 and 2007 due to better control of mother-to-child transmission and increased access to treatment. By 2007 nearly 35 percent of HIV-positive pregnant women worldwide were receiving anti-retroviral (ARV) treatment.

People in developing countries have had far less access to HIV/AIDS medications. However, by the end of 2007, the number of people in low- and middle-income countries who were receiving ARV medications had increased 10-fold in six years, to some 3 million people.

How Does HIV Spread?

Sexual intercourse, either homosexual (between men) or heterosexual (between men and women), is responsible for most HIV infections. Although there are documented cases of transmission of the virus as a result of sexual contact between two women, the incidence of transmission by this means is exceedingly small and close to zero. HIV can be transmitted through vaginal*, anal, or oral intercourse. The virus also spreads among people who share needles when they inject drugs. Infected mothers may pass HIV to their babies during pregnancy, childbirth, or breastfeeding. People can infect others with HIV before they have developed any symptoms or are aware that they are HIV-positive.

Having another sexually transmitted disease, such as syphilis*, genital herpes*, chlamydial infection*, gonorrhea*, or bacterial vaginosis*, appears to increase one's susceptibility to HIV infection during sex with an infected person.

HIV is spread through the mixing of body fluids, including the following:

- Blood
- Semen*
- Vaginal fluids
- Mucous membranes*
- Breast milk
- Any other body fluid containing blood

HIV can be transmitted through any blood-to-blood contact. Because it can be difficult to see small breaks in the skin such as hangnails, precautions should be taken when coming into contact with any cut or wound on someone who could be infected with HIV. Medical personnel are at risk through accidental injuries with medical instruments—such as needles and scalpels—that have been contaminated with the blood of an

Prevention (CDC) warned that the blood supply might be at risk. Within just a few years HIV/AIDS had become one of the worst epidemics in human history.

Where Did HIV Come From?

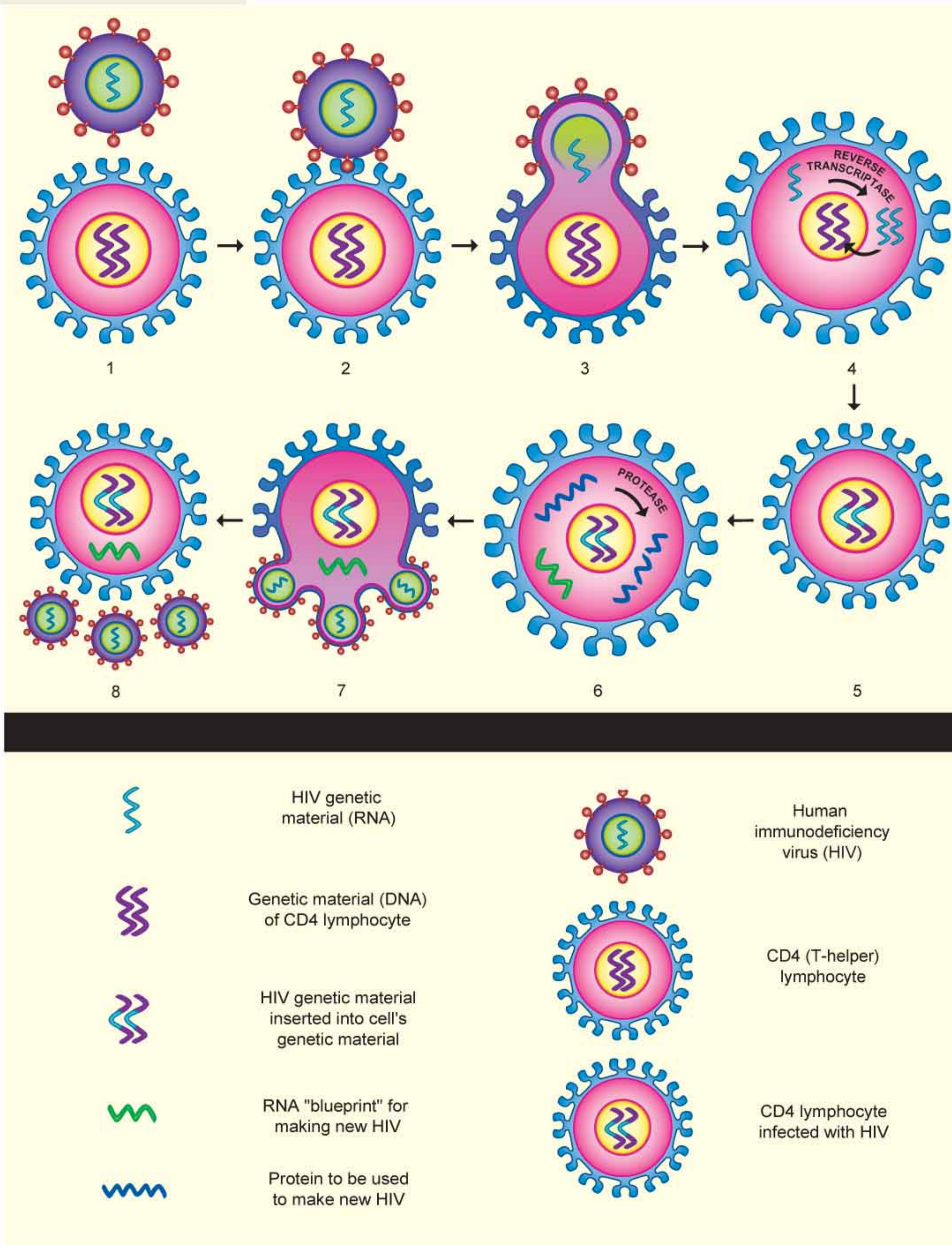
Scientists suspected that HIV arose in Africa from a monkey virus known as SIV (simian immunodeficiency virus). The oldest known HIV was found in a blood sample taken from an African man who died in 1959. In 1999 an international team of researchers found a virus that appeared to be a genetic blend of HIV and SIV in a subspecies of chimpanzee, *Pan troglodytes troglodytes*. Researchers suspected that humans first became infected with SIV in the 1950s while hunting chimpanzees for food. Once in humans, the virus mutated into the deadlier HIV.

* **bisexual** (bi-SEK-shoo-al) means being sexually attracted to both sexes.

* **vaginal** (VAH-jih-nul) refers to the canal in a woman that leads from the uterus to the outside of the body.

* **syphilis** (SIH-fih-lis) is a sexually transmitted disease that, if untreated, can lead to serious life-long problems throughout the body, including blindness and paralysis.

* **genital herpes** (GEN-eh-tal her-PEES) is a viral infection transmitted by intimate contact with an infected person. The herpes simplex type 2 virus enters the mucous membrane and settles in nerves near the spinal column. When an infected person has an outbreak, the virus causes blisters at the infection site.



(1) The human immunodeficiency virus (HIV) particle (top) travels through the bloodstream and (2) attaches to the receptor on the surface of a lymphocyte (bottom), an immune system cell involved in fighting infections. (3) Genetic material (RNA) from the virus enters the lymphocyte and, (4) with the help of an enzyme called *reverse transcriptase*, makes copies of itself to be inserted into the genetic material of the host lymphocyte. Drugs known as *reverse transcriptase inhibitors* act at this step to block the virus' genetic material from copying itself. (5) Copies of the virus' genetic material are inserted into the genetic material of the lymphocyte. (6) This new genetic material in the cell causes the lymphocyte to make the "blueprint" needed for manufacturing new HIV particles. This blueprint contains the code for making virus proteins. An enzyme known as a *protease* acts to clip the large virus protein molecules into smaller pieces so they can be used to make new HIV particles. Drugs known as *protease inhibitors* work at this step by interfering with the processing of virus protein. (7,8) New HIV particles are produced and released from the lymphocyte, which is destroyed. These viruses can then travel through the body and enter and destroy other cells. *Illustration by Molly A. Moore Blessington. Reproduced by permission of Gale, a part of Cengage Learning.*

HIV-infected patient. Although blood transfusions can spread HIV, blood donations and blood products in the United States have been screened for HIV since 1985, and the blood supply was considered to be safe in the early 2000s.

HIV is much less contagious than many other infections such as chickenpox or flu. HIV does not spread through air, water, food, or objects such as doorknobs, eating utensils, clothes, or toilet seats. It is not spread by mosquitoes or other insects. A person cannot “catch” HIV through casual contact such as hugging, shaking hands, playing with, going to school with, or even living with an infected person. There is no evidence that HIV can be transmitted through saliva, sweat, tears, urine*, or feces*.

What Are the Symptoms of HIV/AIDS?

HIV infection Within two months after becoming infected with HIV, most people develop flu-like symptoms, including a fever, sore throat, muscle aches, swollen glands or lymph nodes*, fatigue, and sometimes a measles-like rash. During this period people are very infectious and the genital fluids contain large amounts of HIV. The illness usually disappears within a few weeks, and other symptoms may not appear for 5 to 15 years. Other people have no initial symptoms after contracting HIV. However, the virus can be transmitted to others even in the absence of symptoms.

Although some people have no symptoms of HIV infection until they develop AIDS, over the few years following HIV infection individuals may experience the following occasional symptoms:

- Fevers
- Dry cough
- Night sweats
- Headaches
- Depression
- Swollen glands
- Fatigue
- Skin rashes
- Rapid weight loss
- Persistent diarrhea
- Minor infections such as thrush, a yeast infection (candidiasis) of the mouth characterized by white spots or patches on the tongue or throat
- Shingles, a skin infection caused by the virus that causes chickenpox
- Pneumonia
- Memory loss

Children, especially those infected before birth, generally develop symptoms more quickly than adults. Often these individuals are sick from birth or may fail to grow and develop at a normal rate.

* **chlamydial infection** (kla-MIH-dee-ul) infection can occur in various forms in which the bacteria can invade the urinary and genital systems of the body, as well as the eyes and lungs. One of its most common forms is a sexually transmitted disease (STD), usually passed from one person to another through unprotected sexual intercourse.

* **gonorrhea** (gah-nuh-REE-uh) is a sexually transmitted disease (STD) spread through all forms of sexual intercourse. The bacteria can also be passed from an infected mother to her baby during childbirth. Gonorrhea can affect the genitals, urethra, rectum, eyes, throat, joints, and other tissues of the body.

* **bacterial vaginosis** (back-TER-i-all vag-in-OH-sis) is a condition of the vagina caused by an overgrowth of normal bacteria. Symptoms include an abnormal discharge and fishy odor. This condition is treated with oral antibiotics and vaginal gels.

* **semen** (SEE-men) is the sperm-containing whitish fluid produced by the male reproductive tract.

* **mucous membranes** are the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.

* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

- * **sarcoma** (sar-COHM-ah) one of a group of tumors that occur in connective tissue and are mostly malignant.
- * **bone marrow** is the soft tissue inside bones where blood cells are made.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

AIDS The onset of AIDS is usually characterized by the appearance of OIs or cancers that commonly occur in people with severely weakened immune systems. Many of these conditions are considered to be AIDS-defining, meaning that they can constitute a diagnosis of AIDS. Although these illnesses may be treatable or preventable, they tend to recur repeatedly in AIDS patients. Most people who are said to have “died of AIDS” actually die from one of these illnesses.

The most common AIDS-related cancer is Kaposi's (kuh-POE-zees) sarcoma* (KS). KS is characterized by purplish nodules on the skin and is much more common among gay and bisexual men than among other HIV-infected groups. Other cancers associated with AIDS are non-Hodgkin's lymphoma (the uncontrolled growth of lymphocytes), which can involve the central nervous system, liver, and bone marrow*. Lymphoma of the brain can occur in very late-stage AIDS. Invasive cervical cancer in women is also AIDS-associated.

AIDS dementia (dih-MEN-sha) complex is one of the few conditions that is caused directly by the effect of HIV on the brain. Dementia affects concentration, memory, and thinking.

How Is HIV/AIDS Diagnosed and Treated?

The HIV Test Doctors may suspect HIV infection from the symptoms, especially if a person has an OI. However, HIV infection can only be diagnosed by a blood test. The CDC has called for routine HIV screening of all adults and adolescents. In 2008 the American College of Obstetricians and Gynecologists called for routine HIV screening of all women aged 19 to 64 regardless of risk factors, with targeted screening for high-risk women outside that age group and annual retesting depending on a woman's risk factors. Testing is recommended for all pregnant women and for newborns whose mothers are HIV-positive or were not tested during pregnancy. HIV testing is essential for anyone who may have been exposed to the virus or who has had multiple sexual partners or other risk factors.

The most common test for HIV is a blood test to look for antibodies* to the virus. Some tests measure antibodies to HIV in specially collected oral fluid (not saliva) or in urine. Rapid HIV tests give results in about 20 minutes. A positive HIV test is followed by a different test to confirm the positive result. Confirmatory results may take from a few days to a few weeks. With a home HIV test, which is available in pharmacies, a pinprick of blood is dripped onto a specially treated card and sent to a laboratory for testing.

Antibodies to HIV are usually detectable within two to eight weeks following infection. In rare cases it can take up to six months for antibodies to be detected. Therefore, if an initial HIV test following possible exposure is negative, the test should be repeated within a few months. A test that directly detects HIV RNA in the blood can be performed as early as 9 to 11 days after exposure.

Diagnosis of AIDS The onset of AIDS in an HIV-positive individual is diagnosed by the appearance of one of about 26 AIDS-defining OIs or conditions. A blood test that measures the level of CD4⁺ lymphocytes in the body is performed periodically on HIV-infected people. AIDS is diagnosed if there are fewer than 200 CD4⁺ T-cells per cubic millimeter of blood, compared with 1,000 or more in healthy people.

Diagnosis in Newborns About one in four infants born to untreated HIV-infected mothers are HIV-positive. Sometimes infants who are not infected test positive for HIV antibodies for more than a year after birth, due to their mother's antibodies that passed through the placenta*. Therefore, additional tests are performed to determine whether an infant is in fact infected with HIV.

Treatment Treatment with ARV medications begins as soon as possible after a person tests positive for HIV. Initiating treatment immediately, before symptoms appear, increases the likelihood that an HIV-infected person will remain healthy and live longer. ARVs have improved steadily since the 1990s, dramatically increasing the life expectancy of people with HIV, and new drugs are being developed all the time. With proper treatment most patients with HIV/AIDS can live and thrive as well as people with most other chronic medical conditions. However, ARVs do not prevent a person from transmitting HIV to others, and because there is no cure for HIV infection, drug treatment must continue for the remainder of the infected person's life.

A combination of different types of drugs are prescribed in a treatment called HAART (highly active antiretroviral therapy). As of 2009 there were some 30 drugs approved by the Food and Drug Administration (FDA) for treating HIV/AIDS:

- Nucleoside/nucleotide reverse transcriptase inhibitors (NRTIs) are the oldest class of ARVs. These drugs are faulty DNA building blocks. When they are incorporated into HIV DNA, the RT stops copying HIV RNA into DNA.
- Non-nucleoside reverse transcriptase inhibitors (NNRTIs) bind to RT and prevent it from converting HIV RNA into DNA.
- Protease inhibitors interfere with the protease that HIV needs to make new viral particles.
- Entry and fusion inhibitors interfere with the virus's ability to fuse with the CD4⁺ cell's membrane, preventing the viral RNA from entering the cell.
- Integrase inhibitors block the enzyme that integrates the HIV DNA in the host cell's DNA.
- Multidrug combination products are different classes of drugs combined in a single product.

Regular blood tests measure the amount of HIV in the body (called the viral load) and the CD4⁺ cell count. If the viral load rises above its

* **placenta** (pluh-SEN-ta) is an organ that provides nutrients and oxygen to a developing baby; it is located within the womb during pregnancy.

Protease Inhibitors

Protease inhibitors have proven to be particularly effective in slowing the spread of HIV in the body. HIV uses its protease to cut the new long strands of viral protein into the smaller pieces needed to assemble new viral particles. Protease inhibitors interfere with the cutting action of the protease. Many of the new HIV copies are defective because they contain improperly cut pieces. These defective copies cannot infect other cells.

* **cesarean section** (si-ZAR-ee-an SEK-shun) is the surgical incision of the walls of the abdomen and uterus to deliver offspring in cases where the mother cannot deliver through the vagina.

* **formula** is a prepared, nutritious drink or a dry drink mix designed specifically for infants.

* **hepatitis** (neh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

lowest point or the CD4+ count falls, the medications may be adjusted or changed. A given drug regimen or “AIDS cocktail” may fail for the following reasons:

- The person is infected with a strain of HIV that is resistant to the drug(s).
- HIV has mutated in the body to become resistant to one or more of the drugs.
- The drugs are not strong enough to prevent the HIV from multiplying.
- The medications are not being adequately absorbed by the body.
- The patient is unwilling or unable to take the medications as prescribed.

HAART can reduce HIV to nearly undetectable levels in the bloodstream and enable the immune system to recover and fight off illness. However, the virus remains in the brain, lymph nodes, retina of the eye, and elsewhere in the body. HAART can also cause severe side effects and interactions with other medications.

If an HIV-infected woman is treated with particular ARVs during pregnancy and delivery and the newborn is treated immediately after birth, the baby’s risk of HIV infection drops from about 25 percent to about 6 percent. If mothers are treated with ARVs during pregnancy and deliver by cesarean section*, the risk of HIV infection in the newborn drops to about 1 percent. HIV-infected mothers are advised to feed their infants formula* to prevent transmitting the virus through their breast milk.

Complications of HIV/AIDS In addition to AIDS-related OIs and cancers, HIV-infected people often have chronic hepatitis* B, caused by a virus. Viral hepatitis C infection, which can lead to severe liver damage and death, is very common among HIV-infected intravenous drug users. Complications of syphilis are also common with AIDS.

Various medications are used to treat or prevent OIs. For example, adults whose CD4+ cell counts drop below 200 and HIV-infected children whose T-cell counts are below normal are treated to prevent PCP. Following an episode of PCP the treatment is continued indefinitely. AIDS-associated cancers are treated with chemotherapy*, radiation, or alpha interferon.

Living with HIV/AIDS As a result of HAART, a 20-year-old diagnosed with HIV in 2008 who begins treatment immediately can expect to live to age 63, or 13 years longer than the same person diagnosed in 1996. However, it is crucial that HIV-infected people do the following:

- Take all medications exactly as prescribed to prevent the development of HIV drug resistance
- Maintain good general health

- Have adequate exercise and rest
- Follow a nutritious diet
- Refrain from smoking and drug use
- Have regular medical check-ups and tests, preferably by physicians experienced in treating HIV/AIDS

How Can HIV/AIDS Be Prevented?

The best means of HIV/AIDS prevention is to avoid all contact with the bodily fluids of an infected person. Guidelines for preventing HIV infection include the following:

- Avoiding multiple sexual partners
- Avoiding anal sex or other sexual practices likely to cause breaks in the skin
- Avoiding sexual contact with anyone who may be at risk of HIV infection, including anyone who has ever shared needles for injecting drugs, had many sexual partners (promiscuity), or ever had a sexual partner who shared needles or engaged in promiscuity
- Avoiding drugs and alcohol that can prevent people from making good decisions about protecting themselves and others from HIV
- Obtaining prompt treatment for any sore or blister in the genital area through which HIV could enter the body
- Avoiding intravenous drug use and never sharing needles for drugs, steroids, medications, tattooing, or body piercing

Avoiding sexual contact (abstinence), both homosexual and heterosexual, is the only sure way of preventing HIV infection by sexual transmission. The safest sexual relationship is between two uninfected people who have sex only with each other; however, people with HIV may seem completely healthy and often do not know they are infected. Practicing safer sex by always properly using a male latex condom or a female polyurethane condom for vaginal, anal, or oral sex reduces—but does not eliminate—the risk of HIV infection. Other forms of birth control such as spermicides, birth-control pills, or diaphragms offer no protection against the HIV virus.

Unfortunately the availability and effectiveness of ARV drugs in the developed world have led to complacency among some people with regard to safe sex and other practices for preventing the spread of HIV. Meanwhile intensive research in the United States and elsewhere continues to focus on finding an effective vaccine to protect against HIV and substances called microbicides to prevent transmission of the virus.

▶ See also **Cyclosporiasis and Cryptosporidiosis • Immune Deficiencies • Lymphoma • Pneumonia • Pregnancy • Sexually Transmitted Diseases (STDs) • Substance Abuse • Viral Infections**



▲ In 1984, at the onset of the AIDS epidemic, Ryan White became infected with the HIV virus through a blood transfusion. His spirited fight to educate the public about the disease and to end prejudice against people with AIDS ended with his death in 1990 at the age of 18. *Kim Komenich/Time & Life Pictures/Getty Images.*

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Organizations

- AIDS Education Global Information Service.** 32234 Paseo Adelanto, Suite B, San Juan Capistrano, CA, 92675. Telephone: 949-248-5843. Web site: <http://www.aegis.com>.
- aids.gov.** Web site: <http://www.aids.gov>.
- amfAR.** 120 Wall Street, 13th Floor, New York, NY, 10005-3908. Toll free: 800-39-amfAR. Web site: <http://www.amfar.org>.
- Centers for Disease Control and Prevention.** 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/hiv>.
- Food and Drug Administration.** 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 888-INFO-FDA. Web site: <http://www.fda.gov/oashi/aids/condom.html>.
- International AIDS Society.** Avenue Louis Casar 71, P.O. Box 20, CH - 1216 Cointrin, Geneva, Switzerland. Telephone: 41-(0)22-7100 800. Web site: <http://www.iasociety.org>.
- UNAIDS.** 20 Avenue Appia, CH - 1211 Geneva 27, Switzerland. Telephone: 41-22-791-3666. Web site: <http://www.unaids.org/en>.

Albinism

Albinism is an inherited condition in which a person lacks the usual amount of the pigment melanin, which is the substance that gives color to skin, hair, and eyes.



Many people with albinism have skin and eyes much lighter than that of their family members. People with albinism often have vision problems and must take care to protect their skin from sunburn. *Ken Welsh/Alamy.*



What Is Albinism?

Albinism (AL-bi-niz-im) is a group of disorders that occur when a person inherits various genes* that are defective in their ability to make the pigment melanin (MEL-a-nin). Melanin is the main substance that determines a person's skin, hair, and eye color. In the United States, albinism affects approximately one in 17,000 people, although certain types of albinism are more prevalent among specific groups of people. In some parts of Africa, for instance, about one in 1,000 people experience the condition.

The outward signs of albinism vary depending on the amount of pigment a person has, and many people with albinism have skin much lighter than that of their family members. Caucasians with albinism may have white to light-blond hair, pinkish-white skin, and blue eyes, while people who are black may have yellowish hair, skin with a cream-colored tint, and hazel or green eyes. In some people with albinism, the eyes look pink because they contain no pigment to mask the red of the blood vessels in the retina*.

Albinism always affects vision to some degree. The genes responsible for albinism cause abnormal development of the nerve connections between the eyes and the brain. The retina and the iris (the colored portion of the eye) are also affected by albinism.

What Causes Albinism?

Albinism refers to a group of inherited disorders that are often divided into two major categories: oculocutaneous albinism, or OCA, which involves eye, hair, and skin color; and ocular albinism that mainly affects the eyes. Some of these disorders and their causes are:

- **OCA type 1:** This form of albinism, which is characterized by almost no pigmentation, is caused by a defect in a gene for an enzyme* called

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **retina** (RET-i-na) is the tissue that forms the inner surface of the back of the eyeballs; it receives the light that enters the eye and transmits it through the optic nerves to the brain to produce visual images.

* **enzyme** (EN-zime) is a protein that helps speed up a chemical reaction in cells or organisms.

Albinism and the Eyes

Vision is always affected by albinism. Vision problems that can affect people with albinism include:

- sensitivity to bright light
- crossed eyes or “lazy” eyes
- back-and-forth movement of the eyes
- farsightedness
- nearsightedness
- blurry vision

* **chromosome** (KRO-mo-zom) is a unit or strand of DNA, the chemical substance that contains the genetic code to build and maintain a living being. Humans have 23 pairs of chromosomes, for a total of 46.

tyrosinase that normally is involved in producing melanin. OCA type 1 is more common among Caucasians than among people of African descent. Overall, it affects about one in 40,000 people.

- **OCA type 2:** This form of albinism, which is characterized by some pigmentation, is caused by a defect in what is called the “P” gene. It affects about one in 15,000 people overall but is especially prevalent among African and African-American populations, in which it affects approximately one in 10,000 individuals.
- **Hermansky-Pudlak syndrome (HPS):** This form of albinism, which is characterized by easy bruising and bleeding and by a susceptibility to lung and bowel disease, is caused by a different defective gene. Skin, hair, and eye color vary from person to person with HPS. Although this form of albinism is rare overall, it is much more common in Puerto Rico, where it occurs in about one in 1,800.
- **Ocular (eye) albinism:** This form of albinism, which affects mainly the eyes, includes several disorders that are also gene-related. People with ocular albinism often have no loss of pigmentation in the hair or skin.

Most people with albinism are born to parents without the condition, but both parents must carry a copy of the defective gene, and both must pass on that copy to their child. Albinism is a recessive trait, meaning that if a person inherits even one good copy of the gene, he or she will not have the condition. Parents who both carry the trait have a 25 percent chance that each of their newborn children—either boy or girl—will have albinism. Ocular albinism is the exception because most of these cases are caused by a sex-linked genetic defect, which means that the defective gene is carried by the X chromosome*, which is one of two chromosomes that determine a person’s sex. Sex-linked diseases occur most often in males.

Living with Albinism

Vision and skin care are major considerations for people with albinism. The lack of pigment makes eyes and skin very sensitive to sunlight and the skin prone to sunburn. The latter, a feature of people with oculocutaneous albinism, can lead to premature aging of the skin and skin cancer. The use of sunscreen, hats, and/or protective clothing can help prevent overexposure to the sun. Similarly, people with oculocutaneous and with ocular albinism should use sunglasses to shade their eyes and should take care to avoid direct and bright indoor lights, as well as glare from shiny surfaces both indoors and outdoors. Some people with albinism find that their vision problems can be corrected with glasses, but others may require surgery. While many people with albinism can see well enough to drive a car, many others are legally blind. All people with albinism need consistent and continuing eye care.

While people with most forms of albinism have a normal life expectancy, they may face social and emotional hurdles as they learn to live with being different. Support from family and friends is especially important to helping a child with albinism build self esteem.

▶ See also **Blindness • Farsightedness • Genetic Diseases • Nearsightedness • Strabismus**

Resources

Organizations

Hermansky-Pudlak Syndrome Network. One South Road, Oyster Bay, NY, 11771-1905. Toll free: 800-789-9477. Web site: <http://www.hermansky-pudlak.org>.

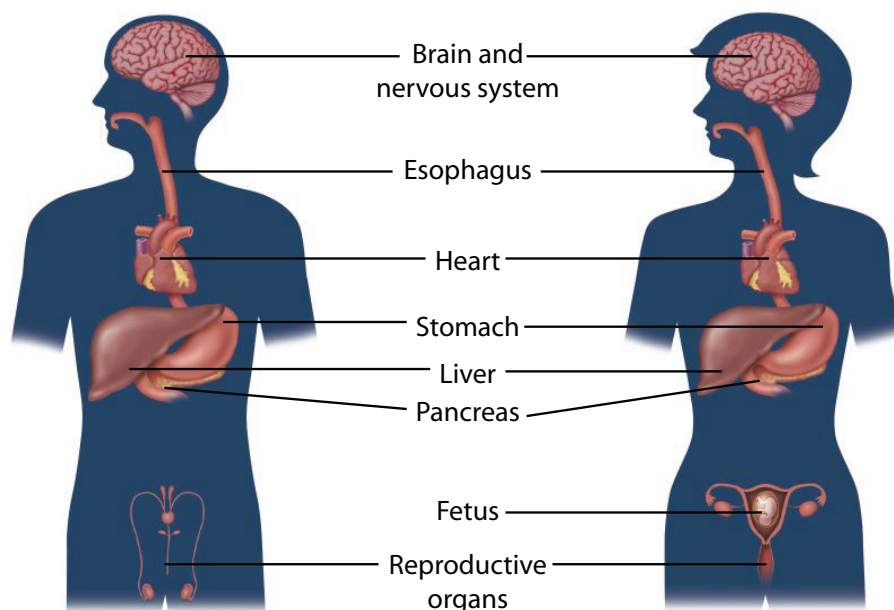
National Organization for Albinism and Hypopigmentation (NOAH). P.O. Box 959, East Hampstead, NH, 03826-0959. Toll free: 800-473-2310. Web site: <http://www.albinism.org>.

Alcoholism

Alcoholism (AL-ko-ha-li-zum) is a condition or progressive disease in which people crave alcohol and keep drinking it even though doing so causes repeated problems in many parts of their life.

Jennifer's Story

Jennifer had her first glass of champagne at a family wedding when she was 11. By the time she was 13, she was drinking beer with her friends on Saturday nights. At 15, she was locking herself in her room and drinking alone during the week, when she was supposed to be getting ready for



◀ Alcoholism affects many different parts of the body. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Campus Life and Alcohol Abuse

Campus fraternity houses have long had an image as places where the alcohol flows freely. Although not all fraternities deserve this reputation, when it is present, this hard-partying lifestyle has taken a terrible toll:

- At Wabash College in October 2008 an 18-year-old student died at a fraternity drinking party. Reports indicated he choked on his own vomit after drinking.
- At the University of New Hampshire, a fraternity was closed in November 2008 when an underage drinking party sponsored by the fraternity caused two students to be sent to the hospital for near-fatal alcohol poisoning (sudden excessive consumption of alcohol).

A study conducted by the Harvard School of Public Health found that binge drinkers in college are 7 times as likely to miss classes and 10 times as likely to damage property as light drinkers. To combat these problems among students, some universities and colleges established alcohol-free fraternities, sororities, and dorms. But the problem of alcohol abuse on campuses continued. According to research summarized in 2005 by the National Institutes of Health, alcohol use nationwide by students between the ages of 18 and 24 was responsible annually for 1,700 deaths; 599,000 injuries; and 97,000 reported cases of sexual assault and acquaintance rape. The report stated that about 25 percent of students have academic trouble (such as poor grades, missing class, and falling behind) linked to alcohol use.

school or doing her homework. At first, drinking seemed exciting. Before long, though, it became something she had to do just to get through the day. Jennifer was not old enough to get a driver's license, but she was already alcohol-dependent.

What Is Alcoholism?

Alcohol is a drug. Alcoholism, also known as alcohol dependence, is a drug addiction (a-DIK-shun), in which people have a strong craving to keep using alcohol even though it causes repeated problems at home, school, or work. Some people call alcoholism a disease because risk factors may be inherited. For certain individuals, often called alcoholics, any use of alcohol predisposes them to use more and more of the substance at the expense of their health and ability to function at work or school. The key traits of alcoholism are:

- Craving: a strong need to drink
- Loss of control: the inability to limit drinking
- Tolerance: the need for ever-increasing amounts of alcohol in order to feel its effects
- Withdrawal: physical symptoms that occur when alcohol use stops after a period of drinking

Alcoholism has little to do with what kind of alcohol people drink, how long they have been drinking, or even how much they drink. What is important is the person cannot control the craving for alcohol, which explains why it is so hard for alcoholics to stop drinking. They may feel the need for alcohol as strongly as other people feel the need for food and water. Although some people are able to break the grip of this powerful craving on their own, most need help to do so.

What Is Alcohol Abuse?

Alcohol abuse refers to overuse of alcohol that can lead to alcoholism. Alcoholics recognize they cannot drink any amount of alcohol and limit the amount they consume. If they begin drinking, they cannot stop. By contrast, alcohol abusers can limit their drinking, but they choose to drink to excess on certain occasions. Thus, when they abuse alcohol, they can get into as serious trouble as any other drunk person can. The distinction between alcohol abuse and alcoholism is a matter of degree, both in behavior and dependence. Abusers of alcohol can experience loss of control and physical signs of tolerance, but if they choose to stop drinking they do not experience painful withdrawal symptoms. Generally speaking, alcohol abuse is a less serious problem than alcoholism, but it still can have very serious consequences. Some symptoms of alcohol abuse are as follows:

- Failing to meet responsibilities at home, school, or work; for example, neglecting chores at home or skipping classes due to drinking
- Drinking in situations that are physically dangerous; for example, just before or while driving a car

- Getting into alcohol-related trouble with the law; for example, being arrested for underage drinking, disorderly conduct, or driving under the influence (DUI)
- Continuing to drink despite relationship problems that are caused or made worse by alcohol; for example, getting into arguments with parents or physical fights with friends or siblings

Alcohol abuse can follow different patterns. Some people are binge drinkers, which means they drink only on certain days, such as on the weekend, and they drink to excess (five or more drinks at one time). Binge drinkers often have accidents that hurt themselves or others or engage in activities while they are drunk that they regret later when they are sober. They are at risk for becoming heavy drinkers (five or more drinks at one time, occurring five or more days per month). Heavy drinkers, in turn, are at risk for becoming alcoholics, because alcohol abusers are at high risk for developing alcoholism.

What Are the Short-Term Risks?

Alcohol dulls the senses, slows reaction time*, decreases coordination, and impairs judgment. It is little wonder that alcohol use is a major risk factor in accidents and injuries. Death by injury is the leading cause of death among individuals from 15 to 20 years of age, and underage drinking is often involved. About two of every five traffic deaths in this age group involve alcohol. Individuals who begin drinking before the age of 15 are seven times more likely to be involved in an alcohol-related car accident in their lifetime, and they are five times more likely to develop alcoholism as an adult.

Alcohol robs people of their ability to think clearly. As a result, people are more likely to engage in risky sexual activity when they are drinking. Thus, they are at higher risk of unwanted pregnancy or sexually transmitted disease*. In addition, some boys believe that it is okay to force a girl to have sex if she is drunk. As a result, girls who drink are at greater risk of being raped* by someone they know. Alcohol is involved in many cases of date rape. Finally, the inability to think clearly causes people who are drinking to take dangerous risks, such as driving under the influence or engaging in daredevil stunts.

What Are the Long-Term Risks?

Alcoholism not only disrupts people's lives but also destroys their health. Long-term, heavy drinking affects almost every organ in the body. The physical risks caused by alcoholism include:

- Liver* disease. More than 2 million Americans have an alcohol-related liver disease. Alcoholic hepatitis (he-pa-TY-tis) is inflammation of the liver, whereas alcoholic cirrhosis (si-RO-sis) is scarring of the liver. Alcohol-related liver disease can cause chronic illness and death.
- Heart disease: Long-term, heavy drinking raises the risk of high blood pressure, heart disease, and some kinds of stroke*.

* **reaction time** is the time it takes a muscle or some other living tissue to respond to a stimulus.

* **sexually transmitted disease** is an infection, such as the human immunodeficiency virus (HIV) or herpes, that can be passed from person to person by sexual contact.

* **rape** is when a person forces another person to have sexual intercourse, or engage in other unwanted sexual activities.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.



▲ Nathaniel Currier's lithograph *The Drunkards Progress: From the First Glass to the Grave* was published in 1846. *The Library of Congress.*

* **esophagus** (eh-SAH-fuh-gus) is the soft tube that, with swallowing, carries food from the throat to the stomach.

* **larynx** (LAIR-inks) is the voice box (which contains the vocal cords) and is located between the base of the tongue and the top of the windpipe.

* **pancreas** (PAN-kree-us) is a gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.

- **Cancer:** Long-term, heavy drinking increases the risk of cancer of the mouth, throat, esophagus*, larynx*, stomach, pancreas*, liver, and possibly the colon* and rectum*. In addition, women who have two or more alcoholic drinks per day have a slightly higher than average risk of breast cancer.
- **Disease of the pancreas.** Pancreatitis (pan-kree-a-TY-tis) is inflammation of the pancreas. It can cause severe abdominal pain, weight loss, and death.
- **Mental disorders:** Long-term, heavy use of alcohol can cause or worsen several mental disorders, especially depression and anxiety disorders.

Alcohol can also interfere with the body's ability to absorb and use vitamins, especially the B vitamins. Vitamin deficiency can damage the brain and cause problems with thought and memory. In severe cases, it can lead to Wernicke-Korsakoff (VER-ni-kee-KOR-sa-kof) syndrome, the early symptoms of which include double vision, repetitive movements, and loss of coordination. If left untreated, this syndrome leads to irreversible mental impairments.

How Are Women Affected?

Women get drunk more easily than men, even when differences in body weight are taken into account. The reason is women's bodies contain less water per pound than men's bodies. Since alcohol mixes with body water, alcohol is closer to its undiluted strength in women than in men. Women appear more vulnerable than men to alcohol-related organ damage and trauma. Women tend to have more legal and interpersonal problems associated with alcohol use.

Women who drink during pregnancy can have children with a wide range of physical, mental, and behavioral problems. Fetal alcohol syndrome (FAS) is the most severe set of birth defects caused by alcohol. Children with FAS may have problems with eating, sleeping, vision, and hearing. They may grow poorly and have birth defects of the heart, kidneys, skeleton, and other parts of the body. As children with FAS get older, they may have trouble following directions, learning to do simple skills, and paying attention in school. They may also find it hard to get along with others and control their behavior. Because no one knows exactly how much alcohol it takes to cause birth defects, it is best not to drink any alcohol at all during pregnancy.

How Are Families Affected?

Living with or caring about a person with alcoholism can be very stressful. This is especially true for the 11 million children under age 18 in the United States who have an alcoholic parent. Alcohol use can lead to frequent arguments in the home, and it plays a role in the breakup of many marriages. In addition, alcohol use is a factor in more than half of all cases of family violence. It is not surprising that children of alcoholic parents are more likely to show signs of depression, anxiety, and low self-esteem than are other children. As they get older, they may have trouble in school, and they may tend to score lower on tests that measure verbal skills. They may also be more likely to have alcohol and drug problems of their own.

However, all children of alcoholic parents are not doomed to have problems with alcohol themselves. Many do well and thrive, particularly if they have positive relationships with other people, such as friends in school, teachers, or neighbors. Support groups for family members and friends, such as Al-Anon and Alateen, also can help people learn to cope with someone else's drinking.

What Causes Alcoholism?

Millions of adults drink alcohol occasionally without any trouble. Yet as many as one in every 13 adults in the United States come to abuse alcohol or become alcohol-dependent. Alcohol problems are more common in men than in women, and they occur most often among young adults between the ages 18 and 29. Yet anyone of any age and either sex can be affected.

Young People and Alcohol Use

- Young people who start drinking before age 15 are five times more likely to become alcohol-dependent than those who delay drinking until age 21.
- The number of young people ages 12 through 17 who say they have drunk alcohol in the past month dropped dramatically after the mid-1980s, from 66 percent in 1985 to 31 percent in 2007.
- Heavy or binge drinkers ages 12 to 17 are five times as likely to drop out of school compared to non-drinkers. Heavy drinkers in high school are disproportionately likely to fail or receive below average grades compared to other students.

* **colon** (KO-lin), also called the large intestine, is a muscular tube through which food passes as it is digested, just before it moves into the rectum and out of the body through the anus.

* **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.

Don't Get Even. Get MADD.

Mothers Against Drunk Driving (MADD) is one of several national nonprofit groups that aim to stop drunk driving and prevent underage drinking. MADD was founded by a group of California women in 1980 after a hit-and-run drunk driver killed a 13-year-old girl who was walking along a residential sidewalk. The driver had been out of jail on bail for only two days for another hit-and-run crash, and he had three previous arrests (and two convictions) for drunk driving. The concerned women started a crusade to get drivers such as this one off the road. In the early 2000s, MADD had more than 600 chapters nationwide.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

Many young people first start drinking as a way to escape their problems, feel accepted, or feel better about themselves. Those youngsters who move on to frequent or heavy drinking are more likely to be depressed, have low self-esteem, or feel as if they do not fit in. Pressure from friends and easy access to alcohol may make it more likely that drinking will get out of control. Alcoholism also may tend to run in families, a pattern that may have psychological and genetic causes. Children of alcoholic parents can be at risk for several reasons. They often live in stress-filled homes where heavy drinking is commonplace. In addition, the genetic* makeup of these children may increase their risk of alcoholism.

What Are the Signs of Alcoholism?

Warning signs include:

- Being preoccupied with drinking: People with alcoholism are always thinking about their next drink.
- Viewing alcohol as a cure-all: People with alcoholism may drink to steady their nerves, treat a hangover, or “fix” almost any problem.
- Needing to drink increasing amounts to feel high: People with alcoholism must drink ever-increasing amounts to get the desired effect.
- Losing control over drinking: Although they may try, people with alcoholism cannot limit themselves to one or two drinks.
- Drinking alone: Social drinkers enjoy the company of others. People who are alcohol-dependent enjoy the alcohol itself.
- Needing to drink to feel normal: People with alcoholism usually feel as if they must drink just to cope with everyday concerns.
- Feeling guilty and making excuses: People with alcoholism often blame their drinking on other people or on outside events.
- Having blackouts: People with alcoholism may be unable to remember what happened while they were drinking, which is sometimes called “alcohol amnesia.”

How Is Alcoholism Treated?

Alcoholism is a treatable disease. Treatment often begins with detoxification, the process of safely getting all the alcohol out of a person's body. During the first days after drinking is stopped, people may be given medication by a physician to replace the alcohol and then gradually be weaned off the medication. The goal is to reduce withdrawal symptoms and restore good health. Rest, a balanced diet, and plenty of fluids also are stressed.

Medications Once detoxification is complete, some people take medications to help prevent a return to drinking. Disulfiram (dy-SUL-fi-ram; Antabuse) can help deter alcohol use by causing several unpleasant symptoms when a person drinks alcohol, including severe nausea, vomiting,

hot flushing, headache, and anxiety. Naltrexone (nat-TREK-zone; ReVia) is another medication that is sometimes given to people with alcoholism. Scientists think it may block the craving for more alcohol that these people usually feel after taking a first alcoholic drink. The problem is that often times the desire to drink again makes the alcoholic stop taking these medications.

Therapy Various kinds of therapy are used to treat alcoholism. Therapy can help people identify the feelings and situations that trigger their drinking. It also can help them find new ways to cope that do not involve using alcohol. Therapy can be provided individually or in a group, and it can take place in a mental health center, a hospital, or other setting. Social skills training teaches people to handle social situations better. Behavioral therapy helps people learn to control harmful behavior and the impulse to drink. Family therapy focuses on problems among family members, which are made worse by alcohol consumption.

Self-help groups Most treatment programs include meetings of Alcoholics Anonymous or other self-help groups. People who take part in such groups get support from peers who face the same problems and are trying to solve their problems by applying positive steps. Membership is open to anyone with a desire to stop drinking. Alcoholics Anonymous has more than 50,000 groups with more than 1 million members in the United States alone.

How Well Does Treatment Work?

Alcoholism can be a tough addiction to beat, but treatment can be very helpful. Studies have shown that 7 of 10 alcohol-dependent people who get treatment have stopped or cut back on their drinking and improved their health within six months, but relapse is common. The goal of treatment is for the alcoholic to quit drinking entirely and permanently, but most people have at least one or two relapses before they reach this goal. Such slips are common, and they do not mean that people have failed. They just mean that people must stop drinking again and get whatever help they need to give up the habit. The longer people go without drinking, the more likely it is that they will stay sober permanently.

▶ See also **Addiction • Cirrhosis of the Liver • Fetal Alcohol Spectrum Disorders (FASD) • Substance Abuse**

Resources

Books and Articles

Bjornlund, Lydia. *Alcohol*. Ann Arbor, MI: Cherry Lake, 2009.

Deboo, Ana. *Alcohol*. Chicago: Heinemann Library, 2008.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **formula** is a prepared, nutritious drink or a dry drink mix designed specifically for infants.

Herrick, Charles, and Charlotte A. Herrick. *100 Questions & Answers about Alcoholism*. Sudbury, MA: Jones and Bartlett, 2007.

Powell, Jillian. *Alcohol and Drug Abuse*. Pleasantville, NY: Gareth Stevens, 2009.

Organizations

Al-Anon/Alateen. 1600 Corporate Landing Parkway, Virginia Beach, VA, 23454-5617. Toll free: 888-4AL-ANON. Web site: <http://www.al-anon.alateen.org>.

Alcoholics Anonymous. Grand Central Station, P.O. Box 459, New York, NY, 10163. Telephone: 212-870-3400. Web site: <http://www.aa.org>.

College Drinking: Changing the Culture. Web site: <http://www.collegedrinkingprevention.gov>.

Mothers Against Drunk Driving. P.O. Box 541688, Dallas, TX, 75354-1688. Toll free: 800-GET-MADD. Web site: <http://www.madd.org>.

National Association for Children of Alcoholics. 11426 Rockville Pike, Suite 100, Rockville, MD, 20852. Toll free: 888-55-4COAS. Web site: <http://www.nacoa.org>.

National Clearinghouse for Alcohol and Drug Information. 11426-48 Rockville Pike, Suite 200, Rockville, MD, 20852. Toll free: 800-729-6686. Web site: <http://www.ncadi.samhsa.gov>.

National Council on Alcoholism and Drug Dependence. 20 Exchange Place, Suite 2902, New York, NY, 10005. Toll free: 800-NCA-CALL. Web site: <http://www.ncadd.org>.

National Institute on Alcohol Abuse and Alcoholism. 5635 Fishers Lane, MSC 9304, Bethesda, MD, 20892-9304. Telephone: 301-443-3860. Web site: <http://www.niaaa.nih.gov>.

Allergies

Allergies are abnormal or hypersensitive responses by the body's immune system to substances that are usually harmless.*

What Are Allergies?

When Latrell plays outside in the fall, he sneezes and his throat itches. When Melinda pets her friend's cat, her eyes start to water. When Annie puts on her nickel-plated bracelet, her arm breaks out in hives. When Mrs. Garcia feeds her baby formula* containing milk products, the baby cries as if he has a stomachache. After Ben was stung by a bee, he suddenly had trouble breathing.

These are all examples of allergic reactions. For most people playing outside, petting a cat, touching metal, or drinking milk cause no problems. A bee sting hurts but is not life-threatening. However, for millions of people with allergies, these substances and hundreds of others can cause the immune system to leap into action. The result can be as mild as a stuffy nose or as severe as death.

Common allergens A substance that triggers an allergic reaction by some people's immune systems is called an allergen*. Most allergens fall into one of four main categories:

- Substances that are inhaled from the air, such as pollen, dust, mold spores, or pet dander*
- Substances that come in contact with the skin, such as nickel in costume jewelry, chemicals in cosmetics, or latex*
- Foods, such as milk, eggs, wheat, shellfish, or peanuts or other nuts
- Substances that are injected, such as penicillin or other medications or the venom from an insect sting.

Allergic responses do not occur with the first exposure to an allergen. The immune system must first become “sensitized” by at least one previous exposure to the allergen or to a very similar substance. For example, a person who is allergic to one type of penicillin will probably have an allergic reaction to other types of penicillin.

The Immune System

The human body's immune system consists of specialized cells and organs that are finely tuned to fight off disease-causing microorganisms*, abnormal cells such as cancer cells, and toxins and other harmful substances. Allergies result from immune-system responses to otherwise harmless substances. Because allergies involve the immune system, they are distinguished from hypersensitivity* to a substance or intolerance* for a food.

The immune system recognizes and responds to foreign substances called antigens*. Antigens can be molecules (usually proteins) on the surfaces of viruses, bacteria, parasites, fungi, or abnormal cells. Toxins, drugs, chemicals, and foreign particles can also be antigens.

Humoral immunity refers to large proteins called antibodies* or immunoglobulins* (im-mune-o-GLOB-u-linz), which are produced by immune-system cells called B-lymphocytes. The immune system can produce millions of different antibodies that circulate in the blood and are present in almost all bodily fluids. Allergies are caused by a specific type of antibody called immunoglobulin E or IgE. One end of an IgE antibody has two antigen-binding sites that recognize and bind to a specific allergen like two puzzle pieces fitting together. The other ends of all IgE antibodies are the same and bind to the surface of connective-tissue cells called mast cells. People with allergies have much higher levels of IgE in their bodies than people without allergies. They may only have IgE antibodies that bind to one allergen such as ragweed pollen that causes hay

* **allergens** are substances that provoke a response by the body's immune system or cause a hypersensitive reaction.

* **pet dander** refers to microscopic parts of the pet's skin that flake off and get into the air people breathe.

* **latex** (LAY-tex) is a substance made from a rubber tree and is used in such things as medical equipment (especially gloves), toys, and other household products.

* **microorganisms** are tiny organisms that can only be seen using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

* **hypersensitivity** being excessively sensitive or abnormally susceptible physically to a specific agent such as a drug.

* **intolerance** lacking an ability to endure exposure to some environmental feature, such as sunlight, or an exceptional sensitivity, for example to milk, so that the food cannot be properly metabolized, as in glucose intolerance.

* **antigens** (AN-tih-jens) are substances that are recognized as a threat by the body's immune system, which triggers the formation of specific antibodies against the substance.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **immunoglobulins** (im-mune-o-GLOB-u-linz) are types of antibodies.

Medic Alert Tags

Medic Alert tags or bracelets can be life-saving for people with drug allergies. In the event of an accident or loss of consciousness, the tag or bracelet alerts medical personnel to the allergy.

Some companies offer medical alert tags that have a unique identification number. In the event of an accident, a doctor anywhere can retrieve the patient's medical history.

* **humoral** (HUM-eh-ral) relating to a hormone, relating to or part of an immune response that involves antibodies secreted by B cells and circulating in bodily fluids.

* **cellular** (cell-U-lar) relating to or consisting of cells, cell-mandated, as in cellular immunity.

fever. Or they may have many different types of IgE antibodies and are, therefore, allergic to many different substances.

Cellular or cell-mediated immunity refers to the specialized cells of the immune system that directly attack foreign substances. These include cells that engulf and destroy the antigen, such as macrophages, and white blood cells called T-lymphocytes, which have receptors for specific antigens and also help B cells to produce immunoglobulins.

Immediate hypersensitivity The most common form of allergy is immediate hypersensitivity or Type I. It depends on both humoral* and cellular* immunities.

Upon first exposure to an allergen such as ragweed pollen, the immune system of a susceptible person becomes sensitized, which means it goes through the following actions:

- The pollen molecules bind to receptors on the surfaces of specific B-lymphocytes.
- Macrophages engulf and break the pollen grain up into tiny pieces that are displayed on the surfaces of the macrophages, a process called “antigen presentation.”
- Antigen presentation activates T-lymphocytes, which stimulate B-lymphocytes to produce large amounts of IgE that specifically bind to the pollen.
- The IgE antibodies migrate through the body and bind to receptors on mast cells and similar cells called basophils. There are a great many mast cells in the nose, eyes, lungs, stomach, and intestines, each with tens of thousands of IgE antibodies on their surfaces.

The next time the person inhales ragweed pollen, pollen molecules attach to their specific IgE antibodies on mast cells and basophils, causing the cells to explode and release histamines and other inflammatory substances. These substances produce symptoms of an inflammatory allergic reaction and recruit other types of inflammatory immune-system cells to the site, increasing the allergic response.

Whereas an allergen-IgE reaction in the respiratory system may cause hay fever, in the skin it may cause a rash or hives. Food and some drug allergies cause reactions in the digestive tract. These allergic reactions happen within a few minutes after exposure to the allergen.

Delayed hypersensitivity Delayed hypersensitivity occurs with some skin allergies. Delayed hypersensitivity does not involve humoral immunity or antibodies. Rather T-lymphocytes that have been previously sensitized by exposure to the allergen upon subsequent exposure release chemicals called lymphokines. Lymphokines call up macrophages to engulf and digest the allergen and any cells containing traces of it. They also cause swelling, redness, tenderness, and rashes. These symptoms may take up to 72 hours to appear after exposure to the allergen.

How Common Are Allergies?

Allergies affect more than 50 million Americans and more than half of all Americans test positive for one or more allergens. Approximately 36 million Americans have seasonal allergies, with allergic rhinitis (ry-NI-TE-is) or hay fever affecting 20 percent of all adults and up to 40 percent of children. In addition, the following allergies occur frequently:

- Skin allergies or allergic contact dermatitis* is the most common skin condition in children under age 11, and hives affects up to 20 percent of all people at some point in their lives.
- An estimated 2 percent of American adults and 8 percent of children have food allergies.
- Allergic reactions account for 5 to 10 percent of all adverse drug reactions. Penicillin is the most common drug allergen.
- About 15 percent of adult Americans have mild, localized allergic reactions to insect bites.

The incidence of allergies among American children increased dramatically in the last decades of the 20th century. Some of this increase can be attributed to better diagnosis and reporting. However, much of it may be due to lifestyle and environmental factors.

Why Do People Develop Allergies?

Although many factors play a role in the development of allergies, heredity appears to be particularly important. If neither parent has allergies, a child has about a 10-percent risk of developing them. If only one parent has allergies, the child has a 30 to 50 percent chance of developing them. If both parents have allergies, the child's risk jumps to 60 to 75 percent. However, the child will not necessarily have the same allergies as the parents. Because people with allergies tend to produce more IgE than those without allergies, it may be this propensity that is inherited. High levels of IgE also increase the likelihood of having many different allergies.

Repeated exposure to an allergen or prolonged exposure to a strong allergen increases the risk of becoming allergic to that substance. Other factors that increase the likelihood of childhood allergies include:

- Low weight at birth
- Being born during a high-pollen season
- Not being breastfed
- Growing up in a home with tobacco smoke
- Having a family pet
- Having a lower socioeconomic status.

How Do People Know If They Have Allergies?

Allergic rhinitis The most common allergy is seasonal allergic rhinitis or hay fever—although it has little to do with either hay or fever. It is caused by pollen from weeds, especially ragweed, which happen to bloom

Allergies and Asthma

Asthma is a chronic disease that causes inflammation of the airways, making it difficult to breathe. Almost 9 million American children suffer from asthma, a leading cause of school absences. Many allergens can trigger asthma attacks and an estimated 50 percent of adults and more than 80 percent of children with asthma have associated allergies. Allergic asthma is an allergen-IgE response in the lungs, and the majority of people with asthma also suffer from allergic rhinitis.

* **dermatitis** is a skin condition characterized by a red, itchy rash. It may occur when the skin comes in contact with something to which it is sensitive.

* **dust mites** are tiny insects that live in dust and in materials such as carpets, pillows, mattresses and furniture.

at the same time as hay is harvested. Rhinitis means inflammation of the nose. Symptoms include:

- Runny nose
- Watery eyes
- Sore throat
- Sneezing
- Coughing
- Wheezing
- Swelling

Oral allergy syndrome is itching and mild swelling around the mouth. It occurs because some fresh fruits and vegetables—such as melons, cucumbers, zucchinis, and sunflower seeds—contain proteins that are similar to the allergens in ragweed.

Some people suffer from perennial allergic rhinitis. They are bothered by airborne allergens all year long, not just during pollen season. Perennial rhinitis is commonly caused by dust mites*. Household mold spores and pet dander are also major causes of perennial rhinitis.

Skin allergies Skin allergies usually cause a rash or itch. However, contact urticaria causes welts or hives on the skin. Various plants—especially poison oak, poison ivy, and poison sumac—cause allergic reactions in the majority of people. Other skin allergens include:

- Nickel
- Formaldehyde in clothing and building materials
- New clothing that has been treated with hydroquinone

Doctors sometimes use skin tests to diagnose allergies. The reactions shown here demonstrate allergic response.
Custom Medical Stock Photo, Inc.
Reproduced by permission.



- Cosmetics, including perfume and hair dye
- Cleaning products, including laundry and dish soaps
- Medications, including antibiotic creams containing penicillin or sulfonamides, anesthetics, antihistamines*, and antiseptics
- Workplace chemicals

Photoallergic contact dermatitis is caused by a combination of contact with an allergen and sunlight. Aftershaves, perfume, sunscreens, and topical medications can contain photoallergens.

With the increased use of latex gloves in the healthcare and food industries, latex allergies have become a growing concern. It is estimated that 5 to 10 percent of healthcare workers are sensitized to latex. Natural latex rubber is also used in a variety of common products, including balloons and condoms. Symptoms are usually similar to other types of allergic contact dermatitis. However, latex can also trigger whole-body allergic reactions, ranging from hives and swelling to asthma attacks and even anaphylaxis.

Food allergies Most adverse reactions to food are caused by intolerances rather than allergies. More than 90 percent of all food allergies are caused by the following:

- Shellfish, including crab, lobster, and crayfish
- Fish

* **antihistamines** (an-tie-HIS-tuh-meens) are drugs used to combat allergic reactions and relieve itching.

ANAPHYLAXIS AND EPINEPHRINE

Whereas most allergic reactions affect only one part of the body, anaphylaxis is systemic—affecting many areas of the body—and is a medical emergency. The throat and airways to the lungs can swell, making it difficult to breathe. Blood pressure may drop. The person may feel nauseated and have diarrhea and stomach cramps. Without immediate medical treatment, the patient can lose consciousness and die:

- Latex causes more than 200 episodes of anaphylaxis annually in the United States.
- Foods—especially peanuts and shellfish—result in an estimated 150 deaths annually in the United States.
- Anaphylactic reactions to penicillin cause about 400 deaths annually.
- About 3 percent of adults and less than 1 percent of children have systemic reactions to insect bites. Insect stings are responsible for about 40 deaths annually, primarily in adults over age 45.

The most common treatment for anaphylaxis is epinephrine (ep-i-NEF-rin), also known as adrenaline. People who have experienced anaphylactic shock often carry injectable epinephrine.

“Peanut-Free” Zones

Some schools have “peanut-free” zones—an area where no peanuts or peanut products can be served or eaten—or have banned peanuts altogether. They are reacting to reports of an increasingly dangerous allergy to that lunchroom staple, peanut butter, as well as to other foods made with peanuts.

Peanuts and other nuts are among the most common foods that cause allergic reactions—and sometimes anaphylaxis. Accidental exposure is difficult to avoid, because some people react to just the smell of peanuts. Avoiding food allergens requires carefully reading the labels on processed foods. Food manufacturers sometimes change ingredients, so even familiar foods and brand names may not remain peanut-free.

- Eggs and egg products
- Nuts from trees, including walnuts
- Peanuts
- Wheat and wheat products
- Milk and milk products
- Soy and soy products.

The most common allergic skin reaction to food is hives. Atopic dermatitis or eczema—patches of itchy, scaly, red skin—can also be triggered by a food allergy. Gastrointestinal symptoms of food allergies can include itching in the mouth and throat, stomach cramps, nausea, vomiting, or diarrhea. Food allergies can also trigger asthma attacks. However, children often outgrow allergies to milk, eggs, wheat, and soy.

How Do Doctors Diagnose Allergies?

Allergy symptoms vary a great deal and can be very similar to symptoms of other conditions, including colds, flu, skin irritations, and food sensitivities or intolerances. Thus allergies can be difficult to diagnose. A physician usually first determines whether there is a family history of allergies and also tries to rule out other causes of the reaction. If possible, the best diagnostic for a suspected allergy is to remove or avoid the allergen and see if the symptoms disappear.

Skin tests Skin tests are performed to determine which substances cause an allergic response in the patient. The prick test introduces a tiny amount of a suspected allergen into the skin. An allergen will cause a small swelling at the spot of the prick. If the prick test is negative but the allergen is still suspected, an intradermal test—in which a small amount of allergen is injected under the skin—may be performed. This test is more sensitive than the prick test.

Food allergies Elimination diets are used to diagnose food allergies. If the symptoms disappear when the suspected food is eliminated from the diet and return when the food is reintroduced, the food is probably an allergen. A skin test may be used to confirm the diagnosis.

Sometimes a skin test for food allergies cannot be performed—for example, if a person is at risk for anaphylaxis. Blood tests called RASTs (radioallergosorbents) and ELISA (enzyme-linked immunosorbent assays) measure the level of food-specific IgE in the blood. A test called the CAP-RAST measures the amount of IgE in the blood that is specific for a given food. However, a positive skin test or CAP-RAST alone does not mean that the person is allergic to that particular food.

In a double-blind oral food challenge, the patient is given capsules that either may or may not contain the suspected food or the suspected food masked with other foods. If no symptoms appear, the patient is probably not allergic to the suspect food.

What Is the Treatment for Allergies?

Left untreated, allergies can lead to additional complications, including asthma. Allergic rhinitis is the leading cause of sinus infections, as along with nasal* polyps from the constant swelling of nasal passages.

Avoiding allergens The first line of defense against allergies is avoiding allergens. Pets, nickel-plated jewelry, or specific foods may be relatively easy to avoid. Allergens such as pollen, mold spores, and dust mites can be harder to avoid. Recommendations include the following:

- Staying indoors and closing windows during high-pollen periods
- Showering and changing clothes after outdoor activities
- Using a clothes dryer rather than drying laundry outside
- Removing rugs
- Vacuuming and scrubbing often
- Covering pillows and mattresses with protective material
- Washing bedding frequently in hot water
- Using special filters on heaters and air conditioners
- Keeping firewood and other sources of mold spores away from the house
- Keeping rain gutters clean to avoid mold
- Keeping grass short so that it will not flower
- Planting an allergen-free landscape

Recommendations for avoiding stinging insects include the following:

- Avoiding brightly colored clothes and perfumes that attract stinging insects
- Always wearing shoes outside
- Keeping all outside food covered

Medications There are many over-the-counter and prescription medications for treating allergies. Some people take them only when symptoms occur. Others use them daily to prevent or decrease the severity of symptoms. Antihistamines interfere with histamines that cause allergic symptoms by preventing the binding of histamines to their target cells. Decongestants to open nasal passages are used alone or in combination with an antihistamine to treat rhinitis. Corticosteroids may be used to treat severe allergies.

Both prescription and over-the-counter nasal sprays are available for treating rhinitis. These include antihistamines, decongestants, nasal steroids, anticholinergic medicines (those that block the physiological action of acetylcholine), and mast-cell inhibitors.

Immunotherapy Immunotherapy, commonly referred to as allergy shots, attempts to decrease the body's sensitivity to an allergen by developing an immunity or tolerance* to the allergen. Immunotherapy is used for allergies to substances such as pollen, dust mites, and animal

* **nasal** (NA-zal) of or relating to the nose.

* **tolerance** (TALL-uh-runce) a condition in which a person needs more of a drug to feel the original effects of the drug.

dander, but not foods. In the build-up phase of immunotherapy, increasing amounts of the allergen are injected once or twice per week for three to six months. Once an effective dose of the allergen has been determined, the treatment enters a maintenance phase and the effective dose is injected every two to four weeks. Immunotherapy may take as long as a year to be effective. Successful immunotherapy is usually continued for three to five years.

Immunotherapy can result in long-lasting relief from allergy symptoms after the treatment is completed. It can also prevent the development of new allergies. In children immunotherapy can prevent allergic rhinitis from progressing to asthma.

Living with Allergies

Although there is no way to prevent allergies, there are many ways to avoid allergic reactions. These include avoiding foods, plants, and other substances that cause allergies.

Identifying the sources of pollen that cause rhinitis can be very useful. Air-pollen counts are reported daily:

- A pollen count of 100 grains or less is considered low.
- Moderate counts of 100–500 may signal the need for an antihistamine before venturing outside.
- An allergic person should stay indoors if the count is over 500.
- Airborne pollen is at its lowest in the early morning.

Mold spores in the air are also tabulated. Wind and warm dry air increase the pollen and spore counts.

▶ See also **Animal Bites and Stings • Asthma • Hives • Immune Deficiencies • Skin Conditions**

Resources

Books and Articles

Ehrlich, Paul M., with Elizabeth Shimer. *Living with Allergies*. New York: Facts On File, 2007.

Mitman, Gregg. *Breathing Space: How Allergies Shape Our Lives and Landscapes*. New Haven, CT: Yale University Press, 2007.

Sutton, Amy L., ed. *Allergies Sourcebook*, 3rd ed. Detroit, MI: Omnigraphics, 2007.

Organizations

American Academy of Allergy, Asthma, and Immunology. 555 East Wells Street, Suite 1100, Milwaukee, WI, 53202-3823. Telephone: 414-272-6071. Web site: <http://www.aaaai.org>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov>.

* **oxygen** (OK-si-jen) is an odorless, colorless gas essential for the human body. It is taken in through the lungs and delivered to the body by the bloodstream.

Alopecia See *Hair and Hair Loss*.

ALS See *Amyotrophic Lateral Sclerosis*.

Altitude Sickness

Altitude sickness occurs at higher altitudes when it is harder for the blood to get an adequate supply of oxygen.

What Causes Altitude Sickness?

High altitudes have decreased atmospheric pressure, a condition under which humans inhale a decreased amount of oxygen*. Altitude sickness is caused by a lack of oxygen supply in the blood, a physiological state known as hypoxemia. The body attempts to compensate for this decrease in oxygen by hyperventilating, or breathing in rapid, shallow breaths. Hyperventilating, which is part of a physical acclimatization process, allows more oxygen to be delivered to body tissues. However, hyperventilation also causes abnormalities in body pH that take time to bring back to normal. The body increases the number of red blood cells to increase oxygen carrying capacity and alters red blood cells to increase their efficiency for dropping oxygen off to body tissues per unit of time. It generally takes a few days for this process to occur at altitudes up to 10,000 feet. The higher the altitude, the longer the acclimatization process.

What Are the Risk Factors for Altitude Sickness?

Altitude sickness can affect anyone ascending to a high altitude, especially if the ascent is done too quickly for the body to adapt accordingly. Rate of ascent to the higher altitude is a key factor. The geographical point above sea level at which an individual experiences altitude sickness varies from person to person. Altitude sickness usually starts to affect people at an elevation of 7,000 feet to 9,000 feet above sea level, especially when ascent occurs within one day. However, some people experience effects as

Did You Know?

During the 1968 Summer Olympics in Mexico City, athletes arrived up to two weeks early to help them become accustomed to the altitude. Mexico City is more than 7,000 feet above sea level, and many of the athletes live at much lower elevations. The athletes who had trained at a high altitude prior to the Olympics may have had an advantage over those who trained at lower altitudes.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

low as 5,000 feet. Physical condition and level of fitness are factors that affect the onset of altitude sickness, although being physically fit will not prevent an individual from developing altitude sickness. The amount of physical exertion placed on the body affects how much oxygen the body needs, making greater exertion a risk factor for altitude sickness when individuals are ascending. Altitude sickness is often seen in mountain climbers, trekkers, and skiers who travel to high-altitude areas. Previous episodes of altitude sickness and living at low altitudes predispose individuals for an episode. Young children are most susceptible to altitude sickness. Maintaining hydration, eating frequent high-carbohydrate meals, avoiding high salt intake, and alcohol avoidance help prevent the occurrence of altitude sickness.

What Are the Symptoms and Treatment of Altitude Sickness?

Altitude sickness may occur in varying degrees of severity. The general set of symptoms includes headache, as well as fatigue, nausea or vomiting, or dizziness. There may also be irritability, muscle aches and pains, and sleep disturbances. Symptoms are exacerbated by physical exertion and dehydration*. Upon reaching a high altitude, individuals usually take six to ten hours to develop symptoms. Given a halt in ascent and rest from physical exertion, symptoms usually either resolve in a day or so or become worse. If altitude sickness increases in severity, the individual may experience confusion, difficulty walking normally, and even development of a stupor or coma*. Difficulty breathing and other respiratory problems may develop.

Treatment of altitude sickness involves stopping the ascent and resting from physical exertion until symptoms resolve. Other treatments include increasing fluid intake and taking pain killers for aches and pain. If symptoms are severe or not resolving, a descent to lower altitude may be necessary. In some cases, patients may be given oxygen therapy. Acetazolamide is a drug sometimes used to prevent or treat occurrences of altitude sickness. Acetazolamide increases ventilation and thereby helps maintain the amount of oxygen present in the blood available to tissues.

Physiological Adaptation to Altitude Sickness

Acute Adaptations When first confronted with an increased altitude, the body automatically changes some of its normal processes to adapt in a process called acclimatization. The goal of adaptation to high altitude is to increase the availability of oxygen to the body tissues. One of the first adaptations is ventilatory acclimatization, which involves a change in breathing patterns. There is an increase in respiratory rate (the number of breaths taken per minute). This type of breathing, called hyperventilation, increases the amount of oxygen available to the tissues and increases the amount of carbon dioxide expired from the body. As the body releases more and more carbon dioxide in greater amounts than

with normal breathing, a change occurs in the blood pH. As the blood pH becomes higher than normal, the brain receives signals that tell it to keep the hyperventilation in check and not let it go on for too long. In the meantime, the kidneys excrete substances that help keep the body pH normal. This process may take up to four days and is improved by the use of acetazolamide.

Another form of adaptation involves the circulation. When individuals ascend to a high altitude, their heart rate increases in order to increase the amount of blood pumped out of the heart to the body tissues. Blood flow also increases to the brain in order to maintain proper brain function. Circulatory acclimatization takes place within minutes of ascent.

Chronic Adaptations In order to maximize the ability of the blood to carry oxygen to the tissues, the amount of hemoglobin present in the blood increases. This process requires weeks to accomplish. Red blood cells are made in the bone marrow and used to transport oxygen to the tissues. The more red blood cells present in the blood, the greater the oxygen-carrying capacity of the blood. In addition to an increase in the number of red blood cells, the change in pH of the blood also triggers an alteration in the red blood cell so that it has a greater than normal capacity to unload oxygen into the tissues.

How Can Altitude Sickness Be Prevented?

The best way to prevent altitude sickness is to ascend to high altitude gradually. For mountain climbers and hikers, a slow ascent allows the body time to acclimatize. When people drive or fly to a high-altitude location making a slow ascent impossible, they should minimize physical activity for the first few days during the acclimatization process. Maintaining hydration, eating frequent high-carbohydrate meals, avoiding high salt intake, and alcohol avoidance help prevent the occurrence of altitude sickness. Acetazolamide is sometimes used preventatively to avoid the occurrence of altitude sickness. The narrowing of blood vessels caused by lack of oxygen to tissue can be helped in part by endothelin and may potentially be prevented or greatly improved by endothelin antagonists*.

Resources

Books and Articles

Piper, Ross. *Death Zone: Can Humans Survive at 26,000 Feet?* Mankato, MN: Capstone Press, 2009.

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://familydoctor.org/online/famdocen/home/healthy/physical/injuries/247.html>.

* **antagonist** (an-TAG-oh-nist) a chemical that acts within the body to reduce or oppose the effects of another chemical.

* **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.

* **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

* **autopsies** (AW-top-seez) are examinations of bodies after death to look for causes of death or the effects of diseases.

American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org/presenter.jhtml?identifier=4618>.

BBC Television Centre. Wood Lane, London, W12 7RJ, UK. Web site: <http://www.bbc.co.uk/health/conditions/altitude1.shtml>.

Alzheimer's Disease

Alzheimer's (ALTZ-hy-merz) disease is an incurable condition in which abnormal plaques and tangles form in the brain, accumulating over time and interfering with nerve cell connections. The disease leads to problems with memory and thinking and to changes in personality and behavior, generally called dementia (de-MEN-sha).

Joey's Story

Joey's grandmother does the strangest things. She tells the same stories over and over and often forgets words for common objects, such as *television* and *fork*. She puts her purse in the refrigerator and sometimes comes to dinner wearing her dress turned inside out. But what is most troublesome to Joey is that she often does not recognize him or his mom.

At first, the family simply thought his grandmother was getting old. She is in her 80s, and his mother told him that sometimes older people have trouble remembering things. But as his grandmother's forgetfulness and odd behavior became worse, the family realized it was more than just an occasional lapse in memory, which happens to everyone once in a while.

Joey's grandmother is one of the 4.5 million Americans who have Alzheimer's disease.

What Is Alzheimer's Disease?

Alzheimer's disease is a neurological* disorder in which structures called plaques and tangles form in the cerebral (se-REE-bral) cortex (KOR-teks), the outer surface of the brain, as well as in the brain matter just under the cortex. The cortex has several functional areas, including those involved with vision, hearing, speech, understanding, and bodily awareness. Plaques and tangles interfere with the normal functioning of the neurons (NOO-rahnz), or nerve cells, and the transmission of messages between the brain and other parts of the body. Although these structures occur to some extent with normal aging, they are much more prevalent in people who have Alzheimer's disease.

Alzheimer's disease is the most common form of dementia*. Autopsies* reveal the following abnormalities in the brains of people with Alzheimer's:

- Twisted nerve cell fibers, known as neurofibrillary tangles
- A mutated or changed protein called tau found in these tangles

- Outside the cells high concentrations of patches of plaque deposits composed of a sticky substance called beta amyloid, especially in the area of the cerebral cortex* and the hippocampus, the regions most responsible for memory and cognition
- Surrounding the plaques debris of dying neurons
- Decreases in a brain chemical called acetylcholine, a neurotransmitter* that helps signals move from one nerve cell to another

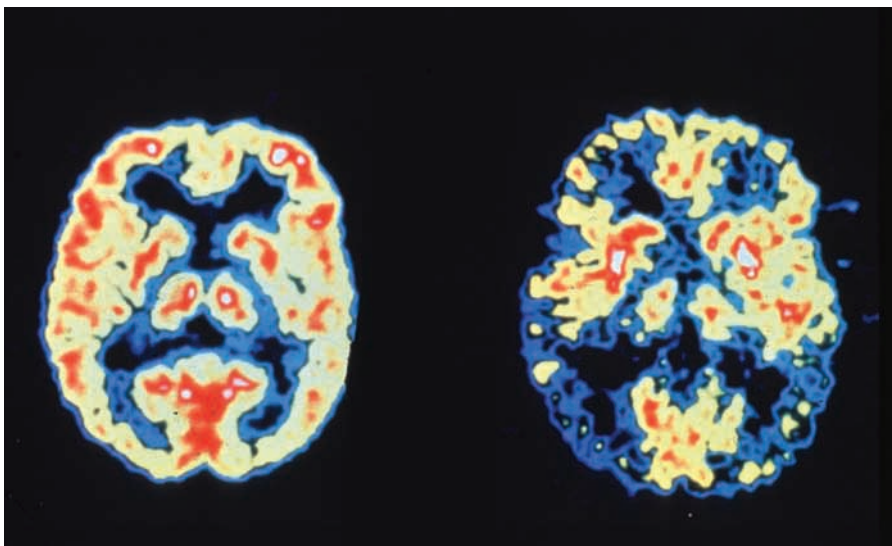
Alzheimer's disease is not a normal part of aging.

History of Alzheimer's Disease

As Alois Alzheimer (1864–1915), a German psychiatrist, peered into his microscope, he was puzzled by what he saw. The slides of the brain of his 51-year-old patient Auguste D. contained deposits and tangles that looked like a mass of threads. He had worked with Auguste D. at the asylum in Frankfurt-am-Main and was amazed by her bizarre behavior. In 1907, he wrote these words:

The woman showed as her first symptom a jealousy towards her husband. Soon she showed a rapidly increasing amnesia; she became lost in her own apartment, carried objects about aimlessly, hid them, sometimes believed she was to be murdered, and had spells of unrestrained screaming. ... The autopsy showed a diffusely atrophied brain ... remarkable changes of the neurofibrillae. In place of a normal cell, one or several fibrillae, which ran parallel to each other, were altered in a similar fashion.... Apparently we are dealing with an unidentified illness.

He did not know that his friend Emil Kraepelin (1856–1926) would refer to the condition as Alzheimer's disease in a journal article in 1911. The name stuck.



* **cerebral cortex** (suh-REE-brul KOR-teks) is the part of the brain that controls functions such as conscious thought, listening, and speaking.

* **neurotransmitter** (NUR-o-tranz-mit-er) is a chemical substance that transmits nerve impulses, or messages, throughout the brain and nervous system and is involved in the control of thought, movement, and other body functions.



These positron emission tomography (PET) scans show the dramatic difference in brain activity between a healthy person (*left*) and a person with Alzheimer's disease (*right*). Brain activity, indicated by red and yellow, has been greatly reduced in the brain at right. *Dr. Robert Friedland/Photo Researchers, Inc.*

* **neurologist** (new-RHAL-eh-jist) a physician who specializes in diagnosing and treating diseases of the nervous system.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

However, the disease received little attention until the late 1970s when several factors merged:

- **Science.** Advances in the electron microscope helped confirm that Alzheimer's disease was a neurological condition and thus dismissing the notion that memory loss and confusion are inevitable in aging.
- **Society.** In 1979 Robert Katzman (1925–2008), a neurologist*, became frustrated with doctors who would not accept that dementia is not a normal part of aging. Katzman believed that many doctors had little understanding of family members who struggled with Alzheimer's disease. Katzman and businessman Jerry Stone formed the support group the Alzheimer's Association to disseminate information about the condition.
- **Popular Media.** In October 1980, Abigail van Buren in her column "Dear Abby" referred interested readers to the Alzheimer's Association. The association was overwhelmed with requests.
- **Celebrities.** In May 1986, the famous movie star Rita Hayworth died from Alzheimer's disease. In order to bring attention to her terrible end, Yasmin Khan, her daughter, wrote President Reagan asking for funding for research. Congress passed the Alzheimer's Disease and Related Dementias Act in 1986, providing funds for research. Ironically, Ronald Reagan was to die from Alzheimer's disease in 2004.

What Causes Alzheimer's Disease?

In the early 2000s, scientists did not fully understand what causes Alzheimer's disease, and they suspected several factors may play a role. Age is the most important risk factor; the number of people with the disease doubles every five years beyond age 65.

Family history is another risk factor. Genes* seem to play a role in certain Alzheimer's cases. Studies in the early 2000s suggested that genes are associated with both the common form of Alzheimer's disease, which affects many people and generally begins at ages over 65, with increasing frequency as people age, and with a rare early onset form of the disease with onset between the ages of 30 and 60. At least five genes might be implicated in early-onset form, which runs in families and is inherited.

However, regarding the late onset form of the disease, researchers were as of 2009 unable to trace a clear link to heredity or to other factors, such as dietary habits, occupation, personality type, or environmental factors. Several risk factors were suspected of interacting with other predisposing factors. As of 2009, the only risk factor identified in late-onset Alzheimer's disease was a gene that makes one form of a protein called apolipoprotein E (ApoE). There are three forms of ApoE: ApoE2, ApoE3, and ApoE4. ApoE4 increases the risk but does not always cause Alzheimer's disease. Everyone has ApoE, which helps carry cholesterol in the blood,

but only about 15 percent of people have the form that increases the risk of Alzheimer's disease. Possibly other genes may increase the risk of the disease or protect against it, but in the early 2000s these had not been identified.

Several other factors may predispose one to develop Alzheimer's:

- Heart disease
- High blood pressure
- Stroke, especially small strokes called transischemic attacks or TIAs
- High cholesterol
- Infection from a virus
- Low levels of the vitamin folate
- Blows to the head from accidents or from repeated blows as in boxing or contact sports such as football
- Certain disorders such as Down syndrome associated with Trisomy 21
- Lifestyle factors, such as smoking, poor nutrition, drug use

How Is Alzheimer's Disease Diagnosed?

Alzheimer's is difficult to distinguish from other kinds of mental problems. Doctors usually begin by taking a medical history and doing a physical examination to make sure some other condition or other type of dementia is not causing the memory and behavior problems. Many diseases and conditions can cause symptoms similar to those of Alzheimer's. Some, such as vitamin deficiencies, can be corrected easily; others can be treated with prescription drugs.

Doctors also administer various verbal and written tests to assess how well the person's brain is functioning. They interview the person and his

RONALD REAGAN'S GOODBYE

In November 1994, former president Ronald Reagan, who was suffering from Alzheimer's disease, said farewell to the nation in a letter:

I have recently been told that I am one of the millions of Americans with Alzheimer's disease. Nancy and I had to decide whether we would keep this matter to ourselves as private citizens or would make it known. We had the feeling that it was important to announce this message publicly.

This letter had a great effect. Alzheimer's disease became widely recognized and research dollars funded studies into its cause and the search for a cure.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

* **spinal tap** also called a lumbar puncture, is a medical procedure in which a needle is used to withdraw a sample of the fluid surrounding the spinal cord and brain. The fluid is then tested, usually to detect signs of infection, such as meningitis, or other diseases.

family about recent events, looking for examples of the symptoms. If a person is younger than 60 years of age, a genetic test might be ordered because most cases of Alzheimer's disease in people who are between 40 and 59 years of age are linked to the presence of certain genes that can be identified. Sometimes doctors look for signs of a stroke or abnormal areas in the brain using x-rays or other high-technology equipment that allows them to see inside the body, such as magnetic resonance imaging* (MRI). With this sophisticated equipment and testing, accuracy of diagnosis is about 85 to 90 percent.

Once other possible causes of the symptoms have been ruled out, doctors begin to suspect that a person has Alzheimer's disease. If the symptoms worsen with time and no other explanation can be found, doctors say the person has Alzheimer's. However, diagnosis can only be absolutely confirmed by direct examination of brain tissue during an autopsy. Doctors look for plaques and fibers, which look like small, tangled spiral staircases.

In the early 2000s, some diagnostic methods were being investigated:

- OPTIMA Project from the United Kingdom measures thinning of the brain's medial temporal lobe and has made accurate diagnoses as many as five years before death; with refinement these brain scans may hold the key to early detection of the disease.
- Tau, a protein involved in cell death, can be detected from the spinal fluid of patients; however, most doctors do not want to perform a spinal tap* on frail elderly people.
- An eye drop test using certain chemicals may show greater pupil dilation in people who have Alzheimer's than in unaffected persons; the findings of this test must be replicated by other tests
- Positive emission tomography (PET) scans enable doctors to view brain activity to find affected areas in early cases

How Is Alzheimer's Disease Treated?

Several drugs help relieve some symptoms in some people. These drugs do not cure the disease but may slow its progression. The drugs donepezil (Aricept), rivastigmine (Exelon), and galantamine (Razadyne) may help symptoms for a limited time. Memantine (Namenda) is used sometimes for moderate to severe Alzheimer's cases. Also some medicines may help control behavioral symptoms such as sleeplessness, agitation, wandering, anxiety, and depression. The relief, however, is not permanent, and the drugs do not work for everyone.

Once Promising Treatments That Have Been Discredited

In the search for a cure, scientists looked at many possibilities. As of 2009 more than 75 drugs were being studied, most of them for alleviating symptoms. Sometimes after years of investigation researchers find that a

chosen treatment does not work. Substances that once were seen as promising but were later shown not to be include the following:

- **Estrogen.** Some studies suggested that estrogen, used by women to alleviate symptoms of menopause, also protects the brain; however, clinical trials indicated that estrogen does not slow the progression of the disease, and some studies even suggested that women who used estrogen with progestin were at greater risk of dementia.
- **Antioxidants.** A four-year study conducted at Columbia University on nearly 1,000 older people found that consuming certain antioxidants either through the diet or as supplements did not decrease the risk of Alzheimer's disease.
- **Ginkgo biloba.** Studies showed no evidence that the extracts from the leaves of the ginkgo biloba tree may cure or prevent the disease; studies ongoing in the early 2000s examined its possible potential to delay cognitive decline.
- **Tacrine or Cognex.** One of the first drugs approved, tacrine was withdrawn by its manufacturer because it caused serious side effects.

What Does the Future Hold?

In the early 2000s, scientists were working hard to develop effective therapies. Nine drugs were in their final stage before approval, and 23 were in the second phase of investigation. These drugs were designed to treat the symptoms and to target genetic pathways of the disease. Breakthroughs in drug research may revolutionize the way brain diseases are treated and prevented. Approaches under consideration included the following:

- **Personalized medicine or pharmacogenomics.** Researchers would study the genetic makeup of the patient and then give the right dose of the right drug; in a disease such as Alzheimer's in which tolerance of a drug influences its success, this procedure shows promise.
- **Vaccine.** A vaccine to dissolve beta amyloid plaque was under investigation; this approach worked in mice, but in human trials, several patients developed a type of brain infection. The company directed its research to the people who responded favorably to the vaccine.
- **Stem cell* research.** In animal models, stem cells were stimulated to become nerve cells, but scientists continued to explore if these neurons could replace the complex damage caused by Alzheimer's. As of 2009, there were no human trials with stem cells on Alzheimer's, although promoters of stem cell research mentioned the disease as a possible target.
- **Gene therapy.** This complex approach involves altering an individual's DNA. In 2005 a team of scientists used the first gene therapy procedure for a patient with Alzheimer's. After two years PET

Did You Know?

- Alzheimer's disease can occur in people in their 30s, but it is most common in people over age 65. Almost 90 percent of cases occur in the elderly, and as many as 50 percent of people over age 85 might have the disease.
- An estimated four and a half million people in the United States have Alzheimer's.
- Studies suggest that as many as 19 million adults and children have a relative with the disease. As many as 37 million Americans know someone with it.
- As more Americans live to advanced ages in the 21st century, the number of people with Alzheimer's could reach 14 million.
- The disease costs American businesses more than \$33 billion a year. Most of that, \$26 billion, comes from employees who must miss work to care for relatives with Alzheimer's disease. The rest is money spent on health insurance, research, and taxes for government programs such as Medicare.
- Patients with Alzheimer's disease can live as long as 20 years with the disease. The average person lives eight years after diagnosis of the condition.

* **stem cell** an unspecialized cell that gives rise to differentiated cells.

scans showed increased activity in the area of the gene transplant. Research was ongoing in the early 2000s.

- **Nanotechnology.** This futuristic procedure starts with atoms and rearranges them. Scientists correct misarranged atoms and then rebuild new structures one atom at a time. The hope was they might be able to rebuild the damage caused by the plaques and tangles of Alzheimer's using devices such as nanorobots and quantum devices.

▶ See also **Aging • Dementia**

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Organizations

- Alzheimer's Association.** 225 N. Michigan Avenue, 17th Floor, Chicago, IL, 60601. Toll free: 800-272-3900. Web site: <http://www.alz.org>.
- Alzheimer's Disease Education and Referral Center, National Institute on Aging, National Institutes of Health.** P.O. Box 8250, Silver Spring, MD, 20907-8250. Toll free: 800-438-4380. Web site: <http://www.alzheimers.org>.
- Neuroscience for Kids.** Web site: <http://faculty.washington.edu/chudler/alz.html>.

Amblyopia See *Strabismus*.

Amebiasis

Amebiasis (am-e-BY-a-sis) is an infection of the large intestine by the single-cell parasite Entamoeba histolytica (ent-a-ME-ba his-to-LIT-i-ka). It frequently causes diarrhea or dysentery.

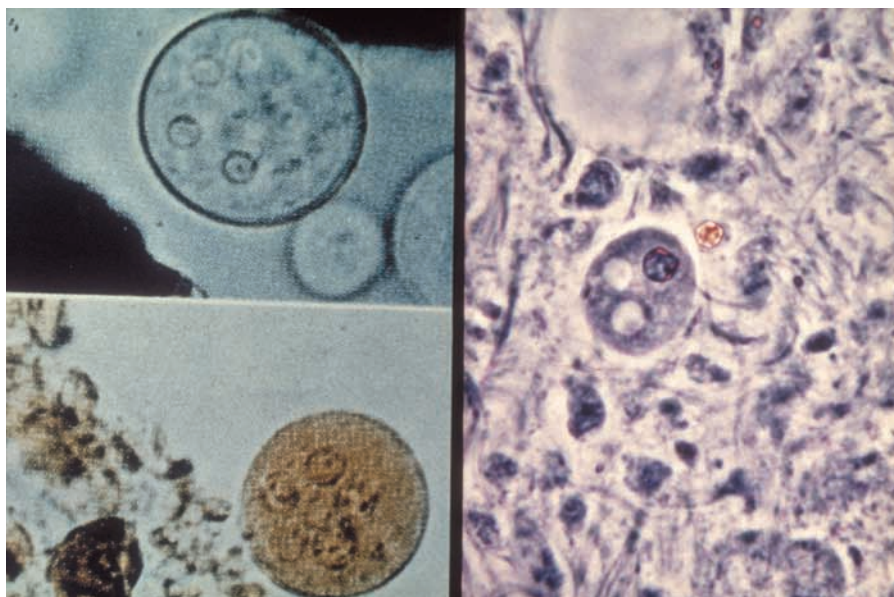
What is Amebiasis?

Amebiasis is a disease caused by an amoeba, or microscopic parasite*. At one stage in the amoeba's life cycle, it is enclosed in a protective wall called a cyst. Infection begins when a person swallows cysts in contaminated food or water. Amebiasis is found worldwide, including the United States, but it is most common in tropical areas where sanitation is poor.

When swallowed, the cysts resist destruction by stomach acids and travel to the intestine. In the intestine, the amoebae (plural) emerge from their cysts and multiply, usually without causing any symptoms. In some people, however, for unknown reasons, the amoebae invade the walls of the large intestine, where they cause abdominal pain, bloody diarrhea (dysentery), and sometimes fever. At this stage, there is a danger that the amoebae will invade other body organs.

During the infection, the amoebae produce cysts that pass out of the intestines in the stools (feces). Outside the body, the cysts can survive for

* **parasite** (PAIR-uh-site) is an organism such as a protozoan (one-celled animal), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. Parasites live at the expense of the host and may cause illness.



Entamoeba histolytica, the parasite which causes amebiasis, seen under the microscope (left) and in the human intestine (right). *Custom Medical Stock Photo, Inc. Reproduced by permission.*

The U.S. and the World

- Nearly 500 million people worldwide may be carrying the *Entamoeba histolytica* parasite, but only about 50 million people develop symptoms of amebiasis.
- Although the *Entamoeba histolytica* parasite is found in the United States, the disease is a much larger problem in developing nations in the tropical areas of Africa, Latin America, and Asia. Poor sanitation, inadequate water treatment, and the use of human feces as fertilizer contribute to the problem.
- Worldwide, amebiasis causes up to 110,000 deaths each year, but only a few of those deaths occur in the United States.

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

days or weeks. In areas with poor sanitation, drinking water contaminated with human feces can quickly spread amebiasis, and the cycle begins again.

What Are the Signs and Symptoms of Amebiasis?

Most ameba infections are asymptomatic, which means there are no symptoms. Even without symptoms, however, cysts are still produced, and the person is considered a carrier or cyst passer.

Amebic colitis Symptoms occur primarily when the amebae attack the wall of the large intestine. This is known as amebic colitis. The most common symptom is abdominal* pain that begins gradually. Additional symptoms may include diarrhea that contains blood or mucus, frequent bowel movements, and a constant nagging feeling of needing to move the bowels. In about one-third of cases, fever is present.

Amebic dysentery In rare cases, the symptoms of amebic colitis worsen with fever, chills, and severe diarrhea with blood and mucus. This condition is known as amebic dysentery (DIS-en-ter-y) and often leads to severe dehydration (excessive loss of body water).

Hepatic amebiasis If the amebae move through the bloodstream to other parts of the body, pockets of infection and pus can form in other organs. In about 1 percent of cases, the amebae infect the liver and cause a condition known as hepatic (he-PAT-ik) amebiasis. The symptoms of hepatic amebiasis include fever, a distended (swollen) abdomen, and pain and tenderness in the area of the liver just below the right ribs.

How Is Amebiasis Diagnosed and Treated?

The most common method for diagnosing amebiasis is examining stained stool smears under a microscope. *Entamoeba histolytica* also can be identified from samples of tissue obtained during visual examination of the colon with a flexible instrument called a colonoscope (ko-LON-os-cope) or during surgery.

If doctors find *Entamoeba histolytica*, they will prescribe medication for asymptomatic carriers (who can spread amebiasis if the amebae are not killed) and for people with active infections. Treatment usually lasts for about three weeks.

How Is Amebiasis Prevented?

There is no vaccine or prophylactic (disease-preventing) drug for amebiasis. Prevention of amebiasis depends on maintaining clean drinking water supplies, disposing of human waste properly, and using appropriate hygiene measures, such as thoroughly washing hands after going to the bathroom and before eating.

Municipal water supplies approved by local health departments in the United States are usually considered safe. When camping or traveling in other countries, however, it is important to use water only from safe sources and to avoid sources such as mountain streams.

▶ See also **Diarrhea • Parasitic Diseases: Overview**

Resources

Books and Articles

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Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/dpd/parasites/amebiasis/factsht_amebiasis.htm.

Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 888-INFO-FDA. Web site: <http://vm.cfsan.fda.gov/~mow/chap23.html>.

Amnesia See *Memory and Amnesia*.

Amyotrophic Lateral Sclerosis

Amyotrophic lateral sclerosis (ALS) is a rare disease. It is hereditary in some cases, but in most cases, its cause is unknown. ALS is not an infectious disease, meaning people cannot catch it from someone who has it. ALS affects the body's neurons, or nerve cells, that control movement of the voluntary (skeletal) muscles.

How Common is Amyotrophic Lateral Sclerosis?

Amyotrophic lateral sclerosis (a-my-o-TROF-ik LAT-er-al skle-RO-sis) (ALS) is also called Lou Gehrig's disease for the famous baseball player who died after developing the condition. ALS is uncommon. In the United States, only one or two cases are diagnosed in every 100,000 people in a year. According to the Amyotrophic Lateral Sclerosis Association, up to 30,000 Americans have ALS at any given time. ALS is rarely diagnosed in people younger than age 40, and it occurs more often in men than in women. Fewer than 10 percent of cases run in families. The other cases occur seemingly at random, and researchers have as of 2009 discovered nothing that puts those with the disease at higher risk. A variant of

- * **neurons** are nerve cells. Most neurons have extensions called axons and dendrites through which they send and receive signals from other neurons.
- * **cerebral cortex** (suh-REE-brul KOR-teks) is the part of the brain that controls functions such as conscious thought, listening, and speaking.
- * **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

LOU GEHRIG'S DISEASE

Lou Gehrig (1903–1941), who played first base for the New York Yankees from 1923 to 1939, was one of the greatest players in the history of baseball. His lifetime batting average was .340, and he hit .361 in six World Series. He twice led the American League in home runs, and he once tied for home runs with Babe Ruth. In 1934, he not only led the American League in home runs with 49, but also in batting average (363) and in runs batted in (165).

Gehrig, whose nickname was the Iron Horse, also set a major league record in 1939 for playing 2,130 consecutive games, a record that held for more than five decades. His career ended in that year, however, when he developed ALS. His fame drew attention to this condition, and in the United States, it had the common name of Lou Gehrig's disease after that.

Lou Gehrig was elected to the Baseball Hall of Fame in 1939. He showed his well-known winning spirit during the recognition day held in his honor at Yankee Stadium on July 4, 1939, shortly after he received the ALS diagnosis. He said: "Fans, for the past two weeks you have been reading about the bad break I got. Yet today I consider myself the luckiest man on the face of this earth. . . . I may have had a tough break, but I have an awful lot to live for."

Gehrig died of ALS just two years later at the age of 37. Several books as well as the 1942 film *Pride of the Yankees* chronicled his story.

ALS, known as Western Pacific ALS, had a particularly elevated incidence among people on the Pacific island Guam in the 1950s and 1960s. The rate later declined, but the prevalence of Western Pacific ALS in Guam in the early 2000s is still high compared to the worldwide incidence of ALS.

What Happens to People with Amyotrophic Lateral Sclerosis?

ALS affects the upper and lower motor neurons* in the body. The upper motor neurons are located in the cerebral cortex* of the brain and send signals for muscle movement to the spinal cord, where the lower motor neurons then carry the signals to the muscles. Damage to the upper motor neurons results in such symptoms as heightened gag reflex or other reflexes, and stiff muscles. Damage to the lower motor neurons includes muscle weakness, cramps, and twitches. In ALS, both upper and lower motor neurons degenerate or die. In either case, they no longer function. For this reason, symptoms of both upper and lower motor neuron damage are part of the diagnosis of ALS.

Typically, the disease produces weakness and paralysis* in the muscles it affects, and it causes these muscles to waste away. About 40 percent of people with ALS first notice very minor symptoms, such as clumsiness in

their hands when they try to perform such routine tasks as buttoning a shirt. Others may feel weakness in their legs or notice that their speech has become slower.

As time goes on, the person's arms and legs become weaker. They may experience muscle spasms, weight loss, and difficulty in breathing, eating, and swallowing. ALS does not affect the mind, however, and people with ALS are able to think as clearly as before. People with ALS have no loss of sensation or sense of touch.

People usually die within a few years after they develop ALS. In a very few cases, symptoms may stabilize at some point, remaining the same for years without getting any worse.

How Is Amyotrophic Lateral Sclerosis Diagnosed and Treated?

Physicians can distinguish ALS from other diseases of the nervous system by its usually late onset in life and by the progressive nature (worsening of symptoms) of the illness. The fact that the sense of touch is not affected also helps in diagnosis. Multiple sclerosis (MS), a more common disease, like ALS, affects the nervous system. Unlike ALS, however, MS attacks the nervous system in a number of different ways rather than involving only the motor nerves.

Physicians perform different kinds of medical tests to diagnose ALS. Tests may include:

- electromyogram (EMG), which measures the electrical activity of the muscles
- computerized tomography (CT), which uses computers and x-rays to record internal body images
- magnetic resonance imaging (MRI), which uses magnetism to create internal body images
- muscle or nerve biopsy, in which a small sample of tissue is removed from the body and studied under a microscope
- blood and urine studies.

Is There a Cure for Amyotrophic Lateral Sclerosis?

ALS has no known cure, but a few medications can ease the muscle spasms and possibly even slow the rate at which symptoms get worse. People who have ALS maintain an independent lifestyle as much as possible by taking different measures. Physical therapy, such as massage and regulated exercises, can reduce disability somewhat by helping the muscles to work better. Such aids as canes, walkers, and wheelchairs can help people with ALS remain independent. Mechanical ventilation (machine-assisted breathing support) is often needed in the later stages of the disease.

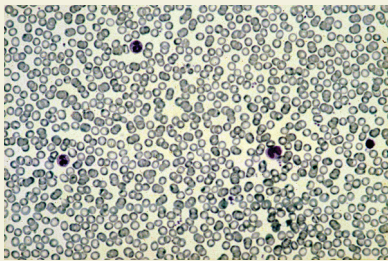
▶ See also **Multiple Sclerosis • Paralysis**



British scientist Stephen Hawking has Amyotrophic Lateral Sclerosis. ALS causes the muscles to waste away but does not affect the mind. Hawking, whose specialty is theoretical physics, is known as a visionary thinker; he has given many lectures using a computerized speech synthesizer. *AP Images.*

How ALS Got Its Medical Name

French neurologist Jean-Martin Charcot (1825–1893) was the first to describe ALS and gave the disease its name. Charcot noted in detail the wasting of muscles (amyotrophy) and the hardening (sclerosis) of motor nerves along the sides (laterally) of the spinal cord. In France, ALS is known as “la maladie de Charcot” (meaning Charcot’s disease) and in Great Britain it is called “motor neurone disease.”



▲
A smear of human blood containing a variety of cells that can be distinguished by cell size, presence of a nucleus, and frequency compared to other elements in the smear. The most numerous are red blood cells, which do not have nuclei and have light centers surrounded by a darker thicker edge. White blood cells are larger than red blood cells and contain a nucleus. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **hemoglobin** (HE-muh-glo-bin) is the oxygen-carrying pigment of the red blood cells.

* **hemophilia** (hee-mo-FIL-e-a) is a hereditary disease that results in abnormal bleeding because the blood fails to clot. It occurs almost exclusively in males.

Resources

Books and Articles

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Talbot, Kevin, and Rachael Marsden. *Motor Neuron Disease (The Facts)*. New York: Oxford University Press, 2008.

Organizations

ALS Society of Canada. 265 Yorkland Boulevard, Suite 300, Toronto, ON, M2J 1S5, Canada. Toll free: 800-267-4ALS. Web site: <http://www.als.ca>.

Amyotrophic Lateral Sclerosis Association. 27001 Agoura Road, Suite 150, Calabasas Hills, CA, 91301. Toll free: 800-782-4747. Web site: <http://www.alsa.org>.

Anemia, Bleeding, and Clotting

Anemia is a condition that occurs when there are too few properly functioning red blood cells to carry oxygen throughout the body. There are many different causes of anemia. Sickle-cell anemia, also called sickle-cell disease, is a hereditary disorder in which abnormal hemoglobin within the red blood cells interferes with their functioning and survival. Hemorrhage (HEM-or-ij) is significant bleeding that can lead to anemia. Clotting is the process that changes blood into a thick, jellylike substance that stops bleeding. Hemophilia* is a hereditary disorder in which the blood does not clot normally, leading to excessive bleeding and possibly hemorrhage and anemia.*

Carrie's Story

When Carrie turned 13, she was determined to finally get rid of what she called her “baby fat.” She longed to look like the skinny models who graced the covers of fashion magazines. Carrie stopped eating the well-balanced meals her mother prepared. Instead she grabbed rice cakes or low-fat chips to stop the hunger pangs. At about the same time Carrie got her period for the first time.

It was not long before Carrie started to feel lightheaded whenever she stood up. In gym class she had to stop and rest every five minutes. Noticing Carrie's behavior and how pale she looked, the gym teacher suspected that Carrie had iron-deficiency anemia. This type of anemia is very common in teenage girls due to poor eating habits and iron loss

from menstruation*. At her coach's suggestion, Carrie visited her doctor. Together they came up with a healthy diet and exercise plan to help Carrie reach an appropriate weight and keep her iron level normal.

What Is Anemia?

Anemia is a condition in which the blood does not contain enough properly functioning red blood cells to carry oxygen to all the cells of the body. There are several dozen types of anemia that fall into three broad categories according to their underlying causes:

- The process for making red blood cells, called erythrocytes (e-RITH-ro-sites), is not functioning normally: Either the bone marrow—the tissue in the center of most bones—does not make enough erythrocytes, the erythrocytes do not contain enough hemoglobin, or the hemoglobin does not function correctly.
- Erythrocytes are destroyed faster than the bone marrow can replenish them. Sickle-cell anemia, caused by defective hemoglobin genes* inherited from one's parents, is an example of this type of anemia.
- The body's total blood volume is lost faster than it can be replaced, caused by hemorrhage or impaired clotting such as in cases of hemophilia.

The life of an erythrocyte Blood contains red and white blood cells, platelets, and plasma—the yellow-tinted portion made up of water and other substances. Erythrocytes are the most abundant cells in the blood and give blood its red color. They are produced from stem cells* in the bone marrow by a process called hematopoiesis (he-ma-tow-po-EE-sis).

As erythrocytes mature in the bone marrow, they fill up with hemoglobin. Hemoglobin consists of four protein chains, called globins, and four heme molecules. Heme contains iron that binds to and transports oxygen and carbon dioxide. This characteristic enables hemoglobin to absorb oxygen in the lungs, release oxygen to the cells of the body, and transport carbon dioxide from the cells back to the lungs.

As an erythrocyte matures, it rids itself of most of the normal cell components (including the nucleus) to make room for about 300 hemoglobin molecules, which take up most of the cell's volume. Without the usual components, erythrocytes cannot grow and divide, and each erythrocyte survives for only about 120 days. The spleen, an oval organ located between the stomach and the diaphragm on the left side of the body, contains cells called macrophages (MAK-ro-fayj-ez). The macrophages engulf and break down the old, dying erythrocytes and recycle the iron from the hemoglobin to be used to make more hemoglobin. More than 2 million erythrocytes die every second, and they must be replaced by hematopoiesis at exactly the same rate. If there are too few erythrocytes, the kidneys (and to a lesser extent, the liver) make a hormone called erythropoietin (ee-rith-ro-po-EE-tin). This protein is secreted into the blood and signals the bone marrow to make more red blood cells.

* **menstruation** (men-stroo-AY-shun) is the discharge of the blood-enriched lining of the uterus. Menstruation normally occurs in females who are physically mature enough to bear children. Most girls have their first period between the age of 9 and 16. Menstruation ceases during pregnancy and after menopause. Because it usually occurs at about four-week intervals, it is often called the monthly period.

* **genes** are chemicals inherited from both parents that help determine physical characteristics, such as whether a person has brown hair or blue eyes, or in this case, normal or abnormal hemoglobin.

* **stem cell** an unspecialized cell that gives rise to differentiated cells.

Blood production is a complex process that requires communication between many parts of the body, including the bone marrow, the kidneys, and the spleen. There are many places in the process where something can go wrong. Problems with stem cells, with the production and maturation of erythrocytes, with the manufacture of hemoglobin, and with spleen function, and problems caused by improper signaling between the kidney and bone marrow can all lead to anemia. A person can have anemia due to an inherited blood disorder, because of an acquired blood condition, or as a side effect of a disease or condition not directly related to the blood. Sometimes anemia can be related to the ingestion of certain medications.

Types of anemia Among the many different conditions and disorders that can cause low production of erythrocytes leading to anemia are the following:

- An iron-deficient diet, as in Carrie's story, is the most common cause of this type of anemia.
- Folate-deficiency anemia is caused by a lack of folate (folic acid) in the diet or poor absorption of the nutrient.
- Pernicious anemia is caused by vitamin B12 deficiency.
- Sideroblastic (sid-er-o-BLAS-tik) anemia is a disorder in which the heme portion of hemoglobin does not correctly bind iron.
- Thalassemia (thal-a-SEE-me-a) is a group of inherited disorders in which the rate of hemoglobin production in the bone marrow is low because of a defect in the globin portion of hemoglobin.
- Diamond blackfan anemia is a very rare blood disorder in which the bone marrow does not make enough red blood cells.
- Aplastic anemia refers to a group of disorders in which the hematopoietic cells of the bone marrow are defective or destroyed.

Hemolytic anemias are caused by the premature destruction of red blood cells. Sickle-cell anemia is the best-known hemolytic anemia. In this disorder abnormal hemoglobin—called hemoglobin S—causes the erythrocytes to be sickle- or crescent-shaped rather than rounded and flattish like a saucer. Because of their shape, sickle cells cannot flow easily, and they tend to bunch up and clog blood vessels and break apart. This action can cause inflammation, pain, and tissue damage. Sickle cells are also more easily destroyed than normal red blood cells, having a lifespan of only 10 to 20 days. Although people with sickle-cell disease make red blood cells faster than healthy people, their bodies cannot keep up with the destruction of their red blood cells, resulting in anemia.

Hemorrhage, which means losing a lot of blood very quickly, can result in anemia because the body cannot make new blood as fast as it is being lost. Hemorrhages can be caused by injury, a burst blood vessel, childbirth, or surgery.

What Are Bleeding and Clotting Disorders?

Almost as soon as blood starts to flow from a cut finger or scraped knee, tiny, clear disc-shaped platelets begin the process of clotting, which entails turning the blood from liquid to solid to stop the flow. Platelets stick together and form a small plug at the point of bleeding. They contain an enzyme (a protein) that causes fibrinogen (fy-BRIN-o-jen), a substance in the blood, to change to fibrin (FY-brin), a hard substance that does not dissolve. The fibrin piles up, helping the platelets to block the opening and stop the blood flow. Fibrin needs other proteins in the plasma, called clotting factors, to do its job. The clotting factors are numbered I through XIII.

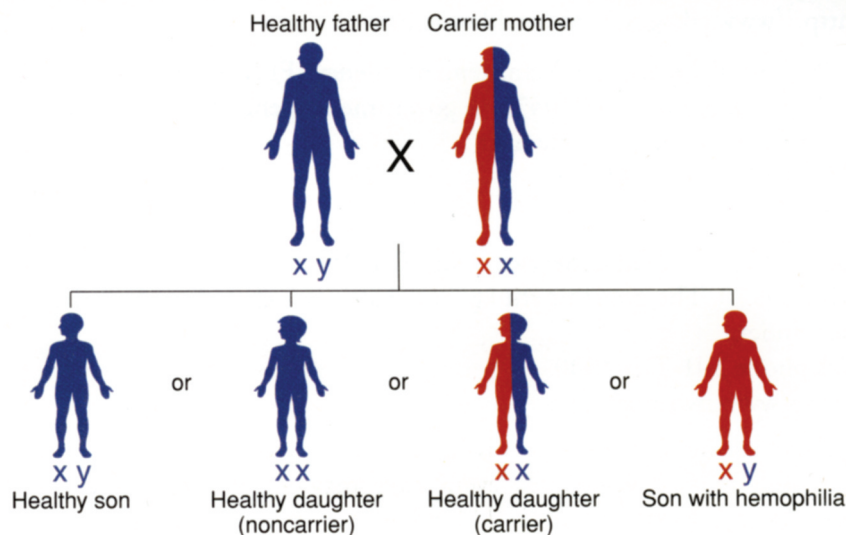
Some people have blood that does not clot well. Blood clots also can form in the wrong places and at the wrong time.

Hemophilia and other bleeding disorders Hemophilia is an inherited deficiency in a blood-clotting factor that results in excessive bleeding. For hemophiliacs losing a tooth or falling off a bicycle can be life-threatening because the bleeding does not stop.

Hemophilia A is a deficiency in clotting factor VIII. Factors I through VII function properly, but then the clotting process is interrupted and blood from a wound continues to flow. Hemophilia B is caused by a deficiency in factor IX.

Hemophilia varies in severity:

- With mild hemophilia the levels of factors VIII or IX are 6 to 50 percent of normal. Excessive bleeding is usually associated only with major injuries, surgical procedures, or tooth extractions.
- With moderate hemophilia factors VIII or IX are 1 to 5 percent of normal. Excessive bleeding follows minor injury as well as dental extractions and surgeries.



◀ The gene for hemophilia is unintentionally passed from mothers (XX) to sons (XY) via the X chromosome. A son who inherits a defective X chromosome from his mother does not have a healthy X chromosome to rely on the way daughters (XX) do. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **blood clots** are thickenings of the blood into a jelly-like substance that helps stop bleeding. Clotting of the blood within a blood vessel can lead to blockage of blood flow.

* **pulmonary embolism** is a blockage of the pulmonary artery or one of its branches that is frequently caused by thrombosis, or formation of a blood clot, in the lower extremities.

- With the most severe forms of hemophilia, factors VIII or IX are less than 1 percent of normal. The blood cannot clot at all, and hemorrhaging or internal bleeding can occur even in the absence of injury.

Von Willebrand's disease is a common bleeding disorder caused by a deficiency or defect in von Willebrand factor, a protein that helps the blood to clot. Liver disorders can also prevent the blood from clotting well because the liver produces some of the most important clotting factors.

Thrombophilia Thrombophilia is the name for any of several inherited disorders in which the blood may clot excessively. Factor V Leiden is the most common form of thrombophilia. Some people with thrombophilia develop blood clots or thrombosis.

Thrombosis is a condition in which blood clots* form in the wrong places, such as in a leg vein. Clots in veins can break free and travel to the heart and lungs, where they can cause a pulmonary embolism*, or blockage, which can be fatal.

How Common Are Anemia and Bleeding and Clotting Disorders?

Anemia Anemia caused by nutritional deficiencies is very common in Africa and Southeast Asia. The World Health Organization estimates that between 1993 and 2005, 24.8 percent of the world's population, about 1.62 billion people, suffered from anemia, including 47.4 percent of all preschool-age children, that is approximately 293 million children.

Iron-deficient anemia is very common, especially in infants and teenagers who need a lot of iron to fuel their growing bodies. In addition 30 to 50 percent of American women are at risk for anemia because of blood loss during menstruation and inadequate amounts of iron in their diets to offset these monthly losses.

Thalassemia is most common in Asia, the Mediterranean basin, and the Middle East. It is also fairly common in Africa. It affects about 1,000 Americans. Diamond blackfan anemia is so rare that there are only 25 to 35 new cases each year in the United States and Canada combined.

In contrast sickle-cell anemia affects millions of people around the world. In some parts of Africa up to 40 percent of the population has at least one *HbS* gene. In the United States more than 70,000 people have sickle-cell disease and 2 million carry the sickle-cell trait. It is particularly common in people whose ancestors came from sub-Saharan Africa, Spanish-speaking regions of the Western Hemisphere, Saudi Arabia, India, and Mediterranean countries such as Turkey, Greece, and Italy. One in every 500 African Americans is born with the disease and one in 12 has sickle-cell trait.

Bleeding and clotting disorders Hemophilia affects approximately 20,000 Americans and more than 400,000 people worldwide. Hemophilia A occurs in one out of every 5,000 live male births; hemophilia B in about

EUROPEAN ROYALTY AND HEMOPHILIA

History's most famous carrier of the gene for hemophilia was Queen Victoria (1819–1901), monarch of Great Britain and grandmother to most of the royalty in Europe. In 1853 Queen Victoria gave birth to her eighth child, Leopold, Duke of Albany, who had hemophilia and died at the age of 31 from internal bleeding after a fall.

Two of Queen Victoria's four daughters, Alice (1843–1878) and Beatrice (1857–1944), also carried the gene for hemophilia and subsequently transmitted the disorder to three of Victoria's grandsons and to six of her great-grandsons.

Alice's daughter Alexandra (1872–1918) was a carrier of hemophilia. She married Tzar Nicholas II (1868–1918) of Russia. Their son Alexei (1904–1918) was perhaps the most famous of the European royals with hemophilia. Alexei was the heir to his father's throne and his medical condition caused much anxiety in the royal household. Historians still discuss the role that Alexei's hemophilia played in the Russian revolution of 1918.

one in 10,000 live male births. About 60 percent of all cases of hemophilia are severe, and worldwide about 70 percent of people with hemophilia have no access to treatment.

Von Willebrand's disease is a common bleeding disorder that affects 1 to 2 percent of the U.S. population. Type I, the mildest form of the disease, accounts for 70 percent of cases. Although von Willebrand's disease occurs in both men and women, women are more likely to have symptoms because of heavy bleeding during menstruation and childbirth.

In the United States 5 to 8 percent of people have some form of thrombophilia, and more than 600,000 Americans are affected by abnormal blood clots. Deep-vein thrombosis affects 200,000 to 400,000 Americans. Almost one-third of them have post-thrombotic syndrome, a chronic disabling condition in the affected limb. In addition 100,000 to 200,000 Americans have pulmonary embolism and almost one-third of them die from it.

What Causes Anemia and Bleeding and Clotting Disorders?

Nutritional deficiencies Iron, folic acid, and vitamin B12 are all required for the bone marrow to make hemoglobin and erythrocytes. If these elements are missing from the diet or are not absorbed by the gastrointestinal tract, anemia can result.

Folate-deficiency anemia can be caused by a diet that is deficient in fresh fruits and vegetables that contain folic acid. It can also be caused by

What Do Babies and Teenage Girls Have in Common?

Infants and teenage girls are all at risk of developing iron-deficiency anemia. Teenage girls are at risk because they lose blood when they begin to menstruate, at a time when they are having growth spurts. In addition, many teenage girls are concerned about their weight and how they look: They may go on diets that do not provide enough iron. The combination of these factors often results in anemia.

Babies need lots of iron to fuel their rapid growth; their blood volume increases as fast as their bodies grow. Many doctors test 6- to 12-month-old babies for anemia, even if they seem happy and healthy because in the past so many babies developed iron-deficiency anemia. Typically iron is added to baby formula and baby cereals and only 2 to 3 percent of middle-class infants develop anemia. For breastfed babies, the iron in cereal or in supplements is especially important because breast milk alone cannot provide enough iron. Unfortunately, the rates of infant anemia are higher in lower-income communities because of poor nutrition.

* **bulimia** (bu-LEE-me-a) is an eating disorder in which a person has episodes of out-of-control overeating, or binges, and then tries to make up for them by making themselves vomit, by taking laxatives, or by exercising to excess to avoid gaining weight.

* **anorexia nervosa** (an-o-REK-se-a ner-VO-sa) is an emotional disorder characterized by dread of gaining weight, leading to self-starvation and dangerous loss of weight and malnutrition.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **autoimmune diseases** (aw-toh-ih-MYOON) are diseases in which the body's immune system attacks some of the body's own normal tissues and cells.

diseases, alcoholism, or some medications that interfere with the absorption of folate by the body.

Pernicious anemia occurs when individuals do not eat enough foods containing vitamin B12 or are unable to absorb the vitamin properly. To absorb vitamin B12, the lining of the stomach must produce hydrochloric acid and a chemical called “intrinsic factor.” If acid production is low or intrinsic factor is missing, the vitamin is not absorbed. People with a poor diet, bulimia*, anorexia nervosa*, diabetes, or thyroid disease, or who have had stomach surgery, stomach cancer, or a family history of pernicious anemia are all susceptible.

Other causes of low red blood cell production Sideroblastic anemia can be an inherited disorder, but it can also be caused by alcoholism, exposure to toxins such as lead, or acquired bone-marrow disorders. Thalassemia is an inherited disorder. Diamond blackfan anemia has an identifiable inherited genetic defect in about 25 percent of patients.

Aplastic anemia can result from destruction of blood-forming cells by cancer of the bone marrow or exposure to toxic chemicals, radiation, certain antibiotics*, or other medications. However, in many cases, the cause of aplastic anemia is unknown.

People with kidney diseases often develop anemia because the kidneys no longer produce enough erythropoietin in response to a decrease in red blood cells.

People who are frequently ill with infections are prone to anemia because infection slows the production of red blood cells. Anemia is very common in people with AIDS* because their immune systems* do not function properly, leaving these individuals prone to infections.

Hemolytic anemia In addition to inherited disorders such as sickle-cell disease, there are a variety of other causes of hemolytic anemia. Erythrocytes can be destroyed too soon or too fast for the following reasons:

- Defects in the membranes surrounding red blood cells cause them to be destroyed by macrophages
- Abnormal spleen function
- Exposure to certain drugs or toxic chemicals
- Infection
- Problems with the immune system

People with autoimmune diseases*, such as rheumatoid arthritis, can develop hemolytic anemia. In autoimmune diseases the body's immune system does not work correctly. In addition to destroying foreign cells, such as bacteria that cause infection, the immune system attacks and destroys its own cells, including erythrocytes.

Hemorrhage and hemophilia Hemorrhage is any profuse internal or external bleeding from the blood vessels. The most obvious cause of hemorrhage is trauma (injury) to a blood vessel. Hemorrhage can also be

WHY ARE HEMOPHILIACS ALMOST ALWAYS MALE?

Chromosomes are paired thread-like structures found in the nucleus or controlling region of the body's cells. They determine the development of individual characteristics. One obvious characteristic is sex, whether a person is male or female. A female has two X chromosomes and a male has one X and one Y chromosome.

Chromosomes are composed of genes, the individual units that determine everything from eye color to how the body functions. The X chromosome carries genes that control the production of clotting factors VIII and IX. In hemophiliacs, these genes cause the body to produce too little factor VIII or factor IX. Even if a girl (XX) has one X chromosome with a hemophilia gene, the other X chromosome is probably normal, and her body will produce enough factor VIII or IX to ensure that the blood will clot. The Y chromosome, however, has no part in the production of blood-clotting factors. Boys (XY) who inherit an X chromosome with a hemophilia gene from their mothers have no other X chromosome to compensate for the hemophilia gene.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

caused by aneurysms, weak spots in artery walls that are often present at birth. Over time the blood vessel wall at the site of an aneurysm balloons out and becomes thinner, making it more likely to leak and rupture.

Hypertension, or high blood pressure, is often a contributing factor in brain hemorrhage, which can cause strokes*. Uncontrolled diabetes can weaken blood vessels, especially in the eyes, resulting in a condition called retinopathy (ret-i-NOP-a-thee). Blood vessels also simply wear out with age. Some medications that affect blood clotting, including aspirin, can increase the likelihood of hemorrhage.

Bleeding disorders such as hemophilia can lead to hemorrhage. Hemophilia is caused by a defective gene that can be passed from mothers to sons via the X chromosome. Female carriers of the hemophilia gene have normal levels of clotting factors. Although a man with hemophilia and a woman carrier can produce a daughter with hemophilia, this is very rare. Up to one-third of hemophiliacs have no family history of the disorder. In these cases, a mutation (a change in a gene) has produced a new hemophilia gene, which may be passed on to subsequent generations.

What Are the Symptoms of Anemia and Bleeding and Clotting Disorders?

Anemia Mild anemia often has no symptoms. Symptoms of more severe anemia depend on various factors, including a person's age, how quickly the anemia developed, and other concurrent illnesses. Symptoms may be more obvious with a rapidly developing anemia. Moderate anemia,

such as pernicious anemia that usually develops slowly over a long period of time, may have few noticeable symptoms.

Like Carrie, people with moderate-to-severe anemia may feel tired, weak, dizzy, and short of breath, symptoms caused when the cells of the body are not getting enough oxygen. This lack of oxygen can also cause irritability and apathy. Sometimes people with moderate-to-severe anemia appear pale and waxy. Other symptoms may include:

- Headaches
- Loss of appetite
- Indigestion
- Sore tongue
- Bleeding gums
- Insomnia (difficulty sleeping)
- Rapid heartbeat
- Fatigue
- Poor concentration
- Menstrual irregularities in women

Babies born with thalassemia major have severe anemia during the first year of life that results in slow growth, abnormal bone development, and an enlarged liver and spleen. People with thalassemia minor may not have any symptoms.

People with sickle-cell trait usually have no symptoms of anemia, and they grow and develop normally. However, people with sickle-cell disease often have severe anemia, as well as delayed growth, episodes of pain, and frequent infections. Their skin may become yellowish (jaundiced) from the excessive destruction of red blood cells.

Hemorrhage and hemophilia Visible blood is the most obvious sign of hemorrhage. However, internal hemorrhaging may have no symptoms until complications develop. Symptoms of a brain hemorrhage depend on where the bleeding is occurring and can include the following:

- Headache
- Stiff neck
- Decreased alertness
- Balance problems
- Vomiting
- Drowsiness
- Changes in vision
- Numbness or weakness
- Difficulty swallowing, speaking, reading, or writing
- Confusion

- Loss of function on one side of the body
- Coma

Although hemophilia is present at birth, babies who are not circumcised (a surgical procedure to remove the foreskin of the penis) seldom experience problems until they begin to crawl. Once they start to bump into hard surfaces or fall, they begin to bleed into muscles or joints. This internal bleeding can cause joints to bruise and swell painfully.

Symptoms of von Willebrand's disease include frequent nosebleeds, a tendency to bruise easily, and prolonged bleeding during menstruation, childbirth, or following surgery.

How Is Anemia Diagnosed and Treated?

Diagnosis A complete blood count (CBC) is used to test for anemia. A small sample of blood is drawn and the numbers and volume of the different types of blood cells and the hemoglobin content of the red blood cells are measured. Some of the blood is smeared onto a slide and the color, size, and shape of the red blood cells are observed under a microscope. Iron-deficiency anemia is characterized by small red blood cells. Folate-deficiency and pernicious anemias are characterized by large red blood cells.

Sickle-cell disease and sickle-cell trait can be diagnosed by a test called hemoglobin electrophoresis (e-lek-tro-fo-REE-sis), which detects the presence of hemoglobin S and other abnormal hemoglobins.

Anemia is often caused by problems in the bone marrow where blood cells are made. Sometimes it is necessary to take a bone-marrow sample to determine the cause of the anemia. A needle is inserted into the hip bone and a sample of marrow withdrawn and analyzed.

Whereas it is easy to determine if a patient is anemic, finding the underlying cause can be more difficult. Anemia can be a symptom of many different diseases and disorders, and treatment depends entirely on the cause. Individual and family medical histories, symptoms, diet, illnesses, and drugs and medications are all important elements in diagnosing the cause of anemia. Treatment is specific for each type of anemia and is based on treating the underlying deficiency or disease.

Treatments If the anemia has a nutritional cause, changing to a diet rich in the deficient nutrient or taking supplements such as iron or vitamins often cures the problem. Food containing vitamin C, such as oranges, cantaloupe, and broccoli, can help the body to absorb iron. Treatment for most other types of anemia is much more complex and in some cases impossible.

Erythropoietin is sometimes administered to increase the production of red blood cells in anemia caused by cancer, AIDS, kidney disease, or rheumatoid arthritis. Other drugs are used to stimulate red blood cell production in people with some types of thalassemia or sickle-cell disease. Sometimes drugs that reduce the activity of the immune system (immunosuppressives) are used to treat hemolytic anemia caused by autoimmune

Granny Heath and Liver Therapy

In *My Second Life* (1944) author and physician Thomas Hall Shastid (1866–1947) recalls how his schoolteacher, “Granny Heath,” proclaimed that the raw or cooked liver of just about any farm animal was the perfect remedy for what she called the “littleness of blood.”

Doctors George R. Minot (1885–1950), William Parry Murphy (1892–1987), and George Hoyt Whipple (1878–1976) used liver to effectively treat pernicious anemia. They were awarded the Nobel Prize in 1934 for their research on blood chemistry and histology, which established the scientific basis for liver therapy.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **blood transfusion** is the process of giving blood (or certain cells or chemicals found in the blood) to a person who needs it due to illness or blood loss.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

disease. Occasionally the spleen must be removed to stop the premature destruction of erythrocytes.

Aplastic anemia is sometimes treated with a bone-marrow transplant from a relative with compatible cell types. However, it is often difficult to find a transplant donor with the right cell type.

There is no cure for sickle-cell anemia. Treatment is preventative and directed at symptoms:

- Antibiotics to prevent infections
- Pain-relieving medications
- Intravenous fluids to offset dehydration*
- Oxygen therapy
- blood transfusion*

Complications of sickle-cell anemia In addition to the symptoms and complications of anemia, people with sickle-cell disease periodically experience bouts of critical illness, called crises. Sickle-shaped red blood cells clump more easily than normal red blood cells. Sickle-cell crises begin suddenly when clumping of sickled red blood cells in the blood vessels obstructs the normal flow of blood, depriving tissues and organs of oxygen. The first crises usually appear in early childhood.

Crisis can be brought on by respiratory infection, loss of body fluids from vomiting or diarrhea, or situations in which the body’s need for oxygen is increased. They may occur for no obvious reason. A crisis can last for several days and cause fever and sharp intense pain in the back, abdomen*, chest, arms, and legs. In infants the hands and feet may become swollen and painful.

Crisis can damage almost any part of the body, but especially the bones, kidneys, intestines, lungs, liver, spleen, and the central nervous system*, including the brain. Crises can also damage the eyes and cause stroke, convulsions*, or paralysis.

People with sickle-cell disease are more susceptible to all kinds of bacterial and fungal infections. They are more likely to experience kidney failure and liver problems. By age 30, about 70 percent of people with sickle-cell disease have developed gallstones.

How Are Bleeding and Clotting Disorders Diagnosed and Treated?

Sometimes anemia is caused by chronic bleeding, such as from a wound in the skin or mucous membranes inside the body (ulcer). The source of bleeding must first be found and treated. Iron supplements are often needed to help boost hemoglobin production. In severe cases, a blood transfusion is used to replenish the volume of blood in the body.

Hemorrhage When bleeding is visible the causes of most hemorrhages are obvious. Blood tests and spinal-fluid tests can reveal evidence of brain hemorrhage. Computed tomography (CT or CAT) scanning is

an important imaging technique for detecting bleeding in the brain and other tissues.

The first goal in treating a hemorrhage is to stop the bleeding. Hemorrhage caused by trauma or the tearing of blood vessels can be treated by clamping or surgically repairing the tears. Hemorrhage resulting from vessel leakage due to high blood pressure can be treated with medicines to reduce blood pressure, prevent vessel spasm, and reduce pain. Surgery may be needed to reduce the pressure of blood that has collected in the brain. Blood factors to help the blood clot may be administered to those with bleeding disorders.

If the blood loss is life-threatening, a blood transfusion is necessary. In less severe cases, the body itself can slowly bring the blood volume and hemoglobin content back to normal. In fact, people can survive the loss of two-thirds of their blood volume over a 24-hour period.

Hemophilia Hemophilia can be diagnosed by measuring the levels of clotting factors in the blood. DNA testing (direct analysis of the genes) can determine whether a woman carries a gene for hemophilia. Tests can also be performed on fetuses to determine if they have inherited hemophilia. However, mild cases of hemophilia may not be diagnosed until adulthood, when unexplained and excessive bleeding accompanies surgery or a visit to the dentist. Likewise von Willebrand's disease often goes undiagnosed or is misdiagnosed.

Hemophiliacs are often supplied with the missing blood-clotting factor. These factors are collected, purified, and combined from the blood donations of many people. Since the mid-1990s they have also been produced by genetic engineering, which does not require blood donations. The clotting factors are transfused through a person's vein at a hospital, doctor's office, or by a properly trained individual at home.

People with mild cases of hemophilia may never or only rarely need transfusions. With a major injury or surgery, a hemophiliac may need transfusions two or three times per day for days or weeks. Some people with severe hemophilia may get transfusions on a regular basis as a preventative measure.

The medication desmopressin (DDAVP) can sometimes help release any extra stores of factor VIII in people with mild or moderate hemophilia A or von Willebrand's disease. This is a temporary treatment that may help avoid a transfusion after a minor injury.

Complications of hemophilia People with hemophilia bruise very easily, but skin bruises are rarely serious. Bleeding from small cuts and scrapes can usually be stopped by applying firm pressure to the area for several minutes. Deep cuts, however, can bleed profusely and require treatment.

Joint bleeding is a serious complication of hemophilia. Prompt treatment is necessary to prevent severe pain and swelling, and joint bleeding can lead to arthritis (inflammation of the joints), deformity, and disability. Boys with hemophilia often learn to recognize joint bleeding as a tingling sensation before the pain or swelling occurs.

HIV and Hemophilia

Between 1979 and 1985 an estimated 55 percent of people with hemophilia were infected with HIV—the virus that causes AIDS—through transfusions of clotting factors obtained from contaminated blood. Almost 90 percent of those with severe hemophilia became infected. Not only did hemophiliacs often get many transfusions, but each transfusion contained pooled clotting factors drawn from the blood of a large number of donors. This situation greatly increased the risk that the transfusion was infected with HIV.

The blood supply was later considered safe. Today, potential blood donors are screened to eliminate those who might have been exposed to HIV, and all blood is tested for the virus. In addition, clotting factors drawn from blood are treated by heat and other virus-killing techniques.

Did You Know?

Cooking acidic foods such as tomatoes in cast-iron skillets or pans can add significant amounts of iron to the diet.

* **remission** is an easing of a disease or its symptoms for a prolonged period.

Bleeding into a muscle, most often the calf, thigh, or forearm, commonly occurs simultaneous with or following an injury. The resulting swelling, which can develop over several days, may create pressure inside the muscles and damage nerves and blood vessels. Symptoms include muscle tightness, pain, a change in skin temperature, and tingling or numbness. Early treatment is needed to prevent permanent immobility or paralysis.

Any type of neck or head injury can be extremely dangerous for hemophiliacs. Neck and throat hemorrhages can obstruct breathing. Head injury, even a minor fall or bump on the head, can cause bleeding into the brain. Symptoms include irritability, headache, nausea, vomiting, double vision, and confusion.

Thrombophilia Some people with thrombophilia or thrombosis need treatment only during pregnancy, when recovering from surgery, or when sitting for long periods of time in a car or airplane. Other people need to take anti-clotting medication for their entire lives.

How Can Anemia and Hemorrhage Be Prevented?

The long-term effect of anemia is on the heart, which must work harder to pump more blood through the body. Over time the heart enlarges, increasing the risk of heart attack and heart failure.

Good nutrition plays a big part in preventing or treating many types of anemia. Maintaining a healthy diet requires eating daily foods that include the following:

- Iron from beef, liver, oysters, sardines, egg yolks, spinach, collards, kale, turnip greens, dried peas and beans, potatoes in their skins, pumpkin, dried fruit, whole grains, wheat germ, soy flour, iron-fortified cereals, molasses, carob
- Folic acid found in dark-green leafy vegetables, meat, eggs, orange juice, and wholegrain cereals
- Vitamin B12, which is only found in animal products, such as meat, fish, and dairy

A healthy diet, regular exercise, cutting down on excess sodium intake, maintaining a normal weight, and taking prescribed medications properly can often control high blood pressure that can lead to a hemorrhage. The use of cocaine, amphetamines, and alcohol are associated with brain hemorrhages, particularly in young people. Wearing helmets when bicycling, skateboarding, and rollerblading, and always wearing seatbelts in motor vehicles can help prevent serious head injuries. Retinopathy can be prevented or lessened by controlling diabetes by keeping blood sugar at a near-normal level.

Living with Sickle-cell Anemia

Many people with sickle-cell disease go through long periods of remission* during which they may feel relatively well, engage in most normal activities, and are free of crises. Other people experience pain on a daily basis, and some are hospitalized with crises several times per year.

In the United States, babies, regardless of ethnic background, are tested for hemoglobin S as part of routine newborn screening. Before this screening became commonplace, many babies with sickle-cell disease died from infections in infancy. The use of preventative antibiotics significantly reduced this infant mortality. Children with sickle-cell anemia receive a complete set of immunizations.

Daily folic acid may stimulate new red blood cell production. Fluid intake is important to prevent the dehydration of cells that increases their sickling. Lifestyle habits that can help sickle-cell patients stay healthy and have fewer crises include:

- Avoidance of extremes of heat and cold
- Avoidance of stress and overexertion
- Receiving adequate sleep
- Having regular medical check-ups.

Prospective parents who might be carrying the *HbS* gene may choose to be tested and receive genetic counseling before having children.

Living with Hemophilia

As soon as a child is diagnosed with hemophilia, parents try to prevent or reduce occurrences of bleeding. The children should have soft toys without sharp corners and padded clothing, particularly at the elbows and knees, while learning to walk. Children should be immunized, but the injections should be given under the skin, rather than into the muscle, to prevent hemorrhage. Children should clean their teeth regularly and visit the dentist to prevent tooth decay and gum disease* that can lead to bleeding episodes.

Hemophilia is usually not fatal, and people often live long and active lives with the disorder. Activities such as swimming, walking, and bicycling can help build up muscles that support the joints. Contact sports such as football or wrestling, however, are prohibited because of the high risk of head or neck injury. People with hemophilia should never take aspirin because it increases the tendency to bleed and interferes with clotting.

▶ See also **AIDS and HIV Infection • Embolism • Fainting (Syncope) • Genetic Diseases • Hypertension • Nosebleeds • Sickle-cell Anemia • Stroke • Thalassemia**

Resources

Books and Articles

Bardes, Charles L. *Pale Faces: The Masks of Anemia*. New York: Bellevue Literary Press, 2008.

Peak, Elizabeth. *Sickle Cell Disease*. Detroit, MI: Lucent Books, 2008.

Raabe, Michelle. *Hemophilia*. New York: Chelsea House, 2008.

* **gum disease** is an infection caused by bacteria that affect the tissues surrounding and supporting the teeth.

* **hindbrain** the portion of the brain located at the base of the skull responsible for basic functions such as breathing.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

Organizations

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: <http://www.nhlbi.nih.gov/health>.

National Hemophilia Foundation. 116 West 32nd Street, 11th Floor, New York, NY, 10001. Telephone: 212-328-3700. Web site: <http://www.hemophilia.org>.

Sickle Cell Disease Association of America. 231 East Baltimore Street, Suite 800, Baltimore, MD, 21202. Toll free: 800-421-8453. Web site: <http://www.sicklecelldisease.org>.

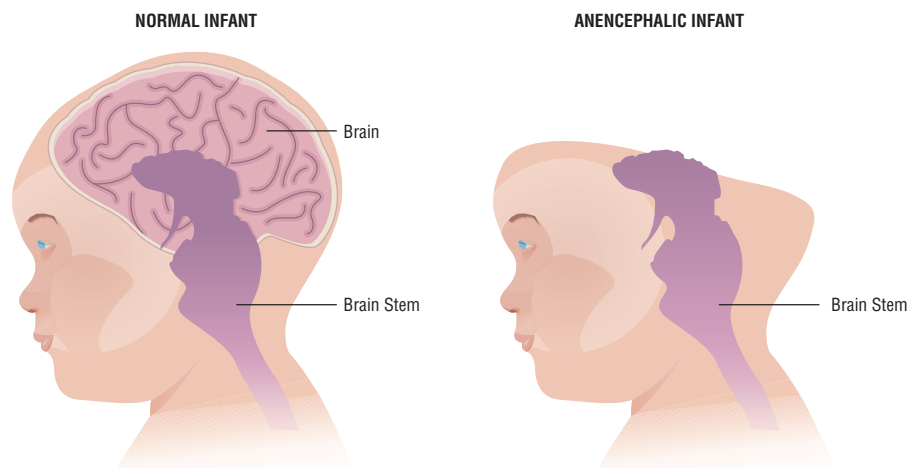
Anencephaly

Anencephaly is a serious and fatal medical condition in which there is defective formation of the brain and skull during fetal development.

What Is Anencephaly?

Anencephaly is a serious and fatal medical condition in which there is defective formation of the brain and skull during fetal development. The brain is minimally developed and almost entirely absent. There may be rudimentary portions of the hindbrain* present, responsible for basic functions such as breathing. The skull is only partially formed. A fetus*

Diagram of Anencephaly



The brain of a normal infant (left); the brain of an infant with anencephaly (right). *Illustration by Argosy. Reproduced by permission of Gale, a part of Cengage Learning.*

with anencephaly may die in the womb or may survive birth and die shortly thereafter. Fetuses with anencephaly are often spontaneously aborted by the body of the mother, or they are stillborn (born dead). Those who are born temporarily breathing are usually blind and deaf, as well as unconscious due to a lack of the portion of the brain that makes consciousness possible.

During fetal development, a structure known as the neural tube is formed as a precursor to what later becomes the central nervous system in the baby. The proper formation of a neural tube, including closure of the tube, is critical to brain formation and function in later life. Anencephaly is caused by a defect in the neural tube structure during formation. Defects in neural tubes during pregnancy usually occur around 24 to 28 days after fertilization or approximately three to four weeks into the pregnancy. Anencephaly is one of many different types of neural tube defects, in which the neural tube fails to close properly.

What Causes Anencephaly?

Many different environmental factors have been implicated as having a potential role in the development of neural tube defects, including anencephaly. Maternal type 1 diabetes*, maternal obesity*, folic acid deficiency or drugs that impact folic acid levels in the body, specific toxins sometimes found in cornmeal, some poisons such as arsenic, and excessively high maternal body temperature may contribute to neural tube defects during pregnancy. Hyperthermia*, a term used to describe excessively high body temperature, may be caused by fever or recreational activities such as using a hot tub.

Folic Acid and Anencephaly Prevention

Folate is a form of folic acid, a type of B vitamin necessary for human health. Folate is found in some food groups and can also be taken as a vitamin supplement. It is a critical component of neural tube formation, which takes place in the third to fourth week of pregnancy. Many pregnant women are not aware of their pregnancy until after this time, and so they may engage in activities that harm neural tube formation without realizing it. In order to reduce the potential incidence of neural tube defects, sexually active women of child-bearing age are encouraged by healthcare providers to take folic acid supplements.

Among women who have a pregnancy affected by anencephaly or some other type of neural tube defect, the recurrence risk is approximately 2 to 4 percent for subsequent pregnancies. If there are multiple occurrences of neural tube defects in a family history, the risk is higher. Women who have had a child with anencephaly are recommended to take 4 mg of folic acid daily, whereas other women of child-bearing age are recommended to take only 0.4 mg daily. Folic acid supplementation is responsible for preventing two-thirds of all neural tube defects. It is a critical component of the campaign against the occurrence of neural tube defects such as anencephaly.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

* **hyperthermia** (HY-per-ther-ME-ah) a state in which the body either produces or absorbs more heat than it can dissipate resulting in a significantly raised body temperature.

* **alpha-fetoprotein** (AL-fah-FEE-toe-PRO-teen) is a substance produced by a fetus and present in maternal blood and amniotic fluid, measured to determine likelihood of neural tube defects.

Frequency of Anencephaly

In the United States approximately 1.2 cases of anencephaly occur per 10,000 births. Because many fetuses with anencephaly never make it to birth, the frequency during pregnancy is higher, approximately one in 1,000 pregnancies. Female fetuses tend to be more frequently affected than male. The United States has geographical regions with higher levels of known neural tube defects such as anencephaly than other regions. An increase in the frequency of neural tube defects has been tracked from the West to the East Coast, with South Carolina having the highest prevalence of neural tube defects of all the states. Hispanic populations also experience a higher rate of these defects for reasons that were unknown as of 2009. Outside the United States, regions with high numbers of neural tube defects include Guatemala, northern China, Mexico, and some areas of the United Kingdom.

Physical Appearance of Anencephaly

At birth, babies with anencephaly are missing a large portion of their brain and part of their skull. The area of missing skull may or may not be covered by skin. Facial features are present and may appear relatively normal. Breathing and reflexes are present, but the child is missing the portion of the brain responsible for consciousness and is also deaf and blind.

Alpha-fetoprotein Measurement

Alpha-fetoprotein (AFP)* is a substance made in the liver of an unborn fetus. AFP can be measured in the blood and amniotic fluid of a pregnant woman. The level of AFP present is used to determine the likelihood that the fetus has a neural tube defect, such as anencephaly. In this manner, AFP measurement can generally be used as a screen for problems such as anencephaly. However, if the region of missing skull on the fetus is covered with skin, the AFP level may not be altered from normal. If the mother has type 1 diabetes, the production of AFP during pregnancy is delayed and altered, and so it may be difficult to use this method as a screen.

Resources

Organizations

Anencephaly Support Foundation. 20311 Sienna Pines Court, Spring, TX, 77379. Web site: <http://www.asfhelpp.com>.

Children's Hospital Boston. 300 Longwood Avenue, Boston, MA, 02115. Telephone: 617-355-6000. Web site: <http://www.childrenshospital.org/az/Site578/mainpageS578P0.html>.

Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 88-463-6332. Web site: <http://www.fda.org>.

National Institutes of Health. 9000 Rockville Pike, Bethesda, MD, 20892. Telephone: 301-496-4000. Web site: <http://www.nih.gov/index.html>.

Aneurysm

An aneurysm (AN-you-rizm) is an abnormal localized dilation, or swelling, of a blood vessel (a balloon-like bulge), that may cause massive bleeding, shock, or death if it ruptures (breaks open).

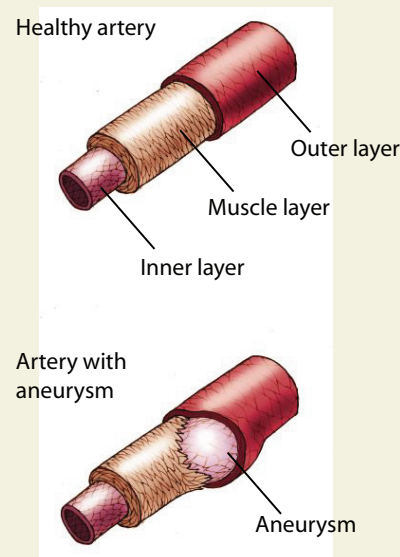
Why Are Aneurysms Called “Silent Killers”?

Aneurysms are sometimes called “silent killers” because they may go undetected for years until they break open. A segment of an artery*, or vein* (although venous aneurysms are not common), or other blood vessel may weaken and begin to bulge, like an underinflated balloon whose air is squeezed from the ends to the middle. The bulge may grow slowly for years until one day the blood vessel wall gives way (ruptures). This rupture is a medical emergency that may lead to death. There are two major classes of aneurysms: aortic aneurysms, which occur in the major artery that carries blood away from the heart, and cerebral aneurysms, which occur in an artery in the brain. Aneurysms of the aorta are virtually always caused by atherosclerosis (the build-up of plaque in arteries, which causes the arteries to lose elasticity and to harden). In the case of aortic aneurysms, a tiny tear develops within the inner layer of the aorta (the largest artery that carries blood away from the heart). Blood leaks through this tear into the middle layer of aortic tissue, causing the inner and middle layers to separate (dissect). Over time, this so-called dissecting aneurysm results in an elongated, blood-filled channel running up and down the aorta, which can break open, causing fatal bleeding.

Aortic aneurysms may arise in the abdominal portion of the aorta (abdominal aortic aneurysms) or the thoracic portion of the aorta (thoracic aortic aneurysms). In the United States more than 15,000 people die annually due to abdominal aortic aneurysm rupture. The most common aneurysm is the cerebral aneurysm, which is a stroke*.

How Do Aneurysms Happen?

Aneurysms result when the normal structure of a blood vessel becomes weak in an area. Such deterioration can be a result of atherosclerosis, where fatty deposits of lipoproteins, including cholesterol, accumulate on the walls of the blood vessels, but this kind of weakness in a blood vessel may also come about as a result of infection or trauma, or the aneurysm

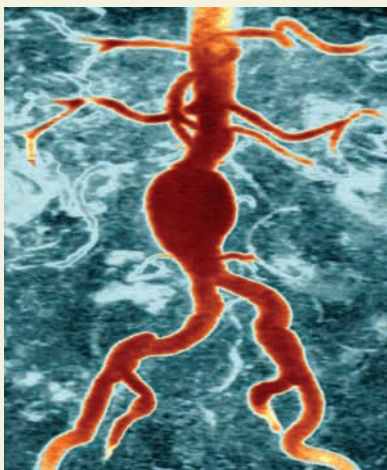


▲ People with aneurysms develop bulges in the walls of an artery, vein, or other blood vessel. Top: A healthy artery. Bottom: Artery with an aneurysm. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **artery** An artery is a vessel that carries blood from the heart to tissues in the body.

* **vein** A vein is a vessel that carries blood to the heart. Veins have greater capacity and thinner walls than arteries and contain valves that prevent blood from flowing backward and away from the heart.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to a region of the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.



Colored magnetic resonance angiography scan of the abdominal arteries (red) of a patient with high blood pressure. At center, just below the renal arteries, the aorta is bulging, a condition known as an aneurysm. If left untreated, the blood vessel can rupture. *Zephyr/Photo Researchers, Inc.*

Monster of a Headache

R.E.M. was rocking its way through Europe during its 1995 “Monster” Tour when drummer Bill Berry got a sudden, terrible headache and could not see. It turned out that Berry had a brain aneurysm, which was operated on immediately. The surgery was a complete success, and the band was able to finish touring with their excellent drummer.

* **congenital** (kon-JEH-nih-tul) means present at birth.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

may be congenital*. An increased incidence of aneurysm may be seen with certain conditions, such as syphilis or Marfan syndrome. Many times, however, an aneurysm develops without any known cause.

Abdominal aortic aneurysm affects many more men than women. It also occurs more often in people who are older than age 55, who are smokers, or who have high blood pressure. People with other family members who have had these types of aneurysms are more likely to develop the aneurysms themselves.

There usually are no signs of a growing aneurysm. In the case of abdominal aortic aneurysms, the affected person will sometimes feel pain in his or her abdomen*. A large aneurysm in the abdomen may press against the spine and cause back pain. The rupture of an aneurysm in an artery can kill a person quickly. The rupture of a brain aneurysm constitutes a kind of hemorrhagic stroke. It is a medical emergency. Symptoms may include numbness, paralysis, stiff neck, vision loss, confusion, and loss of consciousness.

What Are the Signs and Symptoms of Aneurysms?

The signs and symptoms of an aneurysm depend on the location of the aneurysm and how large it is. Initially, for example, there may be no symptoms at all. As the aneurysm grows, however, symptoms may develop. For example, an expanding abdominal aortic aneurysm may cause severe, deep pain in the individual’s back and/or abdomen. The feet and legs may become cold and numb, due to interference with blood flow to the lower limbs. The physician may feel a pulsing mass in the individual’s abdomen and may hear a characteristic sound as he or she listens to the area with a stethoscope. If the abdominal aortic aneurysm should rupture, severe, life-threatening symptoms will occur, including dizziness, fainting, rapid heart rate, nausea and vomiting, intensely severe abdominal and back pain, and eventually shock from blood loss. If the expanding aneurysm is located in the chest (thoracic aortic aneurysm), the individual may develop pain in the jaw, neck, upper back, or chest, as well as coughing, hoarse voice, and difficulty breathing and shortness of breath. The symptoms of an expanding brain aneurysm depend on where it is located. Possible symptoms of a growing brain aneurysm include the drooping of an eyelid, double vision, other vision impairment, pain in or behind the eye, an abnormally dilated pupil, a numb or weak feeling on one side of the body or the face. If the brain aneurysm ruptures, then the signs and symptoms may include an intensely unbearable headache, nausea and vomiting, stiff neck, unconsciousness, and other signs of stroke (difficulty swallowing, difficulty talking and understanding speech, confusion, dizziness, loss of balance, difficulty walking, weakness, or paralysis of limbs). If the patient has a peripheral aneurysm, then the person might notice a pulsing bump in his or her neck, arm, or leg, as well as limb pain or muscle cramping with exercise, unhealing sores on the toes or fingers, or even gangrene due to loss of blood flow.

How Do Doctors Diagnose and Treat Aneurysms?

Fortunately, many aneurysms can be detected before they rupture. Doctors often are able to feel the pulsating sensation of abdominal aneurysms through the skin. Also, aneurysms often cause subtle changes in how the heart sounds, and doctors might notice these changes when listening to the heart. The most reliable methods of checking for aneurysms are x-rays, ultrasound* exams, and other imaging techniques that can provide more detailed images of the body.

Wait and see If an aneurysm is discovered, sometimes a doctor may adopt a wait-and-see strategy, but often this approach depends on the aneurysm's location, size, and the person's overall health. Small aneurysms might be checked every six months or so to confirm that they are not growing. Aneurysms usually grow slowly.

Surgery Sometimes surgery is required. One method involves removing the section that is bulging and replacing it with an artificial blood vessel. Another technique for repairing aortic aneurysms involves snaking a thin, flexible wire up from an artery in the leg to the aneurysm, where a tube or coils are attached to the artery's walls on either side of the aneurysm.

How Are Aneurysm Prevented?

It is most important to detect aneurysms before they break open. More than 60 percent of people whose aneurysms rupture die before they reach the hospital, and a large percentage may die during or after emergency surgery. However, regular medical care and surgery allows the vast majority of people whose aneurysms are discovered before they rupture to recover.

▶ See also **Marfan Syndrome • Stroke**

Resources

Books and Articles

Goetz, C. G. *Goetz's Textbook of Clinical Neurology*, 3rd ed. Philadelphia, PA: Saunders, 2007.

Libby, P., et al. *Braunwald's Heart Disease*, 8th ed. Philadelphia, PA: Saunders, 2007.

Marx, John A., et al. *Rosen's Emergency Medicine*, 6th ed. St. Louis, MO: Mosby, 2006.

Organizations

American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org>.

* **ultrasound** exams or sonograms use inaudible sound waves that can be generated by special equipment, and the reflections, or echoes, of the sound waves are used to produce an image or picture of an organ or tissue. This can help doctors to diagnose an illness and determine how best to treat the patient.

* **rabies** (RAY-beez) is a viral infection of the central nervous system that usually is transmitted to humans by the bite of an infected animal.

Heart and Stroke Foundation of Canada. 222 Queen Street, Suite 1402, Ottawa, ON, K1P 5V9, Canada. Telephone: 613-569-4361. Web site: <http://www.hsf.ca/az/atoz-a.htm>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Web site: <http://ninds.nih.gov/healinfo/DISORDER/Aneurysm/aneurysm.htm>.

National Stroke Association. 96 Inverness Drive East, Suite I, Englewood, CO, 80112-5112. Toll free: 800-787-6537. Web site: <http://www.stroke.org>.

Angina See *Heart Disease*.

Animal Bites and Stings

Animal bites are wounds caused by the teeth of a wild or domestic animal or human. In addition to mammals, many insects, spiders, and reptiles can bite or sting humans. A person's reaction to a bite or sting depends on the type of wound, whether venom is injected during the bite, whether the person is allergic to the venom, and whether the biting animal is carrying a disease-causing agent.

Are Animal Bites Dangerous?

Animal bites can range from mild to serious. When the skin is not broken, bites usually are not dangerous. Animal bites can be very serious if skin, muscles, or tendons are torn; bones are crushed; a deep hole (puncture) is made; or the animal injects venom into the wound or the wound becomes infected by germs in the saliva.

Who Bites and Why?

Between 80 and 90 percent of all bite wounds that receive emergency room medical treatment in the United States are caused by dogs. Of these, about 1 percent are serious enough to require hospitalization. Cats are responsible for 5 to 15 percent of all bites. About 6 percent of cat bites require hospitalization. Other reported bites are caused by animals such as rats, mice, rabbits, ferrets, snakes, farm animals, and zoo animals and vary in severity. Children between the ages of 5 and 14 are most likely to be bitten, and very young children are most likely to die from a bite. Between 10 and 20 people die of bites each year in the United States. In developing countries where rabies* is poorly controlled, the death rate from dog bites can be quite high.

Dogs Dog bites usually occur on the hands, face, or legs. About one million people per year seek medical care for dog bites in the United States, and many more bites are unreported. Sixty percent of those bitten are children, so dog bites are a major health problem of children. Dog bites rarely become infected, and rabies in dogs is rare in the developed world. On average, 12 people, mostly young children, die each year from dog bites in the United States.

Most dogs do not bite unless provoked or teased, so most dog bites can be prevented by following simple guidelines that include the following:

- Ask permission from a dog's owner before petting the dog.
- Do not pet unfamiliar dogs.
- Do not tease dogs or pull their ears or tails.
- Avoid bothering dogs when they are eating or sleeping.
- Do not approach a dog that is protecting puppies.
- Back away very slowly from a growling dog or wait calmly for the dog to leave. Do not run away, as running stimulates the dog to chase.
- Learn the warning signs that a dog may attack: flattened ears, tail held low, lips lifted to expose teeth, growling.

Cats Cat bites and scratches are also very common, and they are more likely than dog bites to become infected and require hospitalization. Cat bites most often involve the hands, followed by the legs, face, and torso. Rabies is rare in cats, but it is more common in cats than in dogs in the United States. One infection caused by cat bites or cat scratches is cat scratch disease, which causes enlargement of the lymph nodes* but usually goes away by itself after about three weeks.

Humans Human bites are dangerous because the human mouth contains bacteria* that can cause serious infection. The most common human bite wound occurs during fights when one person punches another person and cuts his knuckles on his opponent's teeth. Children sometimes bite other children or adults, and these wounds result from skin being caught between the teeth. The condition can be made worse when people are embarrassed about the bite and do not see a doctor right away, because delay in treatment can cause an infection to develop.

Snakes

Twenty-five species of poisonous snake live in the United States, and at least one type can be found in every state except Maine, Alaska, and Hawaii. Pit vipers, which include rattlesnakes, copperheads, and cottonmouths, cause 99 percent of poisonous snakebites in the United States. Coral snakes cause the other 1 percent. Worldwide, about 15 percent of all snake species are poisonous to humans.

Venoms of different snake species range in toxicity, and a poisonous snake does not always release venom when it bites. The poisons in some species are mild, whereas others are neurotoxins (noor-o-TOK-sins;

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **tetanus** (TET-nus) is a serious bacterial infection that affects the body's central nervous system.

* **tourniquet** (tour-nih-KETZ) is a device, often a bandage twisted tight around an arm or a leg, used to stop blood flow or hemorrhage.

poisons for neurons) that may cause damage to the brain or spinal cord or cause people to stop breathing.

Any snake bite should receive emergency medical care because many people do not know what species of snake bit them, and even nonpoisonous snakes can cause infection or an allergic reaction. Each year, between 4,000 and 7,000 people are treated for snakebite in emergency rooms in the United States, with the most bites being reported in North Carolina. Men are bitten about nine times more often than women. Between 1988 and 2008, only 97 deaths in the United States were caused by snakebites.

Other Animals Mice, rats, guinea pigs, and hamsters sometimes bite, as do exotic pets such as ferrets, monkeys, snakes, snapping turtles, and birds. Horses, mules, sheep, pigs, and goats can also bite. Wild animals such as skunks, raccoons, bats, sharks, and Gila monsters cause bite injuries each year. Bites from wild animals are especially dangerous because the animals sometimes have rabies.

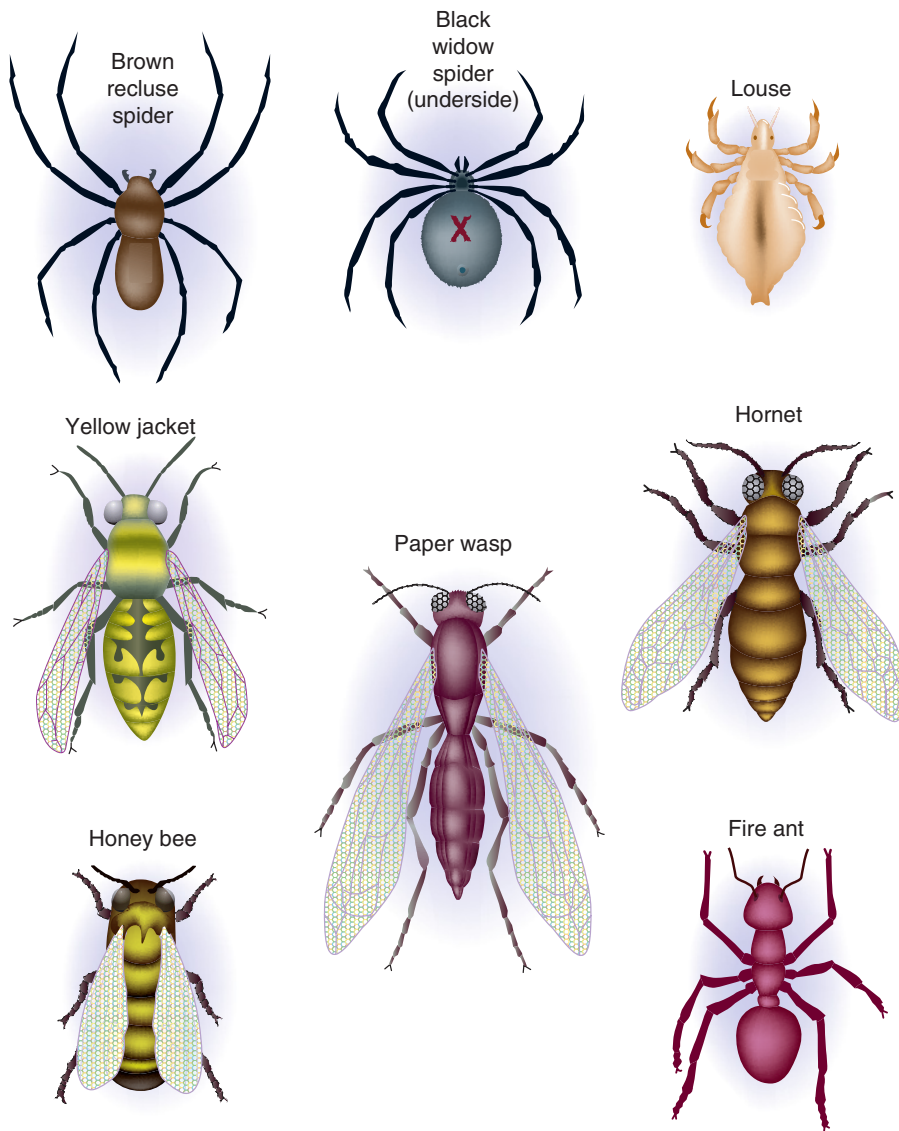
Wild or wounded animals should never be approached. If a wild animal that usually avoids people starts to approach instead or to seem friendly, it may be sick. Skunks and raccoons are nocturnal, and if they are seen walking around in midday, they should be considered to be ill, perhaps rabid. A law officer, park ranger, or animal control officer with training in handling sick or injured animals should be notified promptly about any sick animal or animal that is acting abnormally.

How Are Animal Bites Treated?

All bites should be cleaned as soon as possible. If the skin is broken but not torn or bleeding, the wound should be washed with soap and water and treated with antibiotic cream to prevent infection. When any of the following situations occur, the person who has been bitten should get medical care promptly.

- Any cat bite (but not necessarily a cat scratch wound)
- Any dog bite on the hand, foot, or head
- Any bite that causes substantial tissue or bone damage or that does not stop bleeding after applying pressure for 15 minutes
- Any bite that is wide enough to potentially need stitches or that is especially deep
- Any bite to a person who has diabetes*, cancer, lung disease, AIDS*, or any medical condition that might weaken the immune system*
- Any wild animal bite
- Any bite to a person who has not had a tetanus* shot within the past five years
- Any bite wound that shows signs of infection: redness, warmth, swelling, and tenderness at the bite site and/or discharge of pus

Many doctors agree that ice packs, tourniquets*, and incisions should *not* be used. Bites should be washed with soap and water, and the bitten



Biting and stinging insects.
Illustration by Argosy. Reproduced by permission of Gale, a part of Cengage Learning.



area should be kept still and lower than the heart. Walking and other movement should be limited to what is only absolutely necessary, and a doctor should be seen as soon as possible. Suction devices from snakebite kits if used immediately or tourniquet wrapped snugly two to four inches above the bite might slow the spread of venom until a hospital can be reached. Bites of poisonous snakes are treated with antivenin to neutralize the toxin (poison). Although death is rare, poisonous snakebites usually require 12 to 24 hours of observation in the emergency room. Pain and swelling can last for several weeks.

Rabies Rabies is a viral disease that affects the nervous system and is fatal if left untreated. In humans, symptoms can develop between five days and several years after a person has been bitten by a rabid animal, although the average incubation time is 20 to 90 days. A rabid animal,

- * **mammals** are warm-blooded animals with backbones, who usually have fur or hair. Female mammals secrete milk from mammary glands to feed their young. Humans are mammals.
- * **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.
- * **vectors** (VEK-tors) are animals or insects that carry diseases and transfer them from one host to another.
- * **malaria** (mah-LAIR-e-uh) is a disease spread to humans by the bite of an infected mosquito.
- * **elephantiasis** (eh-luh-fan-TIE-uh-sis) is the significant enlargement and thickening of body tissues caused by an infestation of parasites known as filaria.

whose saliva contains the rabies virus, usually infects other animals or individuals by biting them. All mammals* can get rabies, but the disease is extremely rare among pets or domestic animals in the United States because they are vaccinated against it. More than nine out of ten cases of rabies occur in wild animals, particularly skunks, raccoons, bats, and foxes. Small rodents such as rats and mice are almost never rabid. In the developing world, rabies is common in dogs. The World Health Organization estimates that at least 35,000 people worldwide die from being bitten by a rabid dog each year, almost all of them in developing countries where routine veterinary vaccinations rarely occur.

In the United States, rabies rarely is transmitted to people. Between 1980 and 2003 only 40 cases of human rabies were reported. Nevertheless, a person who has been bitten or scratched by a suspected rabid animal needs immediate medical treatment. Once developed, rabies almost always results in death. A safe, effective rabies vaccination* is available. The vaccine is given in multiple doses beginning as soon as possible after exposure. It is no more painful to receive than any other routine vaccination. Early treatment with the rabies vaccine is essential if the person is to survive.

What Are Animal Stings?

Animal stings occur when an animal, often an insect, breaks the skin and injects saliva into the body. The saliva may contain venom or a substance that causes an allergic reaction. Depending on the type of venom, a person can experience pain, itching, red bumps, nerve damage, or, in rare cases, death. Bites from mosquitoes and ticks can be dangerous in places where those biters are vectors* (carriers) for diseases caused by bacteria, viruses, or parasites.

Which Insects Sting and How Are Stings Treated?

Various insects and spiders sting or bite. The best way to prevent being bitten or stung is to avoid areas where these insects or spiders live or to wear protective clothing when there is the possibility of encountering them.

Mosquitoes In many parts of the United States, mosquitoes are a summertime annoyance. Only female mosquitoes bite. When they bite, they inject saliva into the skin in the process of having a blood meal. The red itchy bump that appears at the site of the bite is an allergic reaction to the saliva. Mosquito bites go away on their own after several days. Mosquito repellent sprays help deter mosquitoes from biting, and calamine lotion or hydrocortisone cream may help ease the itching caused by bites.

In some parts of the world, certain types of mosquito can transmit diseases. For example, parasites carried by mosquitoes cause malaria* and elephantiasis*.

Chiggers Chiggers, also called redbugs, are the larvae (immature stage) of red mites. They live in woods, pastures, and areas with high grass and weeds. Chiggers attach to a person's clothing and then move to bare skin

around the tops of socks, in armpits, or at waistbands. There they bite the skin, inject a fluid that dissolves cells, and suck up the liquefied tissue. Chiggers cause extremely itchy bumps that can keep itching for days after the larvae are removed. Bathing and scrubbing after exposure to chiggers will kill or dislodge them, and rubbing alcohol followed by calamine lotion is said to help relieve the itching.

Fire Ants In the United States, fire ants come in a variety of types: imported (from South America) or native, red or black. Different types live in different geographic regions, but they are most common in the southeastern states. Fire ants usually build mounds in soft soil, but sometimes they nest in the walls of buildings.

Fire ants are very aggressive and territorial. When a person or animal disturbs their nest, they swarm. Thus, many ants can sting people at once. The venom causes a painful burning sensation, hence the name “fire” ant,

ANAPHYLACTIC SHOCK

For most people, insect bites cause pain or itching. For some people, however, insect bites can cause potentially fatal anaphylactic (an-a-fa-LAK-tik) shock. This severe whole-body allergic reaction can be triggered by insect bites and certain foods or drugs in allergic individuals. The severity of the reaction varies from person to person. In severe cases, death can occur within a few minutes.

In general, what happens during an anaphylactic reaction is as follows:

- The reaction usually begins within minutes of being bitten or stung. In response to the substance to which a person is severely allergic, mast cells (a type of immune system cell) release huge amounts of histamines and several other chemicals. Histamines cause the blood vessels to “leak” and allow fluid to escape into the surrounding tissue. Small amounts of histamines help to heal damaged tissue but when too much fluid leaves the blood vessels, blood pressure can drop suddenly.
- At first, a person might begin sneezing, itching, and feeling weak, nauseated, and panicky. The fluid that leaves the blood vessels causes tissues to swell rapidly. Often one can see swelling of the face and ears. Other tissue inside the body also swells, especially those lining the throat, which makes breathing difficult and the person

begins to wheeze and gasp for breath. The chest and stomach muscles then begin to tighten. Fluid begins to leak into the lungs, so that they no longer function properly.

- When blood pressure is very low, the heart has difficulty pumping enough blood through the body. When the airways are blocked and the lungs are filled with fluid, not enough oxygen enters the blood. These two factors cause a condition called circulatory collapse. If left untreated, lack of oxygen in the brain renders the person unconscious, and death soon follows.

Anaphylactic shock is a serious medical emergency and must be treated quickly. A shot of a chemical epinephrine can be given to help reverse the symptoms of shock. Epinephrine (also called adrenaline) stimulates the heart and improves airflow through the lungs. Antihistamines and other drugs are given to counteract the allergic reaction, raise blood pressure, and increase the flow of blood.

People who know they are allergic to insect venom or certain foods often learn how to use an anaphylaxis kit such as an Epi-Pen, which allows them to inject themselves with epinephrine. The kit is carried with them at all times so that an immediate injection of epinephrine can keep them alive until emergency medical personnel arrive.

* **Lyme disease** (LIME) is a bacterial infection that is spread to humans by the bite of an infected tick. It begins with a distinctive rash and/or flu-like symptoms and, in some cases, can progress to a more serious disease with complications affecting other body organs.

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

followed by tiny itchy white blisters. Fire ant stings can be fatal, but only to the small number of people who are allergic to their venom.

Ticks Ticks live in woods and fields all over the United States. Their flat dark bodies are about the size of a match head. Ticks bite humans and other animals because they need blood to survive. Usually, a tick bite causes only minor itching or irritation, but ticks also spread a number of diseases with their bites, including Rocky Mountain spotted fever and Lyme disease*, both of which can be very serious illnesses. If a tick is seen on the skin, tweezers should be used to pull the tick up and out of the skin. The bite should be washed with soap and water and watched for signs of infection.

Spiders Almost all spiders have glands that contain venom, but only 20 to 30 of the 30,000 species of spider in the world are potentially dangerous to humans. Spider bites can cause pain, nausea, fever, and cramps, but the majority of bites are minor and cause only swelling, a blister, and temporary pain. The brown recluse spider and the black widow spiders are the most dangerous spiders found in the United States. Tarantulas also bite, but the bite usually is no worse than a bee sting.

The brown recluse spider is mostly found in the south central United States, in dark places such as woodpiles, sheds, and barns. With legs extended, this spider can be as large as a half-dollar. Males and females look alike and vary in color from orange to brown. They are covered with short hairs and have a violin-shaped marking on their back. Brown recluse bites usually are not fatal, but the spider's venom can cause serious illness, especially for children and the elderly.

Following a bite by a brown recluse spider, the skin around the bite may quickly become warm and swollen. Within about 15 minutes the bitten person may become dizzy and sick to the stomach. Other symptoms include fever, chills, weakness, convulsions*, and joint pain. After about four days, the bite area gets hard to the touch, and it takes about six to eight weeks for the body to recover. There is no known antidote for brown recluse venom, so treatment involves several medications, usually antibiotics, antihistamines, and steroids. Rarely the bite of a brown recluse can result in necrotizing fasciitis, sometimes called the flesh-eating bacteria disease. This bacterial infection begins under the skin and spreads throughout the body. The death rate for necrotizing fasciitis is about 40 percent.

Black widow spiders live in all parts of the United States but are most common in the warmer regions. They live in the same types of places as brown recluse spiders. Black widows are about one-half inch long (not including the legs), and they can be identified by the reddish-orange hourglass shape on the belly of their black bodies.

Black widow spiders do not bite unless they are disturbed. Among black widows, only adult females bite. The juveniles and adult males are harmless. Most people who are bitten by black widows experience some

swelling and redness at the bite site, followed by increasing pain for up to 48 hours. Black widow venom affects the nervous system, and it may cause cramps in the legs, arms, and chest. Other symptoms include sweating, chills, convulsions, fever, nausea, headache, and difficulty breathing. Treatment involves cleaning the bite and receiving antivenin* medicine and antibiotics. In 99 percent of the cases, complete recovery takes place within a few hours. Complications do occur occasionally in children, the elderly, or people with allergies, and in the most serious cases they may result in death.

Scorpions Scorpions are about as long as an index finger. They have eight legs and a curled tail with a stinger on the end. There are 30 different kinds of scorpions in the United States, and they can be found all over the country. The stings of two species, both of which live in the southwestern states, can be fatal.

Scorpion venom causes a burning feeling in the skin, followed by swelling and discoloration. About a day later, the face, mouth, and jaw muscles become hard to control. Other symptoms include nausea, vomiting, drooling, convulsions, and difficulty breathing. Scorpion bites are treated with antivenins and other medications to control muscle spasms and convulsions. In 99 percent of cases, complete recovery occurs after three days. However, if a person is particularly sensitive to the venom, and if muscle spasms begin immediately after the sting, then the person may die.

Bees, Wasps, and Yellow Jackets Honeybees and bumblebees are fat and round, and when they sting they leave their stinger in the skin. Wasps and yellow jackets are long and thin, and when they sting they keep their stinger and they can sting again. All of these insects inject venom into the skin, which causes pain, itching, swelling, and redness. For most people, bee stings are painful but not dangerous. However, some people are severely allergic to bee venom; for these people, bee stings can be fatal unless they are given medication right away. Africanized bees, also often called killer bees, are dangerous because they swarm, and many bees can sting a person at once. Even nonallergic people can be killed by killer bees, but this occurrence is very rare.

After a sting, the stinger should be scraped off the skin, as pulling it out may squeeze more venom into the bite. Ice or cold compresses may help reduce pain and swelling.

Jellyfish

The oceans are home to many types of animal that bite or sting. The most familiar culprit is the jellyfish. All types of jellyfish have stinging tentacles that can cause a burning welt on a person's skin. In Australia, the sting of the box jellyfish can be fatal, but most jellyfish stings are just painful. Jellyfish such as the Portuguese man-of-war and sea nettles are common in warm coastal waters in the United States near the Atlantic Ocean. Avoiding contact with jellyfish while swimming can sometimes

* **antivenin** is an antibody (protein) capable of neutralizing a specific venom.

* **eating disorder** is a condition in which a person's eating behaviors and food habits are so unbalanced that they cause physical and emotional problems.

* **body image** is a person's impressions, thoughts, feelings, and opinions about his or her body.

be difficult, especially when there are many of them in the water. Vinegar, calamine lotion, and antihistamines are said to help relieve the pain of stings.

▶ See also **Cat Scratch Disease • Malaria • Rabies • Tick-borne Illnesses • Yellow Fever • Zoonoses •**

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Organizations

American Veterinary Medical Association. 1931 North Meacham Road, Suite 100, Schaumburg, IL, 60173. Telephone: 847-925-8070. Web site: http://www.avma.org/animal_health/brochures/rabies/rabies_brochure.asp.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncipc/duip/biteprevention.htm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/animalbites.html>.

Anorexia Nervosa

Anorexia nervosa (an-o-REK-see-a ner-VO-sa—commonly referred to as anorexia) is an eating disorder involving excessive dieting; preoccupation with food; distorted body image*; fear of getting fat; and rapid, significant weight loss. The disorder primarily affects young women.*

Wendy's Story

Wendy took ballet since she was five. For as long as she could remember, her dream was to dance professionally after she graduated from high school. When Wendy was 13, her ballet company planned a performance of *Swan Lake*, and Wendy hoped to be chosen for the lead part.

But at that time Wendy was also going through puberty*. She noticed that her hips and thighs got rounder. Constantly in front of the mirror in the dance studio, Wendy could not help seeing every new curve of her body, and she felt self-conscious about how her developing breasts looked in her leotard. She became very worried about gaining weight. What if she got too heavy for her dance partner to lift? With try-outs for the spring ballet fast approaching, Wendy feared a tinier dancer would be chosen for the lead instead of her. She began longing for the body she had at age 11: tiny and light, like the “perfect” ballerina she dreamt of being.

For a month, Wendy was on a crash diet, keeping a strict record of everything she ate. She weighed herself morning and night. When there was time, she jogged after dance class. She was relieved to have lost some weight and wanted to lose more. She allowed herself only the tiniest portions of food and started to skip lunch altogether. Pleased with her weight loss, Wendy decided to cut back to just a small salad for dinner and maybe just a yogurt for breakfast.

Fear of Fat

No one sets out to have anorexia. It takes hold slowly and might start with a simple desire to lose a few pounds. However, in fully developed cases, people with anorexia are malnourished, often depressed, obsessed with food and/or exercise, and are still convinced that they are fat.

People with anorexia refuse to eat enough food to maintain normal healthy body weight. Because they fear getting fat, people with anorexia use extreme dieting to lose a lot of weight rapidly. They also may exercise excessively to burn off calories. People with anorexia lose at least 15 to 20 percent of their normal body weight. For example, a girl who starts out at 130 pounds might drop to 100 pounds. Anorexia involves a distorted awareness of the body. People with this condition become preoccupied with thinness and may continue to believe that they are fat even though others see them as unnaturally thin. Over time, the weight that people with anorexia want so desperately to control becomes frighteningly out of control for them.

Anorexia is much more common among girls and women (90–95% of cases), but boys can have it too. It has been estimated that 1 or 2 out of 100 young women in the United States have anorexia nervosa and that a considerably higher number have less severe eating disorder symptoms. The disorder usually begins during adolescence. Girls who participate in activities that value thinness, such as dancing, gymnastics, or figure skating, are at higher risk than others for developing anorexia.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

* **menstruation** (men-stroo-AY-shun) is the discharge of the blood-enriched lining of the uterus. Menstruation normally occurs in females who are physically mature enough to bear children. Most girls have their first period between the age of 9 and 16. Menstruation ceases during pregnancy and after menopause. Because it usually occurs at about four-week intervals, it is often called the monthly period.

ATHLETES AND ANOREXIA

Girls and young women involved in sports that place a high value on thinness are three times more likely than others to develop anorexia or bulimia (bu-LEE-me-a; binge eating followed by vomiting or other methods of emptying the stomach). A 1992 study conducted by the American College of Sports Medicine estimated that as many as 62 percent of females involved in sports such as gymnastics and figure skating struggled with eating disorders.

Many well-known athletes have spoken out about their battles with eating disorders, including gymnasts and Olympic gold medal winners Nadia Comaneci and Cathy Rigby. Christy Henrich, who in 1989 was ranked the number two gymnast in the United States, died from complications of anorexia in 1994 at the age of 22. The pressure to be thin does not appear to be easing up. The average gymnast in 1976 was 5 feet 3 inches tall and weighed 105 pounds; the average gymnast in 1992 was 4 feet 9 inches tall and weighed 88 pounds. The American Academy of Sports Medicine has expressed concern about insufficient recognition of the problem and lack of treatment for what is called the female athlete triad of disorders, which is defined as the combination of disordered eating, lack of periods (amenorrhea), and osteoporosis (the loss of material from the bone, which makes them weak and brittle).

What Causes Anorexia?

No single factor causes anorexia. Emotional problems, family difficulties, social pressure, and biological variability all play a role. Widespread glamorization of thinness in fashion magazines and among Hollywood stars influences many girls to diet excessively. Once started, some extreme dieting practices can be hard to stop. Girls who have a high need for perfection and control may see dieting as a way to be the prettiest, thinnest, and most perfect person among their peers; to live up to their parents' expectations for perfection; or to look like fashion models or movie stars whom they admire. A girl who feels controlled by others and longs for independence may use control of eating as a way to assert herself. In other cases, anorexia may develop because of pressure to be extra-thin when certain sports or activities demand it.

What Can Happen When Someone Has Anorexia?

Anorexia can cause a number of serious medical problems, such as disturbed heart rhythms and vitamin and mineral deficiencies that can harm vital organs. With anorexia, the body is literally starving. Bone and muscle begin to waste away. Blood pressure and body temperature drop because the body cannot maintain proper levels. Hair, nails, and skin become dry and brittle. Girls with anorexia often stop menstruating*, and overall



An anorexic person has a distorted perception of what her body actually looks like. She may lose a little weight from a normal diet, gain positive attention from people around her, and then become obsessed with losing more and more weight. But no matter how thin she gets, she still sees her body as unacceptable and unattractive.

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body growth and development can begin to slow down. Without treatment, anorexia can cause irreversible damage to the body. It can lead to heart failure* and sometimes death. In the United States, about 1,000 young women die each year from complications of anorexia.

What Can Be Done About Anorexia?

Help is available for people with anorexia, but they need to be convinced they need it. Family members or friends may ask about the weight loss. A girl with anorexia may be ashamed or self-conscious and may say she does not have a problem. Many girls with anorexia resist getting help because they do not want to gain weight. Seeking help sooner, rather than later, can be life-saving, but the distorted body image that is part of anorexia can make it hard for people with the condition to realize how dangerously thin they are.

Treatment for anorexia typically includes several parts and a few different health professionals. Treatment may begin with a medical visit to evaluate nutritional status and overall health. The doctor may ask about weight loss, order blood tests, and ask about the patient's eating habits and beliefs about her body. Nutritional counseling helps with planning and following a healthy diet. Individual psychotherapy allows the person to talk about feelings and problems that led up to the anorexia, come up with new solutions, and work on body image. Group therapy brings together people with similar concerns to share their experiences and receive support. Medications are sometimes used to reduce anxiety* and depression*. Individuals with anorexia who are in a severe health crisis may have to be hospitalized in order for their condition to be stabilized. They may need to become better nourished before other aspects of treatment can begin.

* **heart failure** is a medical term used to describe a condition in which a damaged heart cannot pump enough blood to meet the oxygen and nutrient demands of the body. People with heart failure may find it hard to exercise due to the insufficient blood flow, but many people live a long time with heart failure.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **congenital** (kon-JEH-nih-tul)
means present at birth.

▶ See also **Anxiety and Anxiety Disorders • Body Image • Eating Disorders: Overview • Menstruation and Menstrual Disorders**

Resources

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Organizations

National Association of Anorexia Nervosa and Associated Disorders.
P.O. Box 7, Highland Park, IL, 60035. Telephone: 847-831-3438.
Web site: <http://www.anad.org>.

National Eating Disorders Association. 603 Stewart Street, Suite 803, Seattle, WA, 98101. Toll free: 800-931-2237. Web site: <http://www.nationaleatingdisorders.org>.

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662.
Web site: <http://www.4woman.gov/faq/easyread/anorexia-etr.htm>.

Anosmia

Anosmia is the complete inability to detect odors.

Kayla's Story

Kayla was born with a condition called congenital* anosmia that left her unable to smell any odors. At first Kayla did not realize that she was different from other people. Later when she did, she pretended that she could smell the same way others people did because she did not want to be different. Kayla was eight before her parents realized she had no sense of smell.

Once Kayla's parents discovered that she could not smell, they became concerned about her safety. They knew that she would not smell smoke if a fire started in the house and that she would not be able to smell a gas leak, either. Kayla's parents added extra smoke detectors in their house and switched from a gas stove and hot water heater to an electric one.

Sometimes food was a problem for Kayla. One mean girl played a trick on her and gave her spoiled milk to drink. Kayla could not smell that the milk was sour, so she drank it, but when she tasted it, she spit it out all over herself. As Kayla got older, she became anxious about her personal hygiene because she could not smell her own body odor. Some days she was depressed about her hidden disability, but she tried to remind herself that having no sense of smell was not a life-threatening problem and not nearly as limiting as being blind or deaf.

What Is Anosmia?

People with anosmia cannot smell odors. This condition can be temporary or permanent. Some people are born without the ability to smell, whereas others develop this condition later in life. Although through normal aging, many people's ability to smell gradually weakens, aging rarely causes a total loss of this sense. It is difficult to tell how many people have anosmia. Estimates are that about 2 percent of Americans have a noticeably reduced sense of smell, although not all have completely lost their ability to smell.

What Causes Anosmia?

In order to have a sense of smell, three factors must occur.

1. Air-carrying scent molecules must enter the nose and flow past odor receptor cells.
2. Odor (olfactory) receptors, which are more than 100,000 million separate nerve cells, must be stimulated by the odor molecules.
3. The information from the odor receptors must be transmitted to the brain and processed.

Any time one of these three factors is interrupted, individuals may have a decreased ability to smell or in certain cases may lose their sense of smell completely.

Almost everyone at one time or another has had a stuffy nose from a cold or an allergy*. A bad cold or allergic reaction can block airflow into the nose and prevent a person from smelling odors. This situation illustrates a temporary form of anosmia. The condition clears up when the cold or allergy symptoms go away. Sometimes medicines such as antihistamines* or nasal sprays*, if used in moderation, can help relieve a stuffy nose and restore the ability to smell.

Certain conditions can also lead to a permanent blockage of the nasal* cavity so that air cannot reach the odor receptors. This situation can occur

Smell Disorders

Disorders of the sense of smell are called "osmias." Total inability to detect any odors is called anosmia. Other smell disorders include the following:

- **Hyponosmia:** a decreased sense of smell
- **Dysosmia:** a false identification of a smell
- **Phantosmia:** perceiving a smell when none exists; an odor hallucination
- **Agnosia:** the inability to identify or classify odors

* **allergy** (AL-uhr-jee) is an immune system-related sensitivity to certain substances, for example, cat dander or the pollen of certain plants, that cause various reactions, such as sneezing, runny nose, wheezing, or swollen, itchy patches on the skin, called hives.

* **antihistamines** (an-tie-HIS-tuh-meens) are drugs used to combat allergic reactions and relieve itching.

* **nasal spray** (NA-zal) spray is a mist that is sprayed into the nose.

* **nasal** (NA-zal) of or relating to the nose.

* **polyps** (PAH-lips) are bumps or growths usually on the lining or surface of a body part (such as the nose or intestine). Their size can range from tiny to large enough to cause pain or obstruction. They may be harmless, but they also may be cancerous.

* **endocrine** (EN-do-krin) refers to a group of glands, such as the thyroid, adrenal, and pituitary glands, and the hormones they produce. The endocrine glands secrete their hormones into the bloodstream, and the hormones travel to the cells that have receptors for them. Certain hormones have effects on mood and sometimes cause emotional swings.

* **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

when a person has nasal polyps*. A birth defect or an injury to the nose can also block the nasal cavity.

Damage to the odor receptors can occur from infection with certain viruses. These receptors also can be permanently damaged by inhaling chemicals, either accidentally or intentionally (e.g., snorting cocaine or inhaling paint thinner). Endocrine* (hormonal) disorders can also damage odor receptors. In addition, some people, through an error in prenatal development, are born without odor receptors and never have the ability to smell. Often these people have other congenital defects as well.

Damage to nerves that carry information from the odor receptors to the brain and that process odor information in the brain can occur in many ways. These include:

- Injury from a blow to the head or face
- Accidental nerve damage during surgery or dental work
- A severe, long-term sinus infection
- Spinal meningitis* during infancy
- Long-term use of certain medications
- Diseases in which the central nervous system becomes damaged such as Parkinson's disease and Alzheimer's disease

Even though there are many known explanations for why individuals develop anosmia, in about one-fourth of cases doctors cannot find a specific reason why the sense of smell has been lost.

SMELL AND TASTE ARE RELATED

S mell and taste are closely linked, although in humans the sense of smell is about 10,000 times more powerful than the sense of taste. Odors are detected by nerve cell receptors in the nasal cavity. These receptors allow people to distinguish among hundreds of different odors. Taste is detected by receptors in the tongue. These receptors can detect only five different tastes: sweet, sour, salty, bitter, and *umami* (a Japanese word meaning savory).

The flavor of food is determined by a combination of taste, smell, texture (the way the food feels in the mouth), and appearance. People with anosmia can still taste the five basic tastes, but without being able to smell food, they miss much of the food's flavor. For them, all sweet foods tend to taste very much alike, as do all sour foods or all bitter foods. Because their food lacks a variety of flavors, people with anosmia may lose interest in eating and develop nutrition problems. About 80 percent of people who go to the doctor complaining of a problem with taste actually have a problem with their sense of smell.

How Is Anosmia Diagnosed?

Diagnosis begins with a complete medical history, physical examination, and review of all medications being taken. Many tests may be done to look for conditions that could be causing the anosmia. Some of these tests are a complete blood count, an analysis of the function of various endocrine (hormone-producing) glands, and x-rays or a CT scans* of the head. In some cases a biopsy (tissue sample) may be taken from the nose and examined under the microscope.

Two tests are commonly used to measure the amount and type of smell loss. The Connecticut Chemosensory Clinical Research Center (CCCRC) test has two parts. In part one, the patient is asked to sniff a bottle with plain water and one with the chemical butyl alcohol and ask to identify the sample with an odor. Each nostril is tested separately. In the second part, the patient is given ten samples of common smells such as cinnamon, coffee, peanut butter, and chocolate and asked to identify them. In the other test, called the University of Pennsylvania Smell Identification Test (UPSIT), the patient is given 40 scratch and sniff samples and four possible answers for each sample. The patient is then asked to match the scratch and sniff smell to one of the four suggested answers. These tests help determine the degree of smell loss and whether the patient has anosmia or another type of odor disorder.

How Is Anosmia Treated?

If another disease or disorder is causing anosmia, the doctor treats that medical problem, and in some cases the sense of smell returns. For example, if polyps are blocking airflow into the nose, they can be removed surgically. Sometimes, however, damage to the nerves is permanent or there is no cure for the underlying condition causing loss of smell (e.g., Parkinson's disease* or Alzheimer's (ALTS-hy-merz) disease*). In general, treatment of complete anosmia is difficult and often not very successful.

Resources

Organizations

American Academy of Otolaryngology, Head and Neck Surgery.

1650 Diagonal Road, Alexandria, VA, 22314-2857. Telephone: 703-836-4444. Web site: <http://www.entnet.org/HealthInformation/otitisMediaHearingLoss.cfm>.

Anosmia Foundation of Canada. Web site: <http://www.anosmiafoundation.org>.

Anthrax

Anthrax (AN-thraks) is a rare infectious disease caused by the bacterium Bacillus anthracis.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **Parkinson's disease** is a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.

* **Alzheimer's (ALTS-hy-merz) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.



Over the course of a few days, cutaneous anthrax develops into a sore with a coal-black center. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

What Is Anthrax?

Anthrax is primarily a disease of livestock, such as sheep, cattle, or goats. It is rarely seen in humans, and most cases occur in developing countries. Anthrax is most likely to occur in people whose work regularly brings them into contact with animal hides, such as those who cut sheep's wool, livestock handlers, laboratory workers, and veterinarians. The bacterium *Bacillus anthracis* (buh-SIH-lus an-THRAY-kus) is found naturally in the soil of farming regions all over the world, including parts of the United States. It can exist undisturbed for many years as spores, a temporarily inactive form of the organism with a protective, shell-like coating. Grazing animals typically become infected with anthrax if they eat vegetation or feed (food) contaminated with spores. Livestock in the United States rarely get anthrax.

There are three forms of anthrax in humans, each resulting from a distinct route of infection. Cutaneous (kyoo-TAY-nee-us), or skin, anthrax, the least serious form of the disease, occurs when the bacteria enter a break in the skin. Gastrointestinal* anthrax is caused by eating food contaminated with anthrax bacteria; this form is very rare. The third and deadliest form of the disease, inhalation (in-huh-LAY-shun) anthrax, also called pulmonary anthrax or "wool sorter's disease," is also very uncommon and results from breathing in anthrax spores.

How Common Is Anthrax?

Historians believe that anthrax has existed for thousands of years, at least since the fifth and sixth plagues described in the Bible's Book of Exodus. (In Egypt, the fourth plague was of insects and the fifth plague was a contagious disease among animals. These events may have occurred in the thirteenth century B.C.E.) Cutaneous anthrax, the most common form of the disease (about 95 percent of anthrax cases), occurs most often in agricultural regions in Asia, Africa, South and Central America, southern and eastern Europe, the Middle East, and the Caribbean. Anthrax is rare in the United States: According to the Centers for Disease Control and Prevention, between 1955 and 1999 only 236 cases of anthrax were reported in the United States, nearly all the cutaneous form. Before 2001 the last case of inhalation anthrax in the United States was reported in 1978.

How Does a Person Get Anthrax?

Scientists do not believe that anthrax can be passed from person to person. Cutaneous anthrax occurs when someone with a cut, sore, or other break in the skin touches an infected animal or the by-product of an infected animal, such as contaminated hide, wool, or goat hair. Gastrointestinal anthrax usually is traced to contaminated foods, especially undercooked meat. Inhalation anthrax comes from breathing anthrax spores into the lungs. Although spores are inactive forms of the bacteria, they germinate, or become activated, in the moist, warm environment of the lungs. Someone has to inhale thousands of spores to contract the disease,

ANTHRAX IN THE NEWS

In 2001, just after the terrorist attacks on the World Trade Center in New York and the Pentagon in Washington, D.C., the threat of biological terrorism arose when anthrax spores were discovered in Florida, New York City, and the offices of the U.S. Congress. More than 20 people showed signs of either inhalation anthrax (in the lungs) or cutaneous* anthrax (on the skin). Several of those with the inhalation form of the disease died. In most of those cases, authorities were able to trace the exposure to letters intentionally contaminated with a highly concentrated, aerosolized (designed to spray into the air as an aerosol) form of anthrax spores.

Initially, the anthrax threat was assumed to be part of the same terrorist plot that targeted the World Trade Center. Government investigators later suspected that a single person without ties to a specific terrorist organization could have mailed the anthrax-laced letters. Regardless of their origin, the letters proved that anthrax can be used as a weapon. The production and release of highly potent forms of anthrax bacteria—to cause illness deliberately in large groups of people—is a type of biological warfare, or bioterrorism, that cannot be ignored. As a result, national, state, and local governments and public health officials planned responses to possible future attacks with biological weapons.

- * **cutaneous** (kyoo-TAY-nee-us) related to or affecting the skin.
- * **ulcer** is an open sore on the skin or the lining of a hollow body organ, such as the stomach or intestine. It may or may not be painful.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.
- * **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

and spores found in soil rarely are concentrated enough to cause inhalation anthrax.

What Are the Signs and Symptoms?

Symptoms of the disease usually appear within one to seven days after infection with *Bacillus anthracis* and differ according to the way in which a person became infected with the bacterium. An anthrax skin infection typically begins as a raised, itchy bump, and within a few days it develops into a small sore or ulcer* with a black, coal-like center. This visible sign of cutaneous anthrax explains how the disease got its name, which is derived from the Greek word *anthracis*, meaning “coal.” Gastrointestinal anthrax can cause nausea, loss of appetite, fever, and severe bloody vomiting and diarrhea. The first symptoms of inhalation anthrax often resemble those of a common cold or influenza and include cough, difficulty in swallowing, headache, swollen lymph nodes* in the neck, and tiredness. Within days the symptoms rapidly progress to severe breathing problems and shock*, often leading to heart failure and death.

How Do Doctors Make the Diagnosis?

Bacillus anthracis bacteria sometimes can be seen in a bit of skin from the sore of a person who has cutaneous anthrax or in the coughed-up mucus* of someone with inhalation anthrax when those samples are

* **cultured** (KUL-churd) means subjected to a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

viewed under a microscope. To help confirm the diagnosis, samples of blood or fluid taken from the nose or sores are cultured* to identify the anthrax bacteria. Blood tests also are used to detect anthrax antibodies*, which indicate that someone has come into contact with anthrax-causing bacteria and may have the disease. Chest X-rays can help diagnose inhalation anthrax.

What Is the Treatment for Anthrax?

Doctors prescribe antibiotics to fight anthrax infections. Patients with gastrointestinal and inhalation anthrax typically need intensive, round-the-clock care with intravenous* medications and fluids in a hospital. Inhalation anthrax can cause severe breathing problems that may require the use of a respirator, a machine that can assist a person's breathing until he or she recovers.

What to Expect

Untreated, all three forms of anthrax can lead to widespread infection and death. If it is treated, cutaneous anthrax generally is not fatal. Gastrointestinal anthrax results in death in about half of all cases. Even with medical treatment, inhalation anthrax is often fatal.

How Is Anthrax Prevented?

Agricultural and textile workers in developed countries such as the United States are instructed to wash their hands after working in the soil or handling animals and animal by-products. People who live in high-risk areas of the world are advised to avoid contact with livestock and not to eat improperly prepared or undercooked meat. An anthrax vaccine* exists, but this vaccine is not given routinely in the United States, except to people in the military or to scientists who may come into contact with the bacteria through their research. Veterinarians and people whose jobs involve handling livestock typically are vaccinated against the disease if they work in high-risk areas of the world. In the fall of 2001, when anthrax spores contaminated several U.S. post offices and office buildings, public health experts recommended antibiotics for people who had been exposed to anthrax—even if they had no symptoms of the disease. Officials stressed, however, that it was not necessary or advisable for the general public to take antibiotics to prevent anthrax.

▶ See also **Bioterrorism** • **Vaccination**

Resources

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Tracy, Kathleen. *Robert Koch and the Study of Anthrax*. Hockessin, DE: Mitchell Lane Publishers, 2005.

Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/anthrax>.

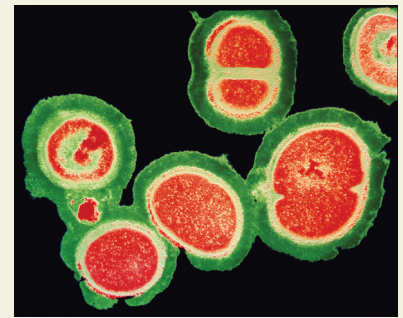
Antibiotic Resistance

Antibiotic resistance is the ability of microorganisms, specifically bacteria, to adapt to and to withstand the effects of antibiotics*. Such microorganisms are often called “superbugs.” As a result of antibiotic resistance, antibiotics for superbug infections may become far less effective or may not work at all, leaving doctors with few, if any, choices with which to treat them. In the early 2000s, antibiotic resistance is a growing, worldwide medical and health problem.*

What Is Antibiotic Resistance?

Normally, doctors use antibiotics to fight infections caused by bacteria. Usually this treatment kills the bacteria, and the patient soon recovers. Sometimes, however, a few unusually hardy bacteria do not die. These bacteria not only survive the antibiotic treatment, but they pass on their hardiness to their offspring so that the next generation is also resistant to antibiotics. According to the World Health Organization, some of the antibiotic-resistant bacteria living in the early 21st century are resistant to as many as 10 different drugs. Because antibiotics are a common treatment for infections, doctors have to try to find another drug that will work against the antibiotic-resistant infection. Unfortunately, options are limited, and in some cases, other treatments are not available.

Ironically, one of the factors that helps bacteria to become antibiotic-resistant is the antibiotic itself. How does this happen? Just as one person has slightly different characteristics from another person, individual bacteria are not all the same. A small percentage of them have characteristics that allow them to resist antibiotics. Some of these bacteria can defuse the antibiotic before it can take effect, others are able to pump out the antibiotic before it can harm them, and still others are able to change their structure so that the antibiotics cannot attack them. Normally, the number of antibiotic-resistant bacteria remains small, because antibiotic resistance does not give a bacterium any advantages over a non-resistant one. The problem arises when people overuse antibiotics, which creates the right environment for resistant bacteria to flourish. The repeated use



▲
Staphylococcus aureus seen under an electron microscope. This bacteria is from a group that is resistant to antibiotics. Some of them are dividing to reproduce. Dr. Kari Lounatmaa/Photo Researchers, Inc.

* **microorganisms** are tiny organisms that can only be seen using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

of antibiotics kills the non-resistant bacteria but leaves the antibiotic-resistant bacteria alone. In a short time, the antibiotic-resistant bacteria multiply, passing on their resistance to the following generation, which then has its own resistant offspring. Sometimes, the bacteria can even pass on its resistance to other bacteria that are not offspring, and it does this by exchanging the genetic material, or DNA*, that makes them resistant to antibiotics. Soon, the number of antibiotic-resistant bacteria can become very large.

Antibiotic resistance can lead to bacterial infections that are extremely difficult to fight and may cause serious illnesses in people and even death.

What Causes Antibiotic Resistance?

Antibiotics are often very helpful for a wide range of illnesses. This pattern of effectiveness causes some doctors to quickly prescribe antibiotics even when they are uncertain about a diagnosis and whether antibiotics will help. In addition, doctors often prescribe so-called broad-spectrum antibiotics that kill many different types of microbes, rather than selecting a more targeted antibiotic that works against the specific microbes that are causing the illness. Both the improper prescribing of antibiotics and the use of broad-spectrum antibiotics can promote antibiotic-resistant bacteria.

As a result, during the second half of the 20th century, dangerous antibiotic-resistant bacteria became prevalent in hospitals. An example is methicillin-resistant *Staphylococcus aureus*, or MRSA, which is a type of bacteria that is resistant to antibiotics such as methicillin, penicillin, amoxicillin, and others. MRSA infections have also become increasingly common in other health centers and nursing homes, and among people who already have weakened immune systems*. Other antibiotic-resistant microbes include vancomycin-resistant enterococci, or VRE; extended-spectrum *Streptococcus pneumoniae*, or ESBL; and penicillin-resistant *Streptococcus pneumoniae*, or PRSP. As of 2009, new strains of resistant bacteria were continually being identified, a pattern causing great concern in the healthcare community.

Patients also contribute to the development of antibiotic resistance. Some individuals have developed much trust in the effectiveness of antibiotics and want prescriptions for them. For instance, a patient with a bad cold may request an antibiotic, even though healthcare professionals know antibiotics have no effect on viruses, and because colds are caused by viruses, antibiotics do nothing for a cold. In some cases, perhaps a doctor gives the prescription to appease the patient. Taking unneeded antibiotics kills some bacteria and leaves behind antibiotic-resistant bacteria that can then multiply.

Some researchers have wondered if the daily use of antimicrobial products, such as hand soaps and household cleaners, may promote antibiotic resistance. A study conducted in 2005 tried to determine if the use of antibacterial cleaning and hygiene products caused an increased antibiotic resistance after one year's time. The results showed that it did not. The conclusion stated that findings might be different if the products

were used more extensively or over a longer period of time and additional studies were suggested.

Some scientists and healthcare professionals believe that antibiotic resistance may also arise, and perhaps primarily arises, from the use of antibiotics to improve the health and the growth of cows and other agricultural livestock. According to the Union of Concerned Scientists, 70 percent of all antibiotics produced in the United States are used on livestock. The overuse of these antibiotics encourages antibiotic-resistant strains of bacteria, which then arrive in the human diet in beef and other food products. Scientists still are not sure exactly how much effect livestock antibiotics have, but several organizations mounted campaigns to curtail the use of antibiotics to promote growth in livestock, so that people can purchase and eat antibiotic-free meats.

What Is the Effect of Antibiotic Resistance?

According to an October 2007 study reported in the *Journal of the American Medical Association*, 94,360 patients in the United States developed an invasive MRSA infection in 2005, and 18,650 of them, or nearly 20 percent, died. In addition, the World Health Organization has stated that antibiotic-resistant bacteria are responsible for up to 60 percent of the infections that occur among hospital patients in the United States, and the Centers for Disease Control reported that 27,000 nursing-home patients in the United States had antibiotic-resistant infections as of 2005. People with such infections are typically ill for a longer period and have a greater risk of dying.

Medical professionals are particularly alarmed because MRSA and similar infections have reached beyond the medical setting and in the early 2000s were occurring in the general population, and among people who were perfectly healthy before the infection. Public outbreaks of infection with antibiotic-resistant bacteria have occurred among people who were evacuated from Hurricane Katrina in 2005, among members of some small religious groups, and even among players on the St. Louis Rams football team in 2000. Medical professionals believe the football players picked up the infection from equipment they shared, and the bacteria probably entered their bodies from cuts they got from the artificial turf on the playing field. Outbreaks have also occurred in schools, and in 2007 a high school student in Virginia died from infection with an antibiotic-resistant strain of bacteria.

How Are Antibiotic-Resistant Infections Treated?

When a patient has an infection that resists a certain antibiotic, medical professionals may try another antibiotic, perhaps several, before finding one that is effective. Doctors sometimes have limited choices, because some of the drug options have dangerous side effects. In addition, doctors are increasingly finding that bacteria are resistant to more than one antibiotic, a particular problem in hospitals where bacteria may be resistant

* **vaccines** (vak-SEENS) are preparations of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

to all of the available antibiotics. When this happens, patients can become very ill or die. Doctors are alarmed about antibiotic resistance, because they fear that surgeries and other hospital procedures that are quite safe in the early 2000s may become much, much more dangerous in subsequent years because of the mounting risk of antibiotic-resistant infection.

Will New Treatments Become Available?

In response to the problem of antibiotic resistance, researchers in the early 2000s were working to develop new drugs that attack the bacteria in a slightly different way than antibiotics typically do. For instance, researchers in 2007 found a way to target an enzyme that helps bacteria exchange its DNA. By curbing the enzyme's function, they could stop the bacteria from passing on its resistance to other bacteria. Other scientists were using different methods to curtail resistant bacteria. This work presented a constant struggle, however, because even the new drugs might only be effective for a short time if the bacteria are able to develop resistance to them, too.

In addition to developing new antibiotics, researchers were working on new vaccines* that improve the body's ability to defend itself against the bacteria, and they were also working on bacteria-attacking viruses, called bacteriophages. Despite these efforts, many medical professionals were concerned that the new drugs were not coming quickly enough to restrain the growing problem of antibiotic resistance, and the number of deaths due to antibiotic resistant infections might continue to rise. Because of concerns like these, antibiotic resistance is often described as a worldwide, public health emergency.

Can an Antibiotic-Resistant Infection Be Avoided?

The Centers for Disease Control launched the Campaign to Prevent Antimicrobial Resistance, which is designed to prevent antibiotic resistance in hospitals and other healthcare facilities. The campaign has four main strategies:

- Prevent infections in the first place, so that antibiotics are not necessary
- Diagnose and treat infection effectively with the appropriate antimicrobial therapy
- Use antimicrobials wisely
- Prevent transmission, or the spread of the infection from one patient to another

Beyond the steps that medical professionals can take, everyone can help reduce antibiotic resistance. Individuals can take several measures to reduce the chance of becoming infected:

- Wash hands often with soap and water. If soap and water are not available, an alcohol-based hand sanitizer is a good replacement.
- Try to keep hands from becoming dry and cracked, because bacteria can infect an individual through even very small openings in the skin.

- Clean and cover cuts and other wounds.
- Keep counters and other frequently touched household surfaces clean.
- Avoid sharing razors, hand towels, and washcloths to prevent the spread of bacteria from one person to another.
- Before touching public surfaces, such as gym equipment or grocery carts, clean them with disinfecting wipes.
- Shower after participating in contact sports.

In addition, medical professionals recommend that patients who have prescriptions for antibiotics follow their doctors' directions exactly. For instance, a patient should take all of the prescribed antibiotic as recommended by the doctor. Even if the patient starts to feel better, the person should take the remaining pills. Patients should not save antibiotics to use for a later illness and should never give them to someone else to take.

▶ See also **Infection • Vaccination**

Resources

Books and Articles

- Goldsmith, Connie. *Superbugs Strike Back: When Antibiotics Fail*. Minneapolis, MN: Twenty-First Century Books, 2007.
- Guilfoile, Patrick. *Antibiotic-Resistant Bacteria*. New York: Chelsea House, 2007.
- Klosterman, Lorrie. *Drug-Resistant Diseases and Superbugs*. Tarrytown, NY: Marshall Cavendish Benchmark, 2010.

Organizations

- Alliance for the Prudent Use of Antibiotics.** 75 Kneeland Street, Boston, MA, 02111-1901. Telephone: 617-636-0966. Web site: <http://www.tufts.edu/med/apua>.
- Centers for Disease Control and Prevention.** 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/dhqp/ar_mrsa_ca.html.
- Union of Concerned Scientists.** 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.ucsusa.org/food_and_agriculture/science_and_impacts/impacts_industrial_agriculture/prescription-for-trouble.html.
- World Health Organization.** Avenue Appia 20, 1211 Geneva 27, Switzerland. Web site: <http://www.who.int/mediacentre/factsheets/fs194/en>.

* **personality disorders** are a group of mental disorders characterized by long-term patterns of behavior that differ from those expected by society. People with personality disorders have patterns of emotional response, impulse control, and perception that differ from those of most people.

* **impulsive** means acting quickly before thinking about the effect of a certain action or behavior.

* **conduct disorder** is diagnosed in children and adolescents who have had serious problems with lying, stealing, and aggressive behavior for at least 6 months.

* **antisocial behavior** is behavior that differs significantly from the norms of society and is considered harmful to society.

Antisocial Personality Disorder

Antisocial personality disorder (APD) is an ongoing pattern of behavior in an adult that involves disregard for social rules and serious violation of the rights of others through aggressive, dishonest, reckless, and irresponsible acts.

What Is Antisocial Personality Disorder?

Antisocial personality disorder (APD) is one of the ten different types of personality disorders* that are classified as of the early 2000s by mental health experts. Like other personality disorders, APD refers to a personality style that consists of troubled ways of thinking, feeling, and behaving, and it is diagnosed only in adults (but the personality style and the problematic behavior it causes must have been present since adolescence). As of 2009, of all the personality disorders, APD had been the focus of the most research and attention, perhaps because people with APD often cause harm to others and have a negative effect on society.

Adults with APD engage in aggressiveness or physical assaults, cheating, lying, or other behaviors for which they can get arrested. They are often impulsive* and reckless and disregard their own safety or the safety of others. People with APD tend to be poor planners, and they may ignore financial responsibilities such as paying rent or other bills. They often have poor work records, and many engage in impulsive criminal behavior or spousal abuse. To be diagnosed with APD, a person must have had symptoms of conduct disorder* since the age of 15, thus demonstrating a long-standing pattern of antisocial behavior*.

APD was first described in the 1800s as a “defect of moral character” and as “moral insanity.” The terms psychopath and sociopath have also been used to describe what was later called antisocial personality disorder. Those people with APD seem to lack a conscience and fail to learn from consequences or punishment alone. They may fail to show remorse and may lack sympathy for those they have hurt. People with APD may experience most emotions at a shallow level.

What Causes Antisocial Personality Disorder?

Antisocial behavior tends to run in families. Researchers have tried to determine how much of this tendency is due to genetics and biology and how much is learned behavior. Some studies have identified certain brain problems and learning defects in people with APD. For example, researchers have found that areas of the brain that are involved in thinking ahead and in considering the consequences of one’s actions may be different in people with APD. This finding lends evidence to the theory that an inherited brain problem may contribute to the poor planning and impulsivity that are characteristic of people with APD.

Other studies have found differences in the brains of people with APD that may contribute to disordered learning and attention. One series of

experiments demonstrated that people with antisocial personalities did not experience normal anxiety before being given a shock and that they did not learn to avoid the shock like other subjects in the experiment did. This may explain why people with APD do not seem to learn from negative consequences or punishment.

Research that separates genetic from environmental factors (for example, studies of identical twins* raised in different homes) has shown that genetic factors explain about half of antisocial behavior. Family environment or upbringing plays an important role as well. Experts have speculated that a combination of genetic inheritance and environmental factors lead to most cases of APD. In other words, some people seem to have a biological tendency to develop APD and the family environment will determine whether that tendency is fulfilled. People without the biological tendency for APD, regardless of the family environment in which they are raised, are not likely to develop APD as an adult (although they may have conduct disorder as a youth).

How Is Antisocial Personality Disorder Treated?

Treatment of APD presents a challenge because those with APD are unlikely to consider themselves as having a problem and are, therefore, unlikely to seek help. If individuals lack motivation to change their own behavior, it is unlikely that any meaningful change will take place. Because people with APD tend to violate the rights of others, they often encounter the criminal justice system. Although they may be imprisoned, punishment alone usually fails to teach individuals with APD to behave differently. Still, APD is a serious social problem. Some early interventions may help prevent APD from developing in those at risk, such as youth with severe conduct disorders and those who are juvenile offenders.

▶ See also **Conduct Disorder • Oppositional Defiant Disorder • Personality and Personality Disorders**

Resources

Books and Articles

Kantor, Martin. *The Psychopathy of Everyday Life: How Antisocial Personality Disorder Affects All of Us*. Westport, CT: Praeger, 2006.

Organizations

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.psych.org>.

Mental Health America. 2000 N. Beauregard St., 6th Floor, Alexandria, VA, 22311. Toll free: 800-969-6642. Web site: <http://www.mentalhealthamerica.net>.

* **identical twins** are twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/000921.htm>.

Anxiety and Anxiety Disorders

Anxiety (ang-ZY-e-tee) is a feeling of fear, worry, or nervousness that a person experiences for no apparent reason. Anxiety disorders are conditions in which the patient's anxiety becomes so intense and long-lasting that it causes serious distress and may lead to problems at home, school, or work.

Michelle Has a Panic Attack

On the first day of ninth grade, when Michelle started high school, she suddenly felt dizzy, sweaty, and short of breath as she walked down the hall toward her locker. For a few minutes, everything around her seemed strangely unreal. At first, Michelle thought it was just a mild case of nerves. When the scary feelings returned the next day and the next, however, Michelle began to fear that she was losing control of her mind or that she had some terrible physical illness. In fact, Michelle was suffering from an anxiety disorder, namely panic disorder.

What Are Anxiety Disorders?

Everybody feels a little nervous now and then. People's palms may get sweaty when they take an important test, their heart may pound as they wait for the opening kickoff of a big game, or they may have butterflies in their stomach as they get ready for a first date. These common feelings are normal. People with anxiety disorders, however, feel afraid, worried, or nervous even when there is no clear reason for concern. The feelings associated with anxiety disorders are intense and long-lasting, and they may get worse over time. These emotions are very distressing to a person experiencing them, and they can be so overwhelming that they can cause serious problems at home, school, or work.

Anxiety disorders are the most common of all mental disorders. In fact, some type of anxiety disorder affects more than 40 million people in the United States 18 years of age and over, or 18 percent of the adult population. There are several different types of anxiety disorders, and some individuals suffer from more than one at the same time.

Generalized anxiety disorder Generalized anxiety disorder (GAD) is the term for constant, intense worry and stress over a variety of everyday events and situations. People who experience generalized anxiety typically



Self-injury and other behaviors that seem impossible to control are signs of an anxiety disorder. Cognitive-behavioral therapy and medication can help people learn how to change unwanted behaviors like cutting (intentionally cutting one's own skin with a blade or other sharp object), shown here, and how to create new ways of thinking about themselves and the stresses they encounter in their daily lives. *Dr. P. Marazzi/Photo Researchers, Inc.*



expect something bad to happen, even when there is no real reason for thinking this way. For example, they may worry all the time about their grades or sports performance even when they are successful students or athletes. They may worry about the wellbeing of loved ones, about school, their own health and safety, or upsetting experiences they imagine could happen in the future. These feelings may be accompanied by such physical symptoms as tiredness, chest pain, trembling, tense muscles, headache, or upset stomach. When individuals have experienced these symptoms for six months or longer, a mental health professional may diagnose them as having generalized anxiety disorder. GAD affects about 7 million Americans, with women twice as likely to have it as men.

Separation anxiety disorder Separation anxiety is the normal fear that babies and young children feel when they are separated from their parents or approached by strangers. It is not unusual for children to have mild separation anxiety on the first day of school in kindergarten or first grade or the first day of overnight camp. In most cases, this anxious feeling goes away after a few days as a child gets used to a new situation, new friends, and new adults in charge. For most children, separation anxiety lessens with age and experience.

In some children, however, this normal fear is exaggerated. These children experience extreme fearfulness whenever they are away from their parents or their home. Children with separation anxiety disorder may call their parents at work for reassurance, may be afraid to sleep over at a friend's house, or may suffer intense homesickness at camp. Separation anxiety disorder can cause these children to be frequently absent from school and avoid participating in normal childhood social activities that do not involve their parents. Children with separation anxiety disorder tend to worry a great deal; in particular, they may be afraid that their

Nothing to Fear

Not every fear is a phobia or a symptom of another anxiety disorder. Fears are not considered phobias unless they cause long-lasting and serious problems in a person's life. Many fears are common at certain points in a child's development.

Common normal fears include:

- Birth to 6 months: loss of physical support (fear of falling), loud noises, large fast-approaching objects, or sudden movement
- 7 to 12 months: strangers
- 1 to 5 years: loud noises, storms, animals, darkness, separation from parents
- 3 to 5 years: monsters, ghosts
- 6 to 12 years: injury, burglars, being sent to the principal, punishment, failure
- 12 to 18 years: tests in school, athletic competition, social embarrassment

parents will get sick or be injured. They may also have frequent nightmares about getting lost.

Separation anxiety can carry over into the teenage years. Teenagers with separation anxiety may be uneasy about leaving home, and they sometimes start refusing to go to school. Separation anxiety may be triggered by a change in schools or by a stressful event at home, such as a divorce, illness, or death in the family.

Panic disorder Panic disorder involves repeated attacks of intense fear that strike often and without warning. People having a panic attack may feel as if their surroundings are unreal, or they may fear that they are going to die. In addition to the fear, they may have such physical symptoms as chest pain, a pounding heart, shortness of breath, dizziness, or an upset stomach. Many people with panic disorder go to a hospital emergency room thinking they are having a heart attack. Panic disorder affects about 6 million adults in the United States, two-thirds of them women.

Obsessive-compulsive disorder Obsessive-compulsive (ub-SES-iv-kum-PUL-siv) disorder (OCD) is an anxiety disorder in which people become trapped in a pattern of repeated, unwanted, upsetting thoughts called obsessions (ob-SESH-unz) and behaviors intended to control the upsetting thoughts that are called compulsions (kom-PUL-shunz). The thoughts and behaviors seem impossible to control or stop. Common obsessions include fears of dirt or germs, whether the house is locked, and whether a loved one is safe. Common compulsions include washing the hands repeatedly, checking the door repeatedly to make sure it is locked, and saying something over and over to assure someone's stays safe. About 2.2 million adults in the United States are diagnosed with OCD. It is equally common in men and women.

Phobias Phobias (FO-bee-uhz) are unrealistic long-lasting fears of some object or situation. The fear can be so intense that people go to great lengths to avoid the object of their dread. There are three types of phobia problems that mental health professionals may diagnose: specific phobias; social phobia (also called social anxiety disorder); and agoraphobia (AG-or-uh-FO-bee-uh).

People with specific phobias have an intense fear of specific objects or situations that pose little real threat, such as dogs, spiders, storms, water, heights, and flying in planes. Specific phobias are common in the U.S. population, affecting about 19 million adults.

People with social phobia have an extreme fear of being judged harshly, embarrassed, or criticized by others, which leads them to avoid social situations. Social phobia is diagnosed in 7 percent of the adult U.S. population, or about 15 million persons. It is equally common in men and women.

People with agoraphobia are terrified of having a panic attack in a public situation from which it would be hard to escape, such as being in

a crowded store or stadium or in a form of public transportation such as a bus or train. If left untreated, the anxiety can become so severe that the affected person may refuse to leave the house.

Post-traumatic stress disorder Post-traumatic stress disorder (PTSD) is marked by long-lasting symptoms that occur after people have been through an extremely stressful, life-threatening event, such as a rape or mugging, tornado, aviation disaster, car crash, or after engaging in combat during military service. People with the disorder may relive the traumatic event repeatedly in painful memories or nightmares. They may have such other symptoms as depression*, anger, crankiness, and a lack of normal emotions, and they may be easily startled, unusually fearful, and have trouble paying attention. A person with PTSD may also have such symptoms as depersonalization* and derealization*. About 8 million Americans suffer from PTSD.

What Causes Anxiety Disorders?

Genetic factors Many doctors think that anxiety disorders are caused by various factors. Genetics may play a role in some cases. For example, research has shown that a twin is more likely to have obsessive-compulsive disorder if the other twin has it and if they are identical twins* (twins that have identical genes*), rather than if they are fraternal twins (twins that do not have identical genes). Other twin studies have found a genetic component to panic disorder and social anxiety disorder.

Brain circuits Some research has focused on pinpointing the exact brain areas and circuits involved in the emotions of anxiety and fear, which lie at the root of anxiety disorders. Scientists have shown that when faced with danger, the body sends two sets of signals to different parts of the brain. One group of signals goes straight to the amygdala (uh-MIG-duh-luh), a small almond-shaped structure deep inside the brain that sets the body's automatic fear response in motion. This response readies the body to react to the threat. The heart starts to pound and send more blood to the muscles for quick action, while stress hormones and extra blood sugar are released into the bloodstream to provide extra energy. The other set of signals takes a roundabout route to the cerebral cortex (suh-REE-brul KOR-teks), the thinking part of the brain. Thus, the physical response to danger or stress is set in motion before the brain understands just what is wrong. As a built-in safety measure, this learned response is stored in the amygdala so the response will be quickly available for the next dangerous situation.

In people with anxiety disorders, an experience that feels scary, even one involving a normally safe object or situation, can create a deeply etched memory of fear. This memory can lead to the automatic physical symptoms of anxiety when the object or situation is experienced again. These symptoms in turn can make it hard for the individual to focus on

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **depersonalization** (de-person-al-i-ZAY-shun) is a mental condition in which people feel that they are living in a dream or are removed from their body and are watching themselves live.

* **derealization** (de-reel-i-ZAY-shun) is a mental condition in which people feel that the external world is strange or unreal.

* **identical twins** are twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

- * **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.
- * **temperament** (TEM-per-uh-ment) is the genetically or biologically based part of an individual's personality.
- * **self-esteem** is the value that people put on the mental image that they have of themselves.

anything else. Over time, people may start to feel anxiety in many situations that do not resemble the original fear-producing event. Studies have shown that memories stored in the amygdala may be hard to erase. People can, however, gain control over their responses with experience and sometimes with psychotherapy*.

Temperament Another factor to take into account is a personality quality called temperament*. Temperament refers to a person's inborn nature that includes certain behavioral traits. To some extent, people's tendency to be shy or nervous may be inborn, simply part of their nature. Some research suggests that babies who are easily upset never fully learn early in life how to soothe themselves the way other children with calmer temperaments do. Those with a high-strung temperament may react more strongly to stressful or anxiety-provoking situations than people whose temperament makes them more adaptable. Some experts believe that people with an inhibited or cautious temperament may be more likely to have problems with anxiety.

Life experiences Yet another factor that plays a role in some anxiety disorders is stressful or negative life experiences, especially when they occur early in life. Scientists have found that when rat pups are separated from their mothers at an early age they have a much more intense startle response to later stressful situations than rat pups that were not separated. In addition to separation from a parent, human children may be affected by such stressful situations as child abuse, family violence, the untimely death of a parent or sibling, or growing up in an unsafe neighborhood. Unsafe conditions or frightening experiences may teach children to be overcautious, to expect bad events, or to worry excessively about possible dangers. People with low self-esteem* may also be prone to developing anxiety disorders.

What Are the Symptoms of Anxiety Disorders?

The fear response associated with all of the anxiety disorders can involve a number of physical symptoms, including the following:

- Pounding or racing heartbeat
- Heavy sweating
- Trembling or loss of coordination
- Shortness of breath
- Choking sensations or feeling a lump in the throat
- Chest pain
- Nausea and vomiting
- Diarrhea
- Dizziness or faintness
- Numbness
- Tingling sensations in the hands or feet
- Chills

Anxiety disorders also can lead to changes in the way a person feels, thinks, or behaves. For example, people with anxiety disorders might experience the following:

- Feel afraid and nervous
- Fear they are losing their self-control or going crazy
- Fear they will die or be seriously injured
- Worry about a parent's possible future injury or illness
- Worry about being away from home
- Worry about future and what may happen, expecting the worst
- Refuse to go to school
- Be afraid to meet or talk to new people
- Avoid new situations at school or work
- Have trouble sleeping due to worry or fear

Without treatment, people may be driven to take extreme measures to avoid situations that trigger these unpleasant symptoms. They may refuse to join in many activities. Relationships with family and friends may suffer as a result. In addition, people who are always thinking about fears and worries are unable to concentrate on school, work, or sports. They may fail in the present to do as well as they can in these areas.

How Are Anxiety Disorders Diagnosed and Treated?

Anxiety disorders often occur along with other mental disorders, such as depression, eating disorders*, or substance abuse*. Anxiety disorders may also accompany physical illnesses. In such cases, these other problems must also be treated. People with the symptoms of an anxiety disorder need a complete medical checkup to rule out other illnesses. They also need a thorough psychological evaluation. The mental health professional will ask about symptoms and the problems that they cause. With children and teenagers, the professional generally talks to parents and involved teachers.

Medications Medications cannot cure anxiety disorders, but they can help to relieve symptoms. Several kinds of medications are used to treat anxiety. Although these medications work well, they can be dangerous if mixed with alcohol, and some can be habit-forming. Antidepressant medications*, originally developed to treat depression, have increasingly been prescribed to treat anxiety. Finding the right medication and dose for a given person can take some time. Fortunately, if one medication does not work well for a given patient, several other medications can be tried.

Psychotherapy Medications often are combined with psychotherapy, a treatment in which people talk about their feelings, experiences, and beliefs with a mental health professional. In therapy, a person can learn how to change the thoughts, actions, or relationships that play a

* **eating disorders** are conditions in which a person's eating behaviors and food habits are so unbalanced that they cause physical and emotional problems.

* **substance abuse** is the misuse of alcohol, tobacco, illegal drugs, prescription drugs, and other substances such as paint thinners or aerosol gases that change how the mind and body work.

* **antidepressant medications** are used for the treatment and prevention of depression.

part in their problems. There are many kinds of psychotherapy; however, two kinds have been shown to work particularly well in treating anxiety disorders: cognitive (COG-nih-tiv) therapy and behavioral (be-HAY-vyor-ul) therapy. Often techniques from these two types of therapy are combined.

Cognitive-behavioral therapy helps people understand and change their thinking patterns so they can learn to react differently to situations that cause anxiety. This awareness of thinking patterns is combined with behavioral techniques. For example, someone who becomes dizzy during panic attacks and fears he is going to die may be asked to spin in a circle until he gets dizzy. When he becomes alarmed and starts thinking, “I’m going to die,” he learns to replace that thought with another one, such as “It’s just dizziness. I can handle it.” Although anxiety disorders can be extremely distressing to those experiencing them, the good news is that these disorders respond well to treatment.

Behavioral techniques help people replace specific, unwanted behaviors with healthier behaviors. Behavioral approaches that may be used to treat anxiety include relaxation training and deep breathing, for example. People are taught to take slow, deep breaths to relax, because people with anxiety often take fast, shallow breaths that can trigger such other physical symptoms as a racing heart and dizziness. Also, exposure (ek-SPO-zhur) therapy gradually brings people into contact with a feared object or situation, so they can learn to control their fear response to the object or situation that frightens them.

▶ See also **Agoraphobia • Fears and Phobias • Obsessive-Compulsive Disorder • Panic Disorder • Post-Traumatic Stress Disorder • School Avoidance • Stress and Stress-Related Illness**

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Levin, Judith. *Anxiety and Panic Attacks*. New York: Rosen, 2009.

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Organizations

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.psych.org>.

Anxiety Disorders Association of America. 8730 Georgia Avenue, Suite 600, Silver Spring, MD, 20910. Telephone: 240-485-1001. Web site: <http://www.adaa.org>.

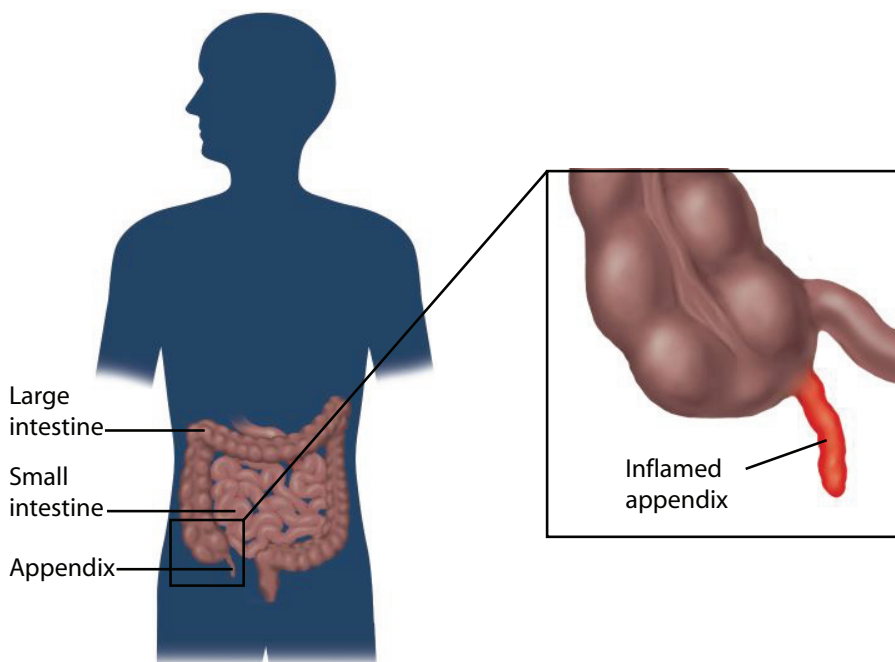
National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov>.

Aphthous Ulcers See *Canker Sores (Aphthous Ulcers)*.

Apnea See *Sleep Apnea; Sleep Disorders; Sudden Infant Death Syndrome*.

Appendicitis

Appendicitis (ap-pen-di-SY-tis) is the inflammation of the appendix (ap-PEN-dix), which is a small organ that branches off the large intestine. The inflammation usually begins abruptly, causes a characteristic right-sided abdominal pain, and may lead to rupture or bursting of the appendix, and to severe illness.



Appendicitis occurs when the appendix, attached to the first part of the large intestine, becomes infected with bacteria and inflamed. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



▲
Appendectomy scar one week after surgery. Dr. P. Marazzi/Photo Researchers, Inc.

* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

* **peritonitis** (per-i-to-NI-tis) is inflammation of the peritoneum (per-i-to-NE-um), which is the membrane that lines the abdominal cavity.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

What Is Appendicitis?

Acute* appendicitis occurs when the appendix becomes inflamed. An inflamed appendix must be removed so that it does not rupture (break) and spread the infection to the rest of the abdomen, a condition known as peritonitis*. The appendix has no known function, and its removal has no adverse effect on the body.

In most cases, acute appendicitis begins with an obstruction of the appendix's interior cavity, known as the lumen. The appendix is a narrow, finger-shaped tube, usually three to six inches (7.6–15.2 cm) long, that branches off the large intestine into the lower right side of the abdomen*. It is also known as the vermiform appendix. Vermiform means worm-shaped. The appendix may become blocked for many reasons. Often, feces obstructs the appendix, but in some cases, a bacterial or viral infection may cause lymph nodes to swell—called lymphoid hyperplasia—and obstruct the appendix. The blockage leads to inflammation. Appendicitis is typically treated with an appendectomy (ap-pen-DEK-to-mee), which is the surgical removal of the appendix. If appendicitis is left untreated, it can be fatal, but it is rare for anyone not to receive treatment in time.

Some people experience off-and-on abdominal pain, a condition that may be identified as chronic appendicitis. Often, the cause of the intermittent pain is a prolonged, partial obstruction of the appendix. Some patients are able to live with the recurrent bouts, but most only experience full relief from symptoms following appendectomy.

Who Gets Appendicitis?

Appendicitis is not preventable. Each year in the United States, it affects about one in 500 people. Anyone can develop appendicitis, but it is most common in young people between the ages of 15 and 24, and it affects boys more often than girls. In all, about 7 percent of the population typically has appendicitis sometime during their lifetime.

What Happens to People with Appendicitis? David's Story

David's appendicitis happened suddenly, when he awoke at 1 a.m. with a terrible bellyache. He blamed it on the chips and ice cream he had eaten after dinner and tried to go back to sleep. By 7 a.m., his bellyache was worse, he was not hungry, and he felt very hot. He told his parents about the intense pain in his right side, and they took him to see the doctor immediately. A series of events followed rapidly.

March 2, 10 a.m. The doctor asked David numerous questions about the pain: Is it constant? Does the right side hurt the most? Is the pain worse when you move, cough, or take a deep breath? Are you nauseated? David said yes to all of them. His abdomen felt hard when the doctor touched it, and when the doctor pushed on the right lower part, David yelled. A nurse took David's temperature and a blood sample.

March 2, noon David's blood test showed more white blood cells than usual, which is one of the signs of inflammation. The boy's other symptoms of fever and abdominal pain led the doctor to diagnose appendicitis and to advise David's parents to check him into the hospital.

March 2, 8 p.m. David had been at the hospital for several hours, during which the nurses continued monitoring his condition. The pain did not go away and started to get worse. The doctor decided that David should be taken to the operating room right away to have an appendectomy. To prepare the patient for the surgery, the doctor explained anesthesia* and showed David where the surgeon would make a small cut in his abdomen to remove the diseased appendix. The doctor and nurses repeatedly reassured David and his parents that this was a common surgery.

March 2, 10 p.m. David awoke in the hospital recovery room, groggy, tired, and a little sore. His appendix, which had not yet ruptured, had been removed.

March 4, 8 a.m. David went home from the hospital, minus his appendix and with a slight soreness at the site of his appendectomy scar, but otherwise healthy.

Within several weeks, David was back to doing just about everything he had done before his bout with appendicitis. His appendectomy surgery had been a complete success.

Resources

Books and Articles

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Organization

National Digestive Diseases Information Clearinghouse (NDDIC).

2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/appendicitis>.

The Ohio State University Medical Center. 410 W. 10th Avenue, Columbus, OH, 43210. Toll free: 800-293-5123. Web site: http://medicalcenter.osu.edu/patientcare/healthcare_services/digestive_disorders/appendicitis.

* **anesthesia** (an-es-THEE-zha) is a state in which a person is temporarily unable to feel pain while under the influence of a medication.

Arrhythmia See *Dysrhythmia; Heart Disease*.

Arteriosclerosis See *Heart Disease*.

Arthritis

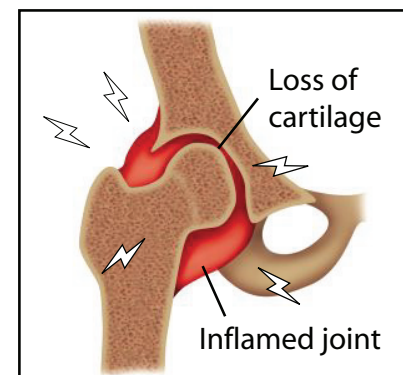
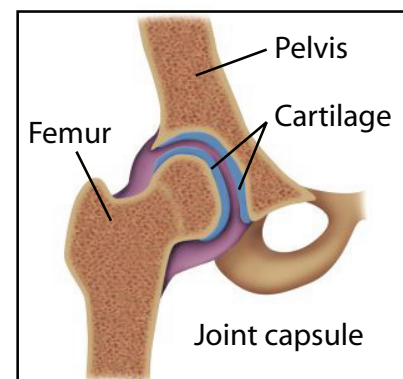
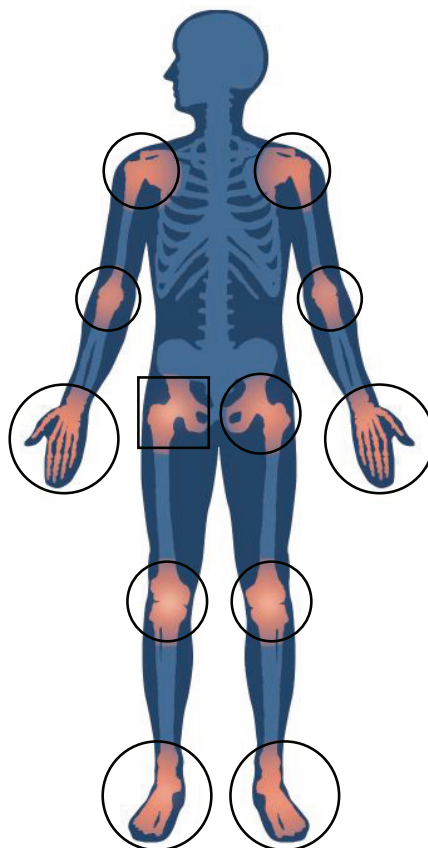
Arthritis refers to inflammation of the joints, often accompanied by pain, stiffness, or swelling. Arthritis may occur in many different diseases and medical conditions.

Jenny's Story

For many years, Jenny's father was a dedicated runner. He got up early each morning for a three-mile jog, and on weekends he sometimes ran as far as 10 miles or competed in road races. He even talked about training for a marathon, which would mean running more than 26 miles in one race. Gradually, however, Jenny began to hear her father mention that his knees were hurting when he ran and that they remained painful for a few hours after he stopped. Jenny noticed that his knees looked swollen and

Arthritis may affect many different parts of the body, including shoulders, elbows, hands, hips, and knees (left). In healthy joints (top right), a flexible cushion of cartilage allows bones to slide past each other smoothly. But in arthritis (bottom right), cartilage loss forces the bones to touch without their usual cushioning, which creates pain and inflammation.

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



that he sometimes had trouble sleeping because the pain annoyed him so much.

Jenny's father assumed the pain was simply a running injury that would get better with rest. But when the pain did not go away, Jenny's father visited a doctor. He was told he had a type of arthritis known as osteoarthritis (os-te-o-ar-THRY-tis). This surprised Jenny because her father was only in his 40s. She thought that arthritis was only a problem for older people like her grandparents.

What Is Arthritis?

Arthritis is a common problem for many older people, but it can affect anyone, from toddlers to centenarians*. Although people use the term as if it were only one disease, arthritis actually refers to a condition found in a large group of disorders. The major symptoms of arthritis occur in and around joints, making them stiff, swollen, and often painful. In addition to the joints, certain types of arthritic diseases may affect other parts of the body, including the heart and lungs.

As a group, the various forms of arthritis are among the most common medical conditions. As of 2006, the Arthritis Foundation estimated that about one in five people, or more than 46 million Americans, had it. Arthritis usually is chronic, which means the problem can last to some degree for months, years, or the rest of people's lives.

Arthritis affects millions of people. Although there are many types, the most common are:

- osteoarthritis*
- rheumatoid arthritis*
- juvenile rheumatoid arthritis*
- gout*
- fibromyalgia*
- lupus*
- Lyme disease*

These conditions develop for a variety of reasons, but they are not contagious*. Some forms of arthritis, however, can develop from contagious infections, such as sexually transmitted diseases or viruses that cause mumps and rubella (German measles). One form of arthritis, Lyme disease, develops from the bite of an infected tick. Sometimes arthritis occurs as one of the symptoms seen in conditions that primarily affect other organs. For example, inflammatory bowel disease may have arthritis as one of its symptoms.

What Is Osteoarthritis?

Jenny's father has osteoarthritis, the most common type of arthritis in adults. About 21 million Americans, almost half of those with arthritis, have this kind. Osteoarthritis is sometimes called "wear-and-tear" arthritis. That is because the pain, stiffness, and swelling often result from the wearing down of the protective tissues within and around joints.

* **centenarians** are people who are at least 100 years old.

* **osteoarthritis** (os-tee-o-ar-THRY-tis) is a common disease that involves inflammation and pain in the joints (places where bones meet), especially those in the knees, hips, and lower back of older people.

* **rheumatoid arthritis** (ROO-mah-toyd ar-THRY-tis) is a chronic disease characterized by painful swelling, stiffness, and deformity of the joints.

* **juvenile rheumatoid arthritis** a joint disease in children with symptoms of high fever, rash, swollen lymph glands, enlarged spleen and liver, and inflammation around the heart and of the lungs. Arthritis in the joints appears later. This disease is also known as systemic-onset chronic arthritis or Still's disease.

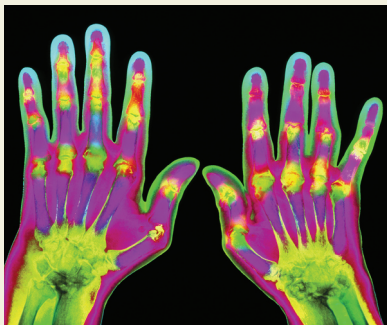
* **gout** occurs when deposits of uric acid in the joints cause inflammation and pain.

* **fibromyalgia** (fi-bro-my-AL-ja) is a group of disorders that are characterized by achy, tender, and stiff muscles.

* **lupus** (LOO-pus) is a chronic, or long-lasting, disease that causes inflammation of connective tissue, the material that holds together the various structures of the body.

* **Lyme disease** (LIME) is a bacterial infection that is spread to humans by the bite of an infected tick. It begins with a distinctive rash and/or flulike symptoms and, in some cases, can progress to a more serious disease with complications affecting other body organs.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.



▲ Colored X-ray of hands with severe rheumatoid arthritis. Swelling and bone deformation (yellow) is seen in finger and hand joints. Most joints are ragged due to bone erosion, with the thumbs also affected. People with rheumatoid arthritis may feel stiffness when they wake up in the morning, and their joints may feel warm to the touch. *SPL/Photo Researchers, Inc.*

More than 150 possible trouble spots The human body contains more than 150 joints that connect more than 200 bones. Toes and fingers have small joints; the spine, elbows, and knees have larger ones, and the hips and shoulders have even bigger ones. The bones do not touch directly. Instead, a tough, smooth, rubbery layer of tissue called cartilage covers the ends of the bones. When a knee, elbow, or other joint moves, the cartilage allows the bones to slide smoothly past each other. Cartilage also is flexible and absorbs some of the weight placed upon certain joints, such as the knee.

People with osteoarthritis, however, have lost some of the smooth cartilage in their joints. Eventually, the cartilage can wear away so much that the ends of the bones touch without any cushioning. The bones also can grow small spurs or bumps, which is why some people with osteoarthritis have lumps in their joints. These lumps often are most noticeable in the hands.

Those odd pains Osteoarthritis usually is felt first in the knees, hips, feet, spine, or fingers. These are joints that bear much of the body's weight or undergo frequent use for everyday activities. The pain increases as the cartilage between the bones wears down. People often start to avoid using the joint. For example, people might exercise less if they have pain in their knees, which only makes the problem worse. It leads to increased stiffness because muscles around the joints begin to weaken from disuse.

Stress No one is exactly sure why osteoarthritis happens, but often it results from stresses placed on the joint. In the example of Jenny's father, his years of running on hard surfaces caused damage to his knee cartilage. The pounding on pavement was too much stress for the cartilage to absorb.

Other types of stress or injury also can lead to osteoarthritis. People whose jobs involve hard physical labor (such as construction workers) or repetitive tasks (such as assembly-line workers) can develop osteoarthritis. In addition, an injury to a knee or elbow can increase the risk of osteoarthritis. Certain activities such as football or ballet can put a person at greater risk for developing osteoarthritis.

Even the stress of too much body weight contributes to the disease. People who are significantly overweight are more prone to osteoarthritis because their weight places extra stress on joints, especially knees and hips.

Age Many older people also develop osteoarthritis, even if they never put extra stress on their joints. That is because as people age, the rubbery cartilage tissue loses some of its ability to stretch and can become thinner. This change in the tissue places people at greater risk for osteoarthritis.

Heredity Not all older people develop osteoarthritis, just as not all runners or laborers do, which is one reason some doctors suspect heredity may play a role in determining who is at greatest risk for this type of arthritis.

Diagnosis It is important to understand what type of arthritis people have because treatments vary. Doctors diagnose osteoarthritis based on

the symptoms they see. They might look for loss of cartilage and bone spurs by performing x-rays. Doctors also look for other causes of the pain. For example, blood tests can show if the problem is rheumatoid arthritis rather than osteoarthritis.

If it hurts, why do doctors want patients to exercise? Once doctors have determined the problem is osteoarthritis, they typically tell patients something that might seem to make little sense. They want their patients to exercise the joint. This does not mean Jenny's father should return to running. It does mean he and others with the disease need to work with their doctors to find the best way to exercise.

Appropriate exercise can strengthen the muscles around the joint and help lessen the stiffness. Often the exercises are different from those done in the past. Some individuals give up running for swimming or water aerobics. Others walk or ride stationary bikes. If the pain is severe, a physical therapist who specializes in helping patients learn appropriate exercises might get involved. If people are overweight, doctors advise them to lose the extra pounds.

The pain of arthritis is often treated with aspirin or other over-the-counter drugs that reduce swelling. In addition, stronger prescription drugs can help if the pain is extreme. In some cases, doctors may recommend that corticosteroids* or artificial joint fluid, known as hyaluronic acid derivatives, be injected into the joints.

Often the pain of osteoarthritis decreases with treatment. For some people, however, surgery is performed to remove stray pieces of damaged cartilage, to smooth bone spurs, or in severe cases to replace damaged joints with mechanical ones. Hips and knees are the most likely candidates for replacement.

What Is Rheumatoid Arthritis?

The ancient Greeks believed the human body is filled with various substances they called "humors." Sometimes they said the humors got out of balance and caused illnesses, such as the aches and pains of swollen joints. The humors, they believed, could get back in balance, and the pain would subside. However, the problems also could return. One disease the Greeks observed is what was later called rheumatoid (ROO-ma-toid) arthritis. "Rheuma" derives from a Greek word that means "flux" or "discharge." The Greeks believed the humors were fluxing, or flowing, through the body to cause the bouts of pain.

When the body turns on itself In a way, rheumatoid arthritis is a disease in which substances in the body are out of balance. The body fights infections with chemicals known as antibodies. However in rheumatoid arthritis, the antibodies turn against healthy areas of the body and cause the thin covering around joints to become inflamed.

The pain usually starts in the hands or feet, but rheumatoid arthritis can affect many different joints as well as other parts of the body, such

* **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.

* **Raynaud's disease** (ray-NOZE) is a condition in which discoloration of the skin typically on the fingers and/or toes occurs when individuals experience changes in temperature or emotional events. An abnormal spasm of blood vessels causes the reduced supply of blood to the affected areas of the body.

as the heart and lungs. The disease's cause is unknown. Some researchers believe that the immune system's attack on healthy tissues may be caused by the body's overreaction to viral infection. Rheumatoid arthritis is sometimes associated with Raynaud's disease*

More than 2 million Americans have rheumatoid arthritis, and most of them are women. Although it is primarily a disease that begins at middle age, its onset may be much earlier.

Known as the most disabling of the various diseases that cause arthritis, rheumatoid arthritis can lead to deformed joints, extreme pain, and loss of the ability to do common tasks such as walking.

Stiffness in the morning The symptoms of the disease can develop in a few days, or over months or years. For most people, a joint in the hands, feet, arms, or legs feels stiff, as it does in osteoarthritis and other forms of arthritis. Rheumatoid arthritis, however, has a few distinctive features. People tend to feel worse in the morning after awakening. They also can get a fever, and their joints can seem warm to the touch.

At first, the antibodies attack only the thin covering around joints. This covering contains cells that produce fluid to keep joints lubricated and working properly. As the covering is injured, it becomes thicker. Soon, damaging cells appear and eat away cartilage, bone, and other tissue. Swelling and pain result, and the joints become deformed. People with rheumatoid arthritis also can develop small bumps around joints, especially in their hands and elbows. Often, the disease flares up and then subsides on its own. Some people, however, receive no relief without treatment.

Diagnosis Doctors diagnose rheumatoid arthritis with special blood tests. They also look for other causes of the joint problems and use x-rays to look at the spaces between bones to see if they are narrowing.

Treatment Over-the-counter medications such as aspirin can ease the pain. Stronger prescription pain relievers and anti-inflammatory drugs are also available. Weight loss is urged for people who are too heavy. Some people need surgery to replace badly damaged joints in the arms, legs, or hips.

Many people, however, learn to live with the disease through a combination of rest and exercise. When the symptoms are at their worst, patients with rheumatoid arthritis try to avoid putting stress on their joints to help reduce damage. When the symptoms are less severe, however, doctors want the patients to exercise as a way of maintaining flexibility in the joints and strength in the muscles around them.

Patients with rheumatoid arthritis often learn relaxation techniques because the disease is known to flare up in times of emotional stress.

What Is Juvenile Rheumatoid Arthritis?

Juvenile rheumatoid arthritis is one of several common forms of juvenile arthritis that cause swelling and pain in the joints, and children with arthritis may experience a great variety of symptoms. The disease affects

THE UNITED STATES AND ELSEWHERE IN THE WORLD

- About 355 million people worldwide have arthritis.
- As of 2006, the Arthritis Foundation estimated that 46 million people in the United States (20 percent of the population) had arthritis. As baby boomers age, though, those numbers are expected to rise. In the decade from 2007–2017, the Centers for Disease Control predicted that 8 million new cases will be diagnosed.
- According to the Centers for Disease Control, the state with the highest percentage of residents with arthritis in 2005 was West Virginia with 35 percent. Hawaii, California, Washington, D.C., and Texas, each with about 22 percent of their population having arthritis, had the lowest percentages. The state median was 27 percent.
- A disease without age boundaries, arthritis affects nearly 300,000 American children. It is, however, especially prevalent among older people. As of 2005, half of all adults 65 years old and older had the disease.
- About three-fifths of Americans with arthritis are female.
- According to the Centers for Disease Control, the cost of arthritis and related diseases to the U.S. economy in the year 2003 was about \$128 billion, up more than \$40 billion since 1997. About 63 percent is due to medical costs, and the remainder is from lost earnings.
- People who have physically challenging jobs have a higher likelihood of developing arthritis. According to the Arthritis Foundation, 48 percent of all players in the National Football League retire with some form of the disease as a result of joint stress and injury-related complications suffered during their years on the playing field.

up to 50,000 American children. The causes are unknown, although heredity is believed to play a role.

Juvenile rheumatoid arthritis affects children under age 16. Although it is very similar to the adult form of rheumatoid arthritis, which is chronic, many young patients “outgrow” juvenile rheumatoid arthritis. Doctors use a similar approach to juvenile and adult rheumatoid arthritis: pain medication, exercise recommendations, and careful treatment to prevent joints from becoming deformed.

What Are the Other Forms of Arthritis?

Osteoarthritis is the most common form of arthritis, and rheumatoid arthritis is the most disabling, but more than 100 diseases are accompanied by the symptoms of arthritis. Listed below are a few of the other major ones, as well as several unusual types:

Gout Gout causes extreme pain that develops suddenly, often in the big toe. The pain, swelling, and redness develop because uric acid crystals build up in the joint. A natural substance found in the body, uric acid usually passes out of the system through the kidneys and urine*. When uric acid is not removed from the body, crystals form and settle in the joints. Many people associate gout with excessive eating and drinking. Although

* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

Rheumatism

Rheumatism is a non-medical word that many people use to refer to many different forms of arthritis, including rheumatoid arthritis. Older men and women sometimes talk about “having a touch of rheumatism” when their joints ache, especially on cold, rainy days.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

those activities, as well as obesity*, increase the risk for gout, it can develop for no apparent reason. According to the Arthritis Foundation, about 2.1 million Americans have gout, and about 75 percent of them are men.

Fibromyalgia Fibromyalgia causes pain in the muscles and in the ligaments and tendons that are attached to bones around joints. Often people with fibromyalgia are excessively tired and have trouble sleeping. The causes are unknown, although people with the disease often experience psychological stress, which does not mean the disease or its pain are not real. Unlike other forms of arthritis, fibromyalgia affects muscles and tissues around joints, not the joints themselves. It also does not lead to permanent damage. About 3.7 million Americans have fibromyalgia, and most of them are women.

Lupus Lupus is a disease that affects joints as well as other body parts, such as the kidneys, nervous system, heart, and skin. Lupus has many symptoms, including fatigue, rashes, chest pain, fever, and sensitivity to sunlight. Like rheumatoid arthritis, lupus is an autoimmune disease with no known cause. In autoimmune diseases, the cells in the body that usually fight infections instead attack healthy cells and tissue. According to the Lupus Foundation of America, this disease affects 1.5 million Americans, and 90 percent of them are women. The disease mainly strikes women in their childbearing years. People of color, including African Americans, Asians, Hispanics, and Native Americans, are two to three times more likely to develop lupus than are women of European ancestry.

Lyme disease Lyme disease is a bacterial infection spread by the bite of an infected insect known as a deer tick. The first signs are usually fever and a red rash on the skin where the bite occurred, although early symptoms are sometimes overlooked. Joint problems may follow but may not appear until months to years later. If caught early, the disease usually can be overcome with antibiotics. Lyme disease is a special concern for people who spend time outdoors in certain regions of the United States.

Living with Arthritis

Severe arthritis can limit a person’s ability to walk, dress, or bathe easily. A growing number of devices are designed to help people with varying forms of arthritis to perform simple tasks more easily and to continue living independently. These range from easy-to-open bottles and gripping clamps on poles for reaching high objects to electric scooters.

Although doctors do not yet know how to prevent arthritis, they typically recommend many ways people can reduce its impact. These include:

- maintaining a healthy weight
- exercising to maintain joint flexibility and muscle strength

- exercising carefully, especially in contact sports such as football
- wearing well-cushioned sneakers when walking or running on hard surfaces
- getting adequate rest
- following the doctor's instructions about pain medications
- learning relaxation techniques to reduce flare-ups in times of stress

With a fuller understanding of arthritis, its limitations, and its treatments, people with arthritis can lead full and happy lives.

▶ See also **Arthritis, Infectious • Collagen Vascular Diseases • Fibromyalgia • Gout • Lupus • Lyme Disease • Raynaud's Disease**

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Organizations

American Academy of Orthopaedic Surgeons. 6300 North River Road, Rosemont, IL, 60018-4262. Telephone: 847-823-7186. Web site: <http://www.aaos.org>.

Arthritis Foundation. P.O. Box 7669, Atlanta, GA, 30357-0669. Toll free: 800-283-7800. Web site: <http://www.arthritis.org>.

* **joint** is the structure where two or more bones come together, allowing flexibility and motion of the skeleton.

Arthritis, Infectious

Infectious arthritis (in-FEK-shus ar-THRY-tis) is a bacterial, fungal, or viral infection of the tissue and fluid within a joint. The infection causes inflammation and can result in pain, swelling, and limited motion of the joint.*

- * **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.
- * **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **sickle-cell anemia** also called sickle-cell disease, is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.
- * **lupus** (LOO-pus) is a chronic, or long-lasting, disease that causes inflammation of connective tissue, the material that holds together the various structures of the body.
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **rheumatoid arthritis** (ROO-mah-toyd ar-THRY-tis) is a chronic disease characterized by painful swelling, stiffness, and deformity of the joints.

What Is Infectious Arthritis?

Most of the time, bacteria cause infectious arthritis. Infectious arthritis is also called septic arthritis, and the infected joint is referred to as a “septic joint.” *Staphylococcus* (stah-fih-lo-KAH-kus) or *Streptococcus* (strep-tuh-KAH-kus) bacteria are the culprits in most cases of septic arthritis. Infectious arthritis also can occur in other diseases, for example, in Lyme disease and tuberculosis. Bacteria can be introduced directly into the joint by injury or surgery, but more often the bacteria are carried to the joint through the bloodstream from an infection somewhere else in the body. The most common cause of septic arthritis in young adults is *Neisseria gonorrhoeae* (nye-SEER-e-uh gah-no-REE-eye), the bacterium that causes gonorrhea. These bacteria may spread from infected areas, such as the cervix*, rectum*, and the male urethra, and infect joints at the hands, wrists, elbows, and knees. Certain viruses, including those that produce measles, rubella (roo-BEH-luh, a rash-causing viral infection that is also called German measles), and hepatitis B or C, also can cause infectious arthritis. Fungi found in soil, bird droppings, and some plants are uncommon causes of infectious arthritis.

People whose immune systems are weak because they have a disease such as diabetes*, sickle-cell anemia*, certain cancers, lupus*, or AIDS* are more likely to get infectious arthritis. Alcoholism and intravenous drug use also put people at higher risk. Because a joint that is damaged is more vulnerable to germs, people with existing disease involving the joints (for example, rheumatoid arthritis*) are more likely to develop infectious arthritis. Anyone who has had joint-replacement surgery is at increased risk for infection of that joint in the future.

How Common Is Infectious Arthritis?

Cases of infectious arthritis are more common in some places than in others. Rates are highest in Africa, Latin America, and Asia. In the United States, about 20,000 cases of infectious arthritis occur each year. Men, women, and children of all ages can get infectious arthritis, but almost half of patients in whom the illness is diagnosed are 65 years or older.

Is Infectious Arthritis Contagious?

Infectious arthritis is not contagious, but certain viruses and the bacterium that causes gonorrhea can be transmitted from one person to another. However, contracting a particular infection caused by these organisms does not necessarily mean individuals will also get infectious arthritis.

What Are the Signs and Symptoms of Infectious Arthritis?

The symptoms of infectious arthritis vary by type of infection and the particular joint that is affected. With infectious arthritis, symptoms usually appear within a few hours or days and include redness, warmth, swelling, pain, and sometimes fever and chills. It is difficult to move the affected

joint because of the pain and swelling. Arthritis from a viral infection tends to come on more slowly, often with absence of fever and with less swelling, limitation of movement, and pain at the affected joint. Viruses may infect the joint directly, or sometimes the response of the body's immune system to a virus may cause joint inflammation (called "postinfectious arthritis"). Inflammation stemming from a fungal infection or tuberculosis usually develops very slowly, sometimes over weeks or months. The bacteria that cause Lyme disease can settle in a joint and may lead to recurrent bouts of infectious arthritis. Usually, swelling and limitation of movement of the joint are the main symptoms of this form of arthritis.

How Do Doctors Make the Diagnosis?

A doctor who suspects infectious arthritis based on a patient's symptoms and the findings of a physical examination will want to know the details of the person's medical history. Taking a medical history might include asking questions about whether the patient is sexually active; injects drugs; has been bitten by a tick (which can cause Lyme disease); has had arthritis in the past; or has recently been injured, hospitalized, or exposed to an illness. Laboratory tests can help confirm the diagnosis. A common diagnostic test is aspiration* of some of the synovial fluid* within the affected joint. The doctor inserts a thin, sterile needle through the skin directly into the joint and removes a sample of fluid. The fluid is then examined under a microscope to look for evidence of microorganisms (such as bacteria) and infection-fighting white blood cells. Some of the sample is put in a jelly-like medium containing nutrients that support the growth of bacteria, and this is placed in an incubator for a few days. If bacteria grow, bacterial infectious arthritis is diagnosed. This synovial fluid can also be tested for evidence of viral or fungal infections. In addition, blood tests can help diagnose arthritis caused by a virus or bacterium. If the suspected cause of inflammation is a fungus or tuberculosis, a tissue sample from the infected joint may need to be removed and analyzed. X-rays, computerized tomography*, or magnetic resonance imaging* studies can detect excess fluid and sometimes destruction of the tissues within or surrounding an affected joint.

What Is the Treatment for Infectious Arthritis?

The type of organism causing infectious arthritis determines which medicines are needed to treat the infection. Antibiotics are prescribed to treat joint infections caused by bacteria, and anti-fungal medications are given for infection due to a fungus. Doctors also may recommend that individuals with infectious arthritis keep the affected joint elevated (raised up) and avoid moving it. Over-the-counter anti-inflammatory medications, such as ibuprofen*, can relieve swelling and pain. Sometimes, to help healing and decrease discomfort, some of the excess synovial fluid is removed from a joint. This procedure may have to be repeated several times. In certain cases, a septic joint might be drained by a surgical procedure to help cure the infection.

* **aspiration** (as-puh-RAY-shun) is the sucking of fluid or other material out of the body, such as the removal of a sample of joint fluid through a needle inserted into the joint.

* **synovial (sih-NO-vee-ul) fluid** is the fluid produced in the synovium, the inner lining of the flexible capsule that encloses the joint space between two bones. This fluid lubricates and nourishes the joint.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

* **ibuprofen** (eye-bew-PRO-fin) is a nonsteroidal anti-inflammatory drug (NISAD) used to reduce fever and relieve pain or inflammation.

How Long Does the Infection Last?

Eliminating the infection can take time. Antibiotics may need to be given intravenously for three weeks or more. It may take even longer for someone to be able to use an affected joint without feeling pain. In cases of severe infectious arthritis, physical therapy may be recommended after other treatment has been completed to help patients recover full movement and function of the joint. Infectious arthritis can be cured with prompt and proper treatment. In cases that are severe or when treatment is delayed, the infection may cause permanent damage to the joint and the bone, sometimes resulting in persistent pain and disability.

Can Infectious Arthritis Be Prevented?

Doctors may recommend that people who have a high risk of the disease, such as those with artificial joints, take antibiotics prior to having certain procedures, such as dental procedures. Administration of antibiotics as a pre-emptive measure (prophylaxis) prior to circumstances in which bacteria may be expected to enter the blood stream may prevent an infection in the joint, even when the person has no symptoms of disease. Abstinence (not having sex) will prevent arthritis caused by sexually transmitted diseases such as gonorrhea. For sexually active people, the use of latex condoms can lessen the risk of exposure to bacteria that can cause infectious arthritis.

▶ See also **Fibromyalgia** • **Immune Deficiencies** • **Sexually Transmitted Diseases (STDs)** • **Staphylococcal Infections** • **Streptococcal Infections**

Resources

Books and Articles

Bird, Howard, et al. *Arthritis: Your Questions Answered*. New York: DK, 2007.

Organizations

American Academy of Orthopedic Surgeons. 6300 North River Road, Rosemont, IL, 60018-4262. Toll free: 800-346-2267. Web site: <http://www.aaos.org>.

Arthritis Foundation. P.O. Box 7669, Atlanta, GA, 30357-0669. Toll free: 800-283-7800. Web site: <http://www.arthritis.org>.

Arthritis Society. 393 University Avenue, Suite 1700, Toronto, ON, M5G 1E6, Canada. Telephone: 416-979-7228. Web site: <http://www.arthritis.ca/types%20of%20arthritis/infectious/default.asp?s=1>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Toll free: 888-346-3656. Web site: <http://www.nlm.nih.gov/medlineplus/arthritis.html>.

Asbestosis See *Pneumoconiosis*.

Ascariasis

Ascariasis (as-kah-RI-ah-sis) is an infection of the intestines by parasitic roundworms that usually causes no symptoms but is sometimes serious.

What Is Ascariasis?

The world is full of roundworms*. Hundreds of thousands of different kinds inhabit the Earth, and a few types inhabit the bodies of humans as well. The most common of these is a worm called *Ascaris* (full name *Ascaris lumbricoides*), which is estimated to infect 1 billion people worldwide.

Ascariasis, which is what the infection or infestation is called, usually occurs in tropical and subtropical areas where sanitation is poor and where raw or improperly treated human sewage is used to irrigate or fertilize crops. Most cases occur in Africa and Asia, but it has been estimated that 4 million people in the United States carry *Ascaris* (AS-ka-ris), most of them in rural southeastern areas.

Ascaris is a parasite*. Like many other parasites, it usually leads a live-and-let-live existence, doing little damage to its host. Unlike many parasites, however, it infects only humans. Although *Ascaris* worms are found in people of all ages, children are most likely to be heavily infected.

What Is the Life Cycle of the Ascaris Worm?

Adult *Ascaris* worms live in the upper portion of the small intestine. They are 8 to 15 inches (20 to 40 cm) long, one-eighth to one-fourth inch (3 to 6 mm) in diameter, and live for about one year. Fertilized females produce up to 240,000 microscopic eggs per day, which pass out of an infected person's body in the stool (feces). Fertilized eggs must remain in the soil for two to three weeks before they can infect another person. The eggs, however, can remain alive and viable*.

Infection usually begins when soil containing eggs gets on people's hands. If they eat or touch their mouths before washing their hands, the eggs can get into their mouths and be swallowed. The eggs may also get into the body in food that has been contaminated with human waste.

The eggs hatch in the small intestine and release free-swimming larvae*. The larvae penetrate the wall of the small intestine and enter the bloodstream. Next comes the pulmonary* stage of the infection, when the larvae enter the lungs and move up the bronchial tubes, which are the passages that carry air to and from the lungs. They finally reach the pharynx (FAR-inks), the back of the throat, where they are swallowed. Then



▲ The roundworm *Ascaris lumbricoides* is the largest of the human intestinal parasites. Sinclair Stammers/Photo Researchers, Inc.

Did You Know?

- About 1 billion people worldwide are infected with *Ascaris* worms.
- An adult *Ascaris* worm is 8 to 15 inches (20 to 40 cm) long.
- A female *Ascaris* worm can produce 240,000 eggs a day.

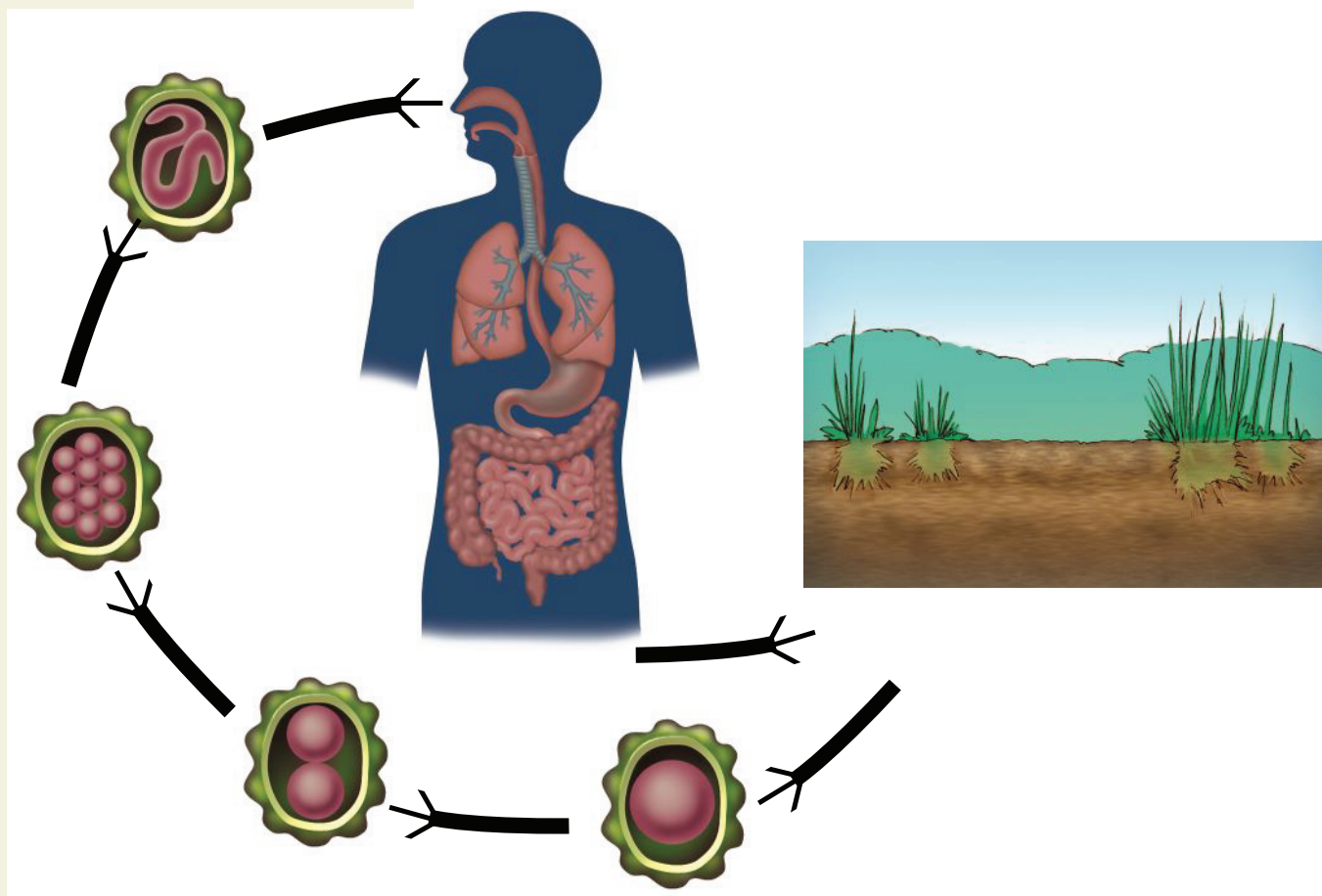
* **roundworm** is one of several types of cylinder-shaped worms that live in people. Roundworms are also known as nematodes (NEE-muh-to-des).

* **parasite** (PAIR-uh-site) is an organism such as a protozoan (one-celled animal), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. Parasites live at the expense of the host and may cause illness.

* **viable** means an organism can survive, grow, develop, and function.

* **larvae** (LAR-vee) are the immature forms of an insect or worm that hatches from an egg.

* **pulmonary** refers to the lungs.



▲ Ascariasis infections begin when people swallow worm eggs that they have picked up from infected food or from soil. The eggs hatch in the small intestine, become larvae, and swim through the bloodstream to the lungs and then on to the throat, where they are swallowed. Back in the stomach and small intestine, the larvae become adults, mate, and produce new eggs. The entire cycle takes 2 to 3 months. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **asthma** (AZ-mah) is a condition in which the airways of the lungs repeatedly become narrowed and inflamed, causing breathing difficulty.

they move through the stomach and back to the small intestine where they were hatched. In the small intestine, they become adults and mate, and the females begin producing eggs. The entire cycle, from eggs being swallowed to new eggs being produced, takes two to three months.

What Are the Symptoms of Ascariasis?

Ascariasis usually causes no symptoms. In heavy infections, however, abdominal cramps occur, and occasionally a mass of worms can block the intestines, causing pain, vomiting, and bloating. Adult worms can also block other parts of the digestive tract, such as the appendix, bile duct, or pancreatic duct, causing similar symptoms. When the larvae are migrating through the lungs, they may cause a fever, dry cough, wheezing, and sometimes asthma*.

How Is Ascariasis Diagnosed and Treated?

Because *Ascaris* produces such an abundance of eggs, they often can be seen when stool samples are examined under a microscope. Less commonly, an adult worm may be passed in the stool or may crawl up the throat and try to exit through the mouth or nose. *Ascaris* larvae may be identified in sputum* coughed up during the pulmonary stage.

Doctors may prescribe several different oral medications to treat ascariasis. If the intestine is blocked, surgery may be necessary. If the pulmonary stage is severe, corticosteroids* may be prescribed to lessen the symptoms.

How Can Ascariasis Be Prevented?

Thoroughly washing fruits and vegetables in clean water, washing hands before eating or preparing food, and washing hands after using the bathroom are advised. Improved sanitation and hygiene in developing countries would cut the risk of infection in those areas. Coupled with such improvements, routine or preventive treatment with deworming drugs, called anthelmintic (ant-hel-MIN-tik) medications, could reduce the prevalence of ascariasis worldwide.

▶ See also **Parasitic Diseases: Overview**

Resources

Organizations

Center for Food Safety and Applied Nutrition, Food and Drug Administration. 5100 Paint Branch Parkway, College Park, MD, 20740. Toll free: 888-SAFEFOOD. Web site: <http://www.cfsan.fda.gov>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/parasites/ascaris/default.htm>.

Asperger's Syndrome

Asperger's syndrome is a developmental condition in which a child does not learn to communicate and interact with others in a typical way. The condition, also called Asperger disorder or Asperger's, is one of the pervasive developmental disorders, which is the group of conditions that includes autism (AW-tiz-um).*

Brian's Story

When Brian turned two years old, his parents were thrilled with his large vocabulary, which surpassed that of any other two-year-old they knew. Because Brian seemed so bright, they tried to ignore the fact that he spoke in a monotone, rarely made eye contact with them, and never wanted to play with the other children in his playgroup. When Brian became fixated on the weather channel on television, however, they had to admit that something might be wrong. When Brian's parents mentioned these

* **sputum** (SPYOO-tum) is a substance that contains mucus and other matter coughed out from the lungs, bronchi, and trachea.

* **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.

* **autism** (AW-tih-zum) is a developmental disorder in which a person has difficulty interacting and communicating with others and usually has severely limited interest in social activities.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

behaviors to their pediatrician, she suspected that Brian had a form of autism called Asperger's syndrome.

What Is Asperger's Syndrome?

Asperger's syndrome is in the same group of developmental disorders as autism. Both autism and Asperger's syndrome are brain conditions that affect a person's ability to relate to others and to use language normally in order to communicate. The main difference between children with Asperger's syndrome and children with autism is that intelligence and development of language is not delayed in children with Asperger's syndrome. In fact, children with Asperger's syndrome are often so clever with words that Hans Asperger (1906–1980), the Austrian doctor who first described the condition, called them “little professors.” However, children with Asperger's syndrome often talk in a monotone, do not look people in the eye when they are talking, and may seem obsessed with odd or narrow interests. For example, they may memorize and recite train timetables or weather statistics but may have little idea of their usefulness.

Despite their intelligence and verbal abilities, children with Asperger's syndrome are socially atypical and unaware of what other people are thinking and feeling. They rarely if ever try to share their interests or enjoyment with people around them. Thus, they have difficulty making friends, and they may be teased and become socially isolated. People with Asperger's syndrome may also be hyperactive, irritable, anxious, or depressed.

What Causes Asperger's Syndrome?

Asperger's syndrome, like autism in general, results from some abnormality in the brain. However, as of the early 2000s, no one knew exactly what the abnormality is or what causes it. Parents of a child with any form of pervasive development disorder, including Asperger's syndrome, are more likely to have another child with the same disorder, suggesting that genes* are involved. Some experts believe that the hereditary link is stronger in Asperger's syndrome than it is in classical autism.

The prevalence of Asperger's syndrome is not known. In some children, it is hard to distinguish Asperger's syndrome from milder forms of classical autism. However, the disorder is diagnosed at least five times more frequently in males than females.

How Is Asperger's Syndrome Treated?

Parents, teachers, and mental health professionals may all become involved in helping children with Asperger's syndrome. Behavioral training to assist in the learning of social skills is important. Children with Asperger's syndrome may attend special education classes and practice behaviors such as looking people in the eye while talking and trying to understand another's point of view. They may also learn to read emotions such as anger or fear from the expressions on other people's faces, something that most children can do easily. Sometimes children with Asperger's syndrome are

helped by special medications to treat associated problems such as hyperactivity, anxiety*, and depression*.

There is no cure for Asperger's syndrome. However, children with this condition, because they have greater verbal skills, often do better as they grow to adulthood than do children with autism. Although they may always be socially awkward, many children with Asperger's syndrome become well educated and live and work independently.

▶ See also **Pervasive Developmental Disorders: Overview**

Resources

Books and Articles

Attwood, Tony. *The Complete Guide to Asperger's Syndrome*. London: Jessica Kingsley, 2008.

Bashe, Patricia Romanowski, Barbara L. Kirby, Simon Baron-Cohen, and Tony Attwood. *The OASIS Guide to Asperger's Syndrome: Completely Revised and Updated: Advice, Support, Insight, and Inspiration*. New York: Crown, 2005.

Carley, Michael John. *Asperger's from the Inside Out: A Supportive and Practical Guide for Anyone with Asperger's Syndrome*. New York: Perigee, 2008.

Organizations

Autism Society of America. 7910 Woodmont Avenue, Suite 300, Bethesda, MD, 20814-3067. Toll free: 800-3AUTISM. Web site: <http://www.autism-society.org>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Web site: http://www.ninds.nih.gov/disorders/asperger/detail_asperger.htm.

Online Asperger's Syndrome Information and Support (OASIS). Web site: <http://www.udel.edu/bkirby/asperger>.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

Asthma

Asthma is a condition that causes episodic breathing difficulties. These episodes are caused by narrowed and inflamed airways of the lungs. Asthma "flares" or "attacks" can be triggered by dust, pollutants, smoke, allergies, cold air, or infections.

* **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

A Breathless Story

When Stacy was young, her parents noticed that she seemed to get tired more quickly than her friends while playing. She also had repeated coughing spells, and her breathing was sometimes noisy. After examining Stacy, asking lots of questions, and having her use a little machine to measure her breathing, the doctor diagnosed her problem as asthma. As part of the way Stacy took care of herself, she sometimes had to take asthma medicine at school. This made her teachers and friends interested in learning more about asthma. When Stacy was 12, she began a school-wide project with the help of her teacher and the nurse. The goal was to make her school more comfortable for those who have asthma. No smoking was allowed, even during after-school events. Extra measures were taken to keep the school as free as possible of substances that can trigger asthma flares, such as dust, mold, cockroaches, and strong fumes from paint and chemicals. A plan was set up that allowed students with asthma to take their own medicines at school. Special lessons were offered to all students and teachers about what asthma is and how to help a classmate who has it. The result was a school that was a healthier place not just for Stacy but for everyone.

What Is Asthma?

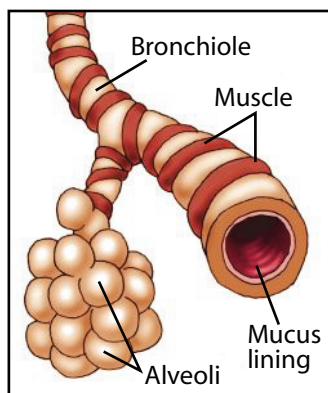
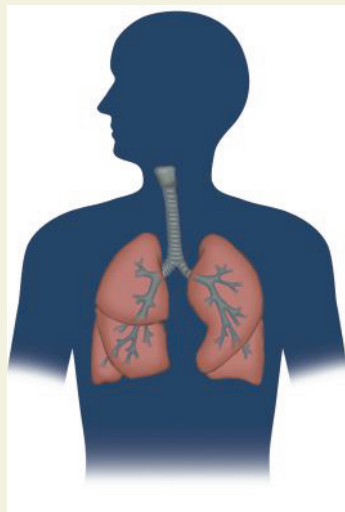
Several changes happen inside the airways in the lungs of people who have asthma. First, there is inflammation, or swelling, of the lining of the airways. Second, the swollen tissues make a thick, slippery substance called mucus*. Third, the muscles around the airways may squeeze tight, causing the airways to narrow. These three processes—inflammation, mucus production, and muscle constriction—combine to reduce the size (the diameter) of the airways. That makes it harder to breathe, like trying to blow air through a narrow straw.

During an asthma attack, these changes get worse. The airways swell on the inside while they are being squeezed on the outside. At the same

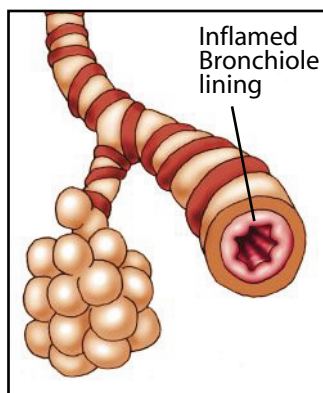
The stages of an asthma attack.

1. Location of bronchial tubes and alveoli.
2. Normal.
3. Inflamed.
4. Bronchospasm with trapped air.

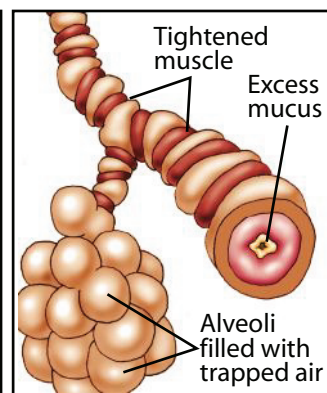
Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



Normal bronchiole and alveoli



Inflamed bronchiole and alveoli



Bronchospasm during asthma attack

time, thick mucus plugs the smaller airways. The person may start to make whistling or hissing sounds with each breath. The person's chest may also feel tight. In addition, the person may cough to try to clear the lungs.

What Are the Severities of Asthma?

Cases of asthma vary in severity. Some people may have only mild symptoms a few times per month, whereas others may have severe symptoms every day. Asthma has four levels, depending on how severe each case is.

Mild intermittent A person with this type of asthma has daytime symptoms less than twice per week and nighttime symptoms less than twice per month. Attacks are brief and usually do not affect activities. Intermittent means the symptoms come and go.

Mild persistent A person with this type of asthma has mild symptoms more than twice per week, never more than once per day. Nighttime symptoms occur more than two times a month.

Moderate persistent A person with this type of asthma has symptoms every day and flare-ups more than twice per week. Nighttime symptoms occur more than once per week. When symptoms do occur, they can last for days and can make it hard for the sufferer to participate in certain activities.

Severe persistent A person with this type of severe asthma has symptoms throughout the day and night. The asthma makes it hard or impossible for a person to participate in many physical activities.

What Triggers Asthma?

People with asthma have what are sometimes called “sensitized” airways. Everyday factors that cause little or no trouble for most people can sometimes cause people with asthma to have a flare-up or attack. These factors are known as asthma triggers. There are two main kinds of triggers: allergic and non-allergic triggers. An allergic trigger results from substances called allergens*, which trigger an allergy. Examples of allergens that may trigger asthma are pollens, molds, animal dander (small scales from fur or feathers), dust mites*, cockroaches, and certain foods and medicines. Most of these allergy-causing substances enter the body through the air people breathe, but some are swallowed.

The second kind of asthma trigger is called an environmental or non-allergic trigger. It has nothing to do with an allergy but causes the same kind of reaction in the airways. Irritating substances in the air, such as tobacco smoke, wood smoke, fresh paint, cleaning products, perfumes, workplace chemicals, and air pollution can trigger or make asthma worse. Other non-allergic triggers include cold air, sudden changes in air temperature, exercise, heartburn, and infections of the airways, such as a cold

* **allergens** are substances that provoke a response by the body's immune system or cause a hypersensitive reaction.

* **dust mites** are tiny insects that live in dust and in materials such as carpets, pillows, mattresses and furniture.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

or the flu. Exactly which of these might trigger a reaction varies from person to person.

Who Gets Asthma?

Asthma is one of the most common health problems in the United States. The number of people with the condition grew rapidly in the late 1990s and early 2000s. The reason for this increase is not yet known. Asthma can affect both children and adults. It is the most common chronic* health problem seen among children and teenagers. Childhood asthma is slightly more common in boys than girls. The condition is also more common among African American children than white children, although the reason for this difference is not clear. It may have to do with environmental conditions.

What Are the Symptoms?

Following are the most common symptoms of asthma. A person may have all, some, or just one of these symptoms:

- Shortness of breath
- Coughing, particularly if it lasts longer than a week
- Wheezing (whistling or hissing sounds made primarily when breathing out)
- A feeling of tightness or discomfort in the chest

The degree to which asthma interferes with a person's daily life varies significantly. Some people have ongoing problems. The frequency of their attacks may range from several times per week to almost constantly. Their ability to take part in physical activities may be limited until, with treatment, they are able to get their asthma under control. Those with milder problems are usually able to do whatever they want to do, so long as they reduce their environmental triggers, take their medicine as directed, and follow any other advice from their doctors.

Childhood asthma Babies often wheeze when they have a cold or other infection of the airways, blockage of the airways, or other problems. This symptom may go away on its own with no ill effects. However, if the problem is severe, lasts a long time, or comes back, treatment may be needed. In older children, normal breathing should be quiet. Wheezing may be a sign of asthma, but it can also signal an infection, lung disease, heartburn, heart disease, a blood vessel blocking the airways, or even a piece of food or other object (such as part of a toy) lodged in the airway. In addition to noisy breathing, asthma in children can cause rapid breathing and frequent coughing spells. Parents may also notice that the child tires quickly during active play.

Nighttime asthma Asthma tends to get worse at night. Nocturnal (or nighttime) asthma occurs while a person is sleeping. For some people, nocturnal asthma is one of many symptoms; other people seem to have coughing or wheezing only at night.

FOUR CENTURIES OF MEDICAL RESEARCH

The word “asthma” comes from the Greek word for “panting,” which is a symptom that occurs in several different pulmonary (lung) disorders.

Asthma was first described as a disease rather than a symptom by the English chemist Thomas Willis (1621–1675).

In 1698, Sir John Floyer (1649–1734) gave the first formal account of an asthma attack or “fit.” However, an accurate diagnosis of asthma was not possible until the early nineteenth century when the celebrated French physician René Laënnec (1781–1826) invented the stethoscope*.

During the early nineteenth century, asthma was treated in a variety of ways, including by taking whiffs of chloroform and even by the smoking of ordinary tobacco.

* **stethoscope** (STETH-o-scope) is a medical instrument used for listening for sounds produced in the chest, abdomen, and other areas of the body.

Exercise-related asthma Many people with asthma have trouble with noisy breathing during or after exercise, a condition known as exercise-induced asthma. Other symptoms include coughing, a rapid heartbeat, and a feeling of tightness in the chest five to ten minutes after exercise. For some people, exercise is the only asthma trigger. That means they only have asthma symptoms after exercise-like activities and do not have symptoms at any other time. Cold or dry air, high pollen counts, air pollution, a stuffed-up nose, and an infection of the airways are all factors that tend to make the problem worse. Types of exercise that may lead to wheezing include running, using a treadmill, and playing basketball—in short, exercises that are aerobic (designed to increase oxygen consumption).

Job-related asthma Occupational asthma is caused by breathing in fumes, gases, or dust while on the job. Asthma can start for the first time in a worker who was previously healthy, or it can get worse in a worker who already had the condition. Symptoms include wheezing, chest tightness, and coughing. Other symptoms that may go along with the asthma include a runny or stuffed-up nose and red, sore, itchy eyes. The asthma may last for a long time, even after the worker is no longer around the substance that caused it.

Severe attacks Status asthmaticus (STA-tus az-MAT-i-kus) is a severe asthma attack that does not get better when individuals take their medicine as usual. This kind of attack is an emergency that must be treated right away in a hospital or doctor’s office, where other medicines may be used.



An asthma patient uses a metered dose inhaler to deliver medication to his lungs. © by Leitha Etheridge-Sims.

How Is Asthma Diagnosed?

The doctor performs a physical checkup and ask questions about symptoms and when they occur. In addition, the doctor may do various tests to help identify asthma and its causes. Some of the tests are described below.

Allergy tests Allergy tests help identify those substances to which a person is allergic. Skin tests are most common. Tiny amounts of possible allergens are put on the skin, and the skin is checked to see which substances, if any, cause a reaction. In another type of allergy test, a blood sample is checked for certain antibodies, which are substances made in the blood that fight foreign or harmful substances. People with allergies may have high levels of immunoglobulin E (IgE) antibodies. However, the blood test is generally not considered as precise as the skin test, and it cannot check for as many allergens.

Chest x-ray An x-ray is an invisible wave that goes through most solid matter depending on its density and produces an image on film. After the film is developed, a special picture can be viewed that shows how the lungs and other structures look. An x-ray can help rule out other causes of wheezing.

Lung-function tests These tests show how well the lungs are working. In one test, the person blows into a device called a spirometer (spi-ROM-i-ter), which measures the amount of air going in and out of the lungs. Another test uses a peak flow meter to measure how fast the person can breathe air out of the lungs. A peak flow meter is a simple, hand-held device that can be used at home. Many people with asthma use peak flow meters regularly to check for early warning signs of an upcoming asthma attack. Doing so gives them time to take certain medicines that can often stop the attack.

Why Is Treatment Needed?

Asthma that is not under control can cause many problems. People miss school or work, must go to the hospital, and can even die (rarely) because of asthma. With a doctor's help, though, most people can control their asthma. People with well-controlled asthma have few, if any, symptoms during the day and can sleep well at night. They can also take part in their usual activities, including sports and exercise. However, asthma does not go away just because its symptoms do. Individuals need to continue taking care of their condition: avoiding triggers, not smoking, and living in a healthy, clean environment. Ongoing attention is required even in mild asthma cases.

How Is Asthma Treated?

Besides avoiding exposure to asthma triggers, asthma is mostly treated with medicines. There are two characteristics of asthma: inflammation and spasms (or constriction) of the muscles in the airways. Asthma

treatment focuses on both. Asthma medicines fall into two groups: those used to prevent symptoms and control the disease for a long time, and those that give short-term relief during an asthma attack. Taking the right medicine at the right time is important.

Long-term control medicines Long-term control medicines are taken every day to help prevent symptoms from starting. It may take several weeks for these medicines to produce their best results, though. The most effective ones work by reducing swelling in the airways. Many are inhaled (breathed into the lungs). Not everyone needs such medicines. However, they may be very helpful for people who have daytime asthma symptoms three or more times per week or nighttime symptoms three or more times per month. Medicines for long-term control of asthma include the following:

- **Inhaled corticosteroids*** (kor-ti-ko-STER-oids). These strong drugs prevent and reduce swelling in the airways. They also make the airways less sensitive to triggers. However, they work only if they are used regularly. These drugs are taken every day by people with long-lasting asthma. They are not the same as the unsafe steroids some athletes use to build muscles.
- **Other inhaled drugs.** These medications also help prevent and reduce swelling in the airways and make the airways less sensitive. However, it can take four to six weeks of regular use before they start to work. These drugs are taken every day by people with long-term asthma, but they can also be used before exercise or contact with a trigger.
- **Oral corticosteroids.** These drugs are taken by mouth in pill or liquid form. Unlike inhaled corticosteroids, they sometimes cause serious side effects when used for a long time. However, they can often be used safely for a short time to treat severe asthma attacks and to quickly bring asthma under control. They are sometimes taken every day or every other day by people with the most severe asthma.
- **Long-acting bronchodilators** (brong-ko-DY-lay-tors). These drugs relax the muscles around the airways, making breathing easier. They can prevent or reduce narrowing of the airways. However, they keep working only if they are used regularly. These drugs are inhaled or taken by mouth in a pill. Some are especially useful for preventing nighttime or exercise-related asthma.
- **Inhaled anticholinergics** (AN-tih-ko-lin-ER-jek). This medicine is a type of bronchodilator. It relaxes the muscles around the airways, making breathing easier. The medicine takes about an hour to work, so it should not when quick relief is needed. The drug can be breathed in using an inhaler or nebulizer. It works best when taken with a short-acting bronchodilator; however, it is not commonly used to treat asthma.
- **Leukotriene modifiers** (loo-ko-TRY-een). These drugs prevent and reduce swelling in the airways and make the airways less sensitive

* **corticosteroids** (kor-ti-ko-STER-oids) a group of adrenal-cortex steroids, such as cortisone, that are distinguished by their main biological activity.

Breathtaking Facts

- About 20 million people in the United States have asthma. Of these, about 9 million are children and teenagers.
- More than one in every ten children in the United States have asthma-like symptoms.
- About one in four children with serious asthma continue to have symptoms as adults.
- Asthma results in about 24.5 million lost days of work each year among adults.
- Children miss about 12.8 million school days each year because of asthma.
- According to the Centers for Disease Control and Prevention (CDC), between 1980 and 2004, the number of Americans who reported having asthma rose from 3 percent to 7 percent.
- During that same time, asthma rates among children increased from 4 percent to 12 percent.

to triggers. They also prevent squeezing of the muscles around the airways. These drugs are taken regularly by mouth in a pill.

- **Anti-IgE therapy.** This is a newer type of medicine that blocks the substances in the blood that cause allergy-related asthma symptoms. The drug is for people who have moderate to severe asthma symptoms that continue despite other treatments. In the early 2000s, anti-IgE therapy was only approved for persons age 12 and older. It is given by injection.
- **Allergy vaccines.** In some cases, a person's asthma symptoms can be prevented or lessened if the individual takes a course of special allergy injections over months or years. These shots contain small amounts of the allergens that trigger the person's asthma. The course of injections causes the person to become less sensitive to the allergen when exposed to it.

Short-term relief medicines Short-term relief medicines are taken only when needed to relax and open the airways quickly. They can be used to relieve symptoms or to prevent them if a person's peak flow meter readings begin to drop, signaling an upcoming asthma attack. However, the effects last for only a few hours. They cannot keep the symptoms from coming back the way long-term control medicines can. These drugs are inhaled and are taken at the first sign of trouble or before contact with a trigger.

Medicines that provide short-term relief of asthma are called short-acting bronchodilators. These drugs relax the muscles around the airways, making breathing easier. They begin to work within five minutes, and their effects last for four to six hours. Such drugs are taken right after symptoms start or just before exercise.

How Are Inhaled Medicines Taken?

Many asthma medicines are made to be breathed into the lungs. Such inhaled drugs go straight to the place where they are needed. The most popular device for taking inhaled medicines is a metered dose inhaler, which gets the drug to the lungs in exact amounts. The inhaler is a small, hand-held canister with a button that the person pushes to make the medicine spray out. Often a tube, called a spacer, is attached to the canister to make it easier to use.

Another type of device that is sometimes used to take inhaled medicines is a nebulizer (NEB-you-lyz-er), which turns liquid medicine into a very fine mist. These devices are helpful for babies, young children, and elderly or very sick adults who would have trouble handling a metered dose inhaler.

Breathing Easier

People with asthma should try to figure out what makes their symptoms worse and take steps to avoid or control those substances or situations. Here are a few ways that many people control some common asthma triggers. Not all of them will work for everyone.

Pollens and outdoor molds To control pollens and outdoor molds, people with asthma often do the following:

- keep windows and doors closed when pollen or mold spore counts are high
- avoid walking in gardens and fields when they are in bloom and when pollen and mold spore counts are highest
- ride with the car windows shut and the air conditioner on during pollen season
- ask their doctors about starting or increasing a long-term control medicine before peak pollen season begins

Indoor molds To control indoor molds, people with asthma often do the following:

- fix leaky faucets, pipes, and other sources of water
- clean moldy surfaces with a product that contains bleach
- remove wallpaper, which can have mold growing on it
- get rid of houseplants, which can gather mold and dust

Animal dander Dander is small scales from the hair of animals, such as cats, and from bird feathers. Some people are allergic to it, and people with asthma often take the following steps:

- keep pets with fur or feathers out of their homes, if possible
- have pets stay out of bedrooms, in particular, and keep bedroom doors closed
- remove carpets and cloth-covered furniture or keep pets away from these materials
- use polyester-fill rather than feather pillows and avoid down comforters

Dust mites People with asthma often find that they are allergic to dust because of the tiny animals that live in the dust, called mites. Many people with asthma find that it helps to keep their homes especially free of dust. For example, they take the following steps:

- wash their bedding each week in hot water (it must be hotter than 130 degrees F to kill mites)
- enclose mattresses and pillows in special dust-proof covers or wash pillows each week in hot water
- try not to sleep or lie on cloth-covered furniture or cushions
- remove carpets in bedrooms and those laid on concrete
- keep stuffed toys out of beds and wash the toys each week in hot water
- wear a dust mask while vacuuming or have someone else do the vacuuming

Winning Ways

Jackie Joyner-Kersey (b. 1962) has often been called the world's greatest female athlete. What many fans never suspect is that she is also an asthma patient. Joyner-Kersey became active in sports at age 9. As a teenager, she was an all-state player in basketball and a Junior Olympics champion in pentathlon, an athletic contest in which each person takes part in five different events. While still in high school, Joyner-Kersey began having trouble breathing. When she first found out that she had asthma, she did not take it seriously. She often skipped her medicine. After a serious asthma attack, though, she realized that she had to work to control the condition just as she worked to win at sports. After college, Joyner-Kersey went on to win six Olympic medals as well as to break the world and Olympic records in the heptathlon, an athletic contest with seven different events: 100-meter hurdles, high jump, shot put, 200-meter dash, long jump, javelin, and 800-meter race. In the early 2000s she served as a spokesperson for groups that educate the public about asthma.

Cockroaches Many people with asthma are sensitive to cockroach droppings and make a special effort to get rid of these stubborn creatures by taking the following steps:

- keeping all food out of bedrooms
- storing food and garbage in closed containers and never leaving food or crumbs sitting around
- using poison bait, powder, gel, paste, or traps (following label instructions) to kill cockroaches
- staying out of the room until the odor goes away if a spray is used to kill roaches

Certain foods and medicines It is important to do the following:

- avoid foods that have caused problems in the past
- tell the doctor about any past reactions to medicines

Smoke and strong odors Smoking is not good for people, not good for the person smoking or people who are in the same room with tobacco smoke. People with asthma are especially endangered by tobacco smoke and find it is best not to smoke, to ask other family members to quit smoking, and to ask visitors not to smoke.

People with asthma also do the following:

- avoid using a wood-burning stove, kerosene heater, or fireplace, if possible
- try to stay away from strong odors and fumes, such as perfume, hairspray, and fresh paint

Exercise It is healthy for just about everyone to exercise, and people with asthma are no exception. To make their exercise and sports activities more enjoyable, people with asthma usually do the following:

- warm up for six to ten minutes before exercising
- avoid exercising outside when air pollution or pollen counts are high or when the air is cold
- pick activities that do not cause symptoms (sports that involve running are the most likely to trigger problems)
- ask a doctor about taking medicine before exercise to prevent symptoms

▶ See also **Allergies • Chronic Obstructive Pulmonary Disease (COPD)**

Resources

Books and Articles

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Berger, William E. *Living with Asthma*. New York: Facts On File, 2008.

Thomas, Pat. *Why Is It So Hard to Breathe? A First Look at Asthma*. Hauppauge, NY: Barrons, 2008.

Organizations

Allergy and Asthma Network/Mothers of Asthmatics. 2751 Prosperity Avenue, Suite 150, Fairfax, VA, 22031. Toll free: 800-878-4403. Web site: <http://www.aanma.org>.

American Academy of Allergy, Asthma, and Immunology. 555 East Wells Street, Suite 1100, Milwaukee, WI, 53202. Telephone: 414-272-6071. Web site: <http://www.aaaai.org>.

American College of Allergy, Asthma, and Immunology. 85 West Algonquin Road, Suite 550, Arlington Heights, IL, 60005. Telephone: 847-427-1200. Web site: <http://www.acaai.org>.

American Lung Association. 1301 Pennsylvania Ave. NW, Suite 800, Washington, DC, 20004. Toll free: 800-LUNG-USA. Web site: <http://www.lungusa.org>.

Asthma and Allergy Foundation of America. 1233 Twentieth Street NW, Suite 402, Washington, DC, 20036. Toll free: 800-7-ASTHMA. Web site: <http://www.aafa.org>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/health/asthma.htm>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: <http://www.nhlbi.nih.gov>.

Astigmatism

Astigmatism (a-STIG-ma-tiz-um) is an eye condition that causes objects to appear blurry because the front part of the eye is misshapen.

What Is Astigmatism?

The eyeball usually is round and nearly the same size as a ping-pong ball. The front part contains a clear layer of tissue called the cornea and the lens that help to focus the light that enters the eye. When people have astigmatism, the cornea and/or the lens is misshapen, and their curved

* **retina** (RET-i-na) is the tissue that forms the inner surface of the back of the eyeballs; it receives the light that enters the eye and transmits it through the optic nerves to the brain to produce visual images.

surfaces are unequal. If the curve is just slightly off-shape, only objects at a distance may appear blurry. People with more serious astigmatism, however, may experience a distortion of all images.

Who Gets Astigmatism?

Astigmatism is a common problem that affects the shape of the cornea or lens and distorts vision. Often the degree of astigmatism is different in one eye than in the other. As of 2009, the cause of astigmatism was unknown. It usually is present at birth and often is found in several members of the same family, which means that in some cases the trait is probably inherited.

What Happens to Vision When People Have Astigmatism?

Variations in the shape of the cornea or lens cause a person with astigmatism to see images that are out of focus when they reach the eye's retina*. The retina is made of layers of light-sensitive cells at the back of the eyeball that act like the film in a camera. The distorted image is projected onto the retina and transmitted to the brain for processing through the optic nerve.

The first signs of astigmatism are determined by how severely the cornea or lens is misshapen. In mild problems, people with astigmatism may find that they have headaches or tired eyes at times or distorted vision at certain distances. In severe problems, people with astigmatism may find they have blurry vision that makes reading, playing sports, and other activities difficult. Often the problem is discovered during an eye exam in school, at the doctor's office during a check-up, or when a parent notices that a child is having trouble seeing clearly. Usually astigmatism does not worsen as a person gets older.

In many people, astigmatism is accompanied by nearsightedness (myopia) or farsightedness (hyperopia). In myopia and hyperopia, the eye is also shaped incorrectly. In the former, the eye is long and egg-shaped rather than round, or has a steep cornea, causing images to focus in front of, rather than on the retina. In hyperopia, the cornea is too flat or the eye is too short, causing images to focus behind the retina. Like astigmatism, these conditions disrupt proper vision.

What Is the Treatment for Astigmatism?

Astigmatism may be managed with prescription eyeglasses or so-called "toric" contact lenses. The latter are available in soft lenses and rigid gas-permeable (RGP) lenses, although some patients find that RGP lenses offer better visual acuity (sharpness). Both glasses and toric contact lenses help change the way that images are focused as they pass through the cornea and the lens, and both allow clear images to arrive at the retina.

Besides eyeglasses and contact lenses, astigmatism can be treated with refractive surgeries. One of the most common is the laser eye surgery called laser assisted in situ keratomileusis (LASIK), which reshapes the cornea and can correct both astigmatism and either nearsightedness or farsightedness. Other surgical options are conductive keratoplasty (CK),

which uses heat rather than a laser to correct vision and is sometimes recommended for patients over 40 years of age, and astigmatic keratotomy (AK), which involves incisions to help reshape the cornea.

Some people with astigmatism report some improvement after doing various eye exercises, but exercise alone cannot eliminate the need for other means of vision correction.

▶ See also **Blindness** • **Farsightedness** • **Nearsightedness**

Resources

Books and Articles

Astigmatism: A Medical Dictionary, Bibliography, and Annotated Research Guide to Internet References. San Diego, CA: ICON Health Publications, 2003.

Organization

American Optometric Association. 243 N. Lindbergh Boulevard, St. Louis, MO, 63141. Web site: <http://www.aoa.org/Astigmatism.xml>.

National Eye Institute. 2020 Vision Place, Bethesda, MD, 20892-3655. Telephone: 301-496-5248. Web site: <http://www.nei.nih.gov>.

Atherosclerosis See *Heart Disease*.

Athlete's Foot

Athlete's foot is a skin infection caused by a fungus. It affects the soles of the feet and the spaces between the toes.

What Is Athlete's Foot?

The human body is home to many different kinds of fungi*. Most never cause a problem. Athlete's foot is caused by one group of fungi called dermatophytes (der-MA-to-fites), which are microorganisms* that live on the skin, hair, and nails. Dermatophytes need a warm, moist environment to survive and to reproduce, such as the feet of athletes, for example. But in fact, anyone with wet or sweaty feet may be prone to getting athlete's foot. Athlete's foot is also called tinea pedis (TIN-e-a PED-is), or ring-worm of the foot.

* **fungi** (FUNG-eye) are microorganisms that can grow in or on the body, causing infections of internal organs or of the skin, hair, and nails.

* **microorganisms** are tiny organisms that can only be seen using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

How Do People Get Athlete's Foot?

Athlete's foot is somewhat contagious*, and the most common places where people catch it are also the dampest ones: public showers, pool areas, wet towels, and bath mats. People who wear the same shoes or sneakers all the time are more likely to develop athlete's foot, as are people who wear shoes or socks made from certain synthetic* materials such as rubber, vinyl, or nylon. Anything that keeps the feet warm, wet, and sweaty gives the fungus an opportunity to grow and survive.

What Are the Signs and Symptoms of Athlete's Foot?

Athlete's foot is a condition with very specific symptoms, and these symptoms can be mild or intense, depending on the case and the person. A person with athlete's foot may feel burning and stinging on the soles of the feet and in between the toes. The skin can feel very itchy as well. The fungus causes the skin to become red, flaky, or soggy. Sometimes the skin can become cracked.

How Do Doctors Diagnose and Treat Athlete's Foot?

Diagnosis When examining a patient with athlete's foot, a doctor usually has an easy time making a diagnosis because the fungi that cause skin problems are usually easy to recognize. Just to be sure, the doctor may take a small scraping of skin to gather some of the fungus. The fungus can then be cultured, or grown, in a small dish in a laboratory, which gives the doctor an opportunity to identify the fungus, if present.

Treatment Most cases of athlete's foot can be cured with antifungal creams or sprays, which are put directly on the skin to kill the fungus. Many of these creams and sprays are available without a prescription at drugstores. If athlete's foot persists, doctors may prescribe stronger antifungal creams than those available over the counter or possibly an antifungal medication to be taken orally. If a bacterial infection has developed along with the fungal infection, then the doctor may also prescribe an antibiotic to kill the bacteria.

How Do People Prevent Athlete's Foot?

People who tend to get athlete's foot can take some simple measures to help prevent it. The most important one is to keep their feet as dry as possible because the fungi that cause athlete's foot do not grow well in dry places. Taking a few extra minutes to dry feet thoroughly after showering, bathing, and swimming can help a lot. Other methods of prevention are:

- Wearing sandals and not going barefoot around a pool area or a public shower
- Wearing shoes that are well ventilated, such as sneakers with small holes on their tops or sides to let air in and out

- Wearing shoes and sneakers made of leather rather than of synthetic materials such as vinyl and nylon
- Wearing cotton or wool socks rather than polyester socks
- If possible, not wearing the same pair of shoes or sneakers every day, as switching between pairs gives shoes a chance to dry out after being worn.

Those people who are particularly prone to athlete's foot may find they can keep the fungi away by using antifungal powders on their feet every day.

▶ See also **Fungal Infections** • **Ringworm**

Resources

Books and Articles

Richardson, Malcolm D., and Elizabeth Johnson. *Pocket Guide to Fungal Infection*. Malden, MA: Blackwell, 2005.

Organization

American Podiatric Medical Association. 9312 Old Georgetown Road, Bethesda, MD, 20814-1621. Toll free: 800-366-8227. Web site: <http://www.apma.org>.

Attention Deficit Hyperactivity Disorder (ADHD)

Attention is the mental process in which a person concentrates awareness on a specific object, issue, or activity and excludes other potential stimuli from the environment. Attention Deficit Hyperactivity Disorder (ADHD) is a common developmental disorder that affects both children and adults, although it is usually diagnosed in childhood. ADHD affects a person's ability to study, learn, work, play, and even socialize with others. People with ADHD are less able to sit still, plan ahead, organize and finish tasks, and tune in fully to what is going on around them than are people without the disorder.*

A Tale of Two Students

Justin and Katie are both seventh-grade students with ADHD. However, they act quite differently at school. Justin has a very hard time sitting still and staying in his seat. His classmates and teachers think of him as "hyper." Justin gets bored easily, so he tends to talk too much and get

* **stimuli** (STIM-yoo-lie) are things in the environment that excite a person to function, become active, or respond. The singular form is stimulus.

* **hyperactivity** (hy-per-ak-TI-vi-tee) is overly active behavior, which makes it hard for a person to sit still.

into trouble. He also bothers the other students, which leads them to get angry at him.

Katie does not wiggle and fidget the way Justin does. But she has similar difficulty keeping her mind on her work and paying attention to the teacher. Katie also forgets which assignments she is supposed to do. She finds it tougher than most to keep track of her backpack, books, and school supplies. Sometimes she loses her homework, and sometimes she just forgets to turn it in.

Just about every classroom in the United States has students like these. Experts believe that about 5 percent of students, or one in 20, have a form of ADHD. Boys are three to four times more likely than girls to be affected by ADHD. Of course, everyone has a hard time paying attention and staying focused now and then, but students with ADHD have this problem more often and to a greater degree.

What Is Attention Deficit Hyperactivity Disorder?

Attention Deficit Hyperactivity Disorder (ADHD, also called ADD) is a condition that causes poor attention span, easy distractibility, hyperactivity*, and impulsiveness. People with ADHD may have only one or two of these problems, or they may have all of them. Those with an attention problem have a hard time keeping their mind on any one subject for long. They may get bored with a task after only a few minutes. People who are hyperactive seem to be in constant motion. They may feel restless and squirm or fidget a lot. People who are overly impulsive seem not to think before they speak or act. They may blurt out embarrassing comments without thinking or take dangerous risks. The symptoms usually begin before seven years of age, although they may not be recognized as signs of ADHD until later. The behaviors associated with ADHD can lead to trouble with school; work; or relationships with family, friends, and teachers.

Difficulties caused by ADHD often improve during the late teen years and adulthood. Many adults are left with only a few signs of ADHD, but a few still have the full disorder. People with ADHD do not outgrow the condition. While they often become less hyperactive when they get older, people with ADHD may still have problems with restlessness and short attention span. By using certain coping strategies, many people with ADHD learn to deal with the condition successfully and can achieve in school and thrive in rewarding careers. Many people are able to find the right kind of job for their strengths and abilities. For example, a person might be better suited for a position that offers variety and constant change rather than one that requires long periods at a desk.

What Causes Attention Deficit Hyperactivity Disorder?

Doctors and researchers are not sure why certain people have ADHD. Theories have focused on various possible causes, such as diet, head injuries, exposure to drugs before birth, and even family and home environment.

However, none of these theories offers a satisfactory explanation for most cases of ADHD.

Researchers interested in learning about possible biological causes of ADHD have looked at how the brains of people with ADHD may function differently than other people's brains. Neuroscientists, or scientists who study the brain and nervous system, believe that attention is largely a function of the brain's reticular activating (re-TIK-yoo-lur AK-ti-vay-ting) system, or RAS. This system includes a group of nerve fibers located in several parts of the brain, including the thalamus*. Within the RAS, the thalamus appears to play a key role in the moment-to-moment changes in the focus of attention. The thalamus and cerebral cortex cooperate to register any incoming sensory signals, evaluate their contents, and mobilize brain resources in response to the demands made. Put simply, the thalamus receives the messages that comes through a person's senses and then relays the information to the proper receiving areas in the brain.

Using a special scanning test called a positron emission tomography, or PET scan, researchers can watch the brain as it works. The test lets them see how much glucose, a type of sugar, is used by the areas of the brain that inhibit impulses and control attention (glucose is the brain's main source of energy). Some studies have found that the areas of the brain that control attention use less glucose in people with ADHD, which means that these areas of the brain appear to be working less hard. Other researchers speculate that ADHD has something to do with differences in the neurotransmitters* that deliver signals to the brain areas that control attention. Some research also suggests that use of alcohol or drugs by the mother during pregnancy can harm development of the baby's brain cells. Such maternal choices may be one cause of ADHD, although it is

* **thalamus** (THAL-uh-mus) refers to a pair of large egg-shaped areas located in the middle of the brain just under the cerebral cortex. The plural form is thalami.

* **neurotransmitters** (nur-o-trans-MIH-terz) are chemical substances that transmit nerve impulses, or messages, throughout the brain and nervous system and are involved in the control of thought, movement, and other body functions.



A boy with Attention Deficit Hyperactivity Disorder receives one-on-one instruction with his teacher. The method of teaching a child according to his or her own special way of learning is an effective way of managing ADHD.
Ellen B. Senisi/Photo Researchers, Inc.

* **identical twins** are twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.

* **psychiatrist** (sy-KY-uh-trist) is a medical doctor who has completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can diagnose mental illnesses, provide mental health counseling, and prescribe medications.

likely there are many causes. A person's genetic makeup may be involved. ADHD seems to run in families. Children with ADHD usually have at least one parent, sibling, or other close relative with the disorder. Scientific studies have also found that if one identical twin* has ADHD, the other twin is likely to have it as well.

What Does *Not* Cause Attention Deficit Hyperactivity Disorder?

Experts used to think that attention problems were caused by slight brain damage or minor head injuries. However, most people with ADHD have no sign of brain damage or history of head injury. Another theory was that overactive behavior was caused by refined sugar and food additives. However, scientists found that eating a special diet seemed to help only about 5 percent of children with ADHD, mostly very young children or those with food allergies. It is true, however, that too much caffeine (found in coffee, tea, and some sodas) or some red/yellow dyes can intensify hyperactive behaviors.

How Is Attention Deficit Hyperactivity Disorder Diagnosed?

Many factors besides ADHD can cause similar kinds of problems. For example, depression can lead to trouble paying attention, and anxiety can make it hard to sit still. A learning disability can lead to poor school performance, and small seizures can cause mental lapses. Even an ear infection that leads to on-again-off-again hearing loss can cause behaviors that look like ADHD symptoms. In addition, everyone has trouble staying focused and getting organized at times. For these reasons, ADHD needs to be diagnosed by a trained medical or mental health professional.

Diagnosing ADHD is difficult because symptoms vary, and no single test can determine whether someone has ADHD. In most cases, parents notice early on that their child is much less attentive or has less control over his behavior than other children. However, the disorder usually is not diagnosed until the child enters school and is expected to follow directions, cooperate with others, and be quiet at certain times.

To make the diagnosis, a psychologist or psychiatrist* looks for patterns of certain behaviors that have lasted for more than six months and interfere with two or more areas of a person's life (such as school and play, school and home, or home and work). In addition to interviewing the child and family members, the specialist may need to speak with others who know the child well, such as teachers and coaches. Former teachers may be asked to fill out an evaluation. Special tests may also be administered to clarify the diagnosis.

The behaviors that experts look for fall into three categories: inattention, hyperactivity, and impulsivity. Signs of inattention in a child include:

- Failure to pay close attention to details
- Difficulty in sustaining attention in work and play

- Seeming not to listen when spoken to directly
- Failure to follow through on instructions and finish tasks
- Difficulty organizing tasks and activities
- Avoidance, dislike, or seeming reluctance to engage in tasks that require concentration
- Likelihood to be distracted by peripheral sights and sounds
- Tendency to lose things
- Tendency to forget things

Hyperactivity refers to overly active behavior. Children experiencing hyperactivity might engage in the following:

- Fidgeting with their hands or feet
- Squirming while seated
- Leaving their seat in the classroom and elsewhere
- Running about or climbing excessively
- Having difficulty playing or engaging in leisure activities quietly
- Seeming constantly on the go or acting as if driven by a motor
- Talking excessively

An impulsive child might engage in the following:

- Blurting out answers before questions have been completed
- Interrupting or intruding on others
- Having difficulty waiting his or her turn

Not everyone with ADHD has all of the above symptoms. There are three kinds of ADHD that are commonly recognized. People who have significant problems with attention but are not really hyperactive or impulsive are diagnosed with ADHD-Inattentive Type. Those who have problems mainly with hyperactivity and impulsivity are diagnosed as having ADHD-Impulsive Hyperactive Type. Individuals with significant problems with impulsivity, hyperactivity, and attention are diagnosed with ADHD-Combined Type.

Children with ADHD may have other behavioral disorders as well. These may include oppositional defiant disorder*, depression*, anxiety*, and delays in learning speech and language.

How Is Attention Deficit Hyperactivity Disorder Treated?

Usually, ADHD is first treated with behavioral (be-HAY-vyor-ul) therapy, which involves working with a psychologist or psychotherapist* to learn ways of coping with the condition. The therapist can help people become more aware of their behavior, develop strategies for controlling it, and even help them practice how to deal with situations that caused problems in the past. A person also might find it helpful to participate in a support group with others who have similar difficulties.

* **oppositional defiant disorder** (op-uh-ZIH-shun-ul de-FY-unt dis-OR-der) is a disruptive behavior disorder that can be diagnosed in children as young as preschoolers who demonstrate hostile or aggressive behavior and who refuse to follow rules.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.

* **psychotherapist** (sy-ko-THER-a-pist) is any mental health professional who works with people to help them change thoughts, actions, or relationships that play a part in their emotional or behavioral problems.

Can Food Cause Hyperactivity?

Anyone who drinks too much cola or coffee is likely to have a hard time concentrating, because caffeine can overstimulate the brain. At one time, mental health specialists believed that sugar and other food additives actually contributed to ADHD. As a result, parents were encouraged to stop serving children foods containing artificial flavorings, preservatives, and sugars. It was thought that this restricted diet could actually prevent or cure the symptoms of the condition. Later, researchers abandoned this theory.

* **stimulant** (STIM-yoo-lunt) a drug that produces a temporary feeling of alertness, energy, and euphoria.

* **side effects** are unwanted symptoms that may be caused by vaccines or medications.

Parents and teachers are involved in the treatment plan as well. Parents can learn how to establish more structure for the child, define limits more clearly, and be consistent with discipline, all of which are especially important for a child with ADHD. Teachers can provide predictable routines and structure in the classroom and try to keep the student away from distractions. Both parents and teachers can establish certain penalties and rewards to help the child make progress with behavior.

If these strategies are not effective enough in controlling the condition on their own, then a psychostimulant (SY-ko-STIM-yoo-lint) medication such as methylphenidate (meth-il-PHEN-uh-date; Ritalin, Concerta, Methylin, Metadate), dextroamphetamine (dex-tro-am-PHET-uh-meen; Dexedrine, Dextrastat), or mixed amphetamine salts (Adderall) might be prescribed. It may seem strange that an inattentive, overly active person would be treated with a stimulant*. However, these medications work by stimulating certain areas of the brain that make it possible for many people with ADHD to concentrate, behave more consistently, and take part in activities that were impossible before. These drugs may work to control ADHD by increasing the amount and activity of some of the brain chemicals known as neurotransmitters. The behavior and general functioning of nine out of ten typical children with ADHD improve when the individuals take one of these drugs. If one stimulant medicine does not help, another can be tried.

When taken as directed by a doctor, stimulant medicines are considered safe. They usually do not make the patients “high” or jittery. However, they may cause other unwanted side effects*. Some patients may lose weight, feel less hungry, or grow more slowly. Others may have trouble falling asleep. If such side effects occur, they can often be handled by changing the dose or drug. A doctor needs to track closely the growth of any patient taking these medicines.

Why Is Attention Deficit Hyperactivity Disorder Diagnosed More and More Frequently?

More children than ever before are being diagnosed with ADHD-Predominantly Impulsive Hyperactive Type or ADHD-Predominantly Inattentive Type. In addition, the use of stimulant medications increased dramatically during the 1990s; according to one estimate, production of these medications increased by 700 percent between 1990 and 1997. There is some disagreement over why these patterns occurred. Some people think that greater awareness of the condition led more teachers to suspect problems among their students and more parents to seek help for their children. Others believe that some cases of bad behavior were misdiagnosed as ADHD. Some argue that parents may find it easier to accept that their child has a mental disorder rather than learn how to deal with unruly behavior or poor school performance due to other reasons. The debate continued, but as of 2009 experts agreed that ADHD is a real condition that can have serious consequences if it is not diagnosed and managed appropriately.

Strategies for Living with Attention Deficit Hyperactivity Disorder

The National Institute for Mental Health, the Federal agency for research on mental disorders, recommends the following strategies for living with ADHD:

- When necessary, ask the teacher or boss to repeat instructions instead of guessing about what was said.
- Break large assignments or job tasks into small, simple tasks. Set a deadline for each task and provide rewards for each completed task.
- Each day make a list of what needs to be done. Plan the best order for doing each task then make a schedule for doing them. Use a calendar or daily planner.
- Work in a quiet area. Perform one activity at a time. Take short breaks.
- Keep track by using a notebook with dividers. Write different kinds of information, such as assignments, appointments, and phone numbers, in different sections. Keep the book on hand.
- Post reminders of what needs to be done.
- Store similar objects together.
- Create a routine. Get ready for school or work at the same time, in the same way, every day.
- Exercise, eat a balanced diet, and get enough sleep.

▶ See also **Brain Chemistry (Neurochemistry)** • **Learning Disabilities** • **Oppositional Defiant Disorder**

Resources

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Quinn, Patricia O., and Judith M. Stern. *Putting on the Brakes: Understanding and Taking Control of Your ADD or ADHD*, 2nd ed. Washington, DC: Magination Press, 20091.

Organizations

ADDvance. 1001 Spring Street, Suite 118, Silver Spring, MD, 20910. Toll free: 888-238-8588. Web site: <http://www.addvance.com>.

ADD Warehouse. 200 NW Seventieth Avenue, Suite 102, Plantation, FL, 33317. Toll free: 800-233-9273. Web site: <http://www.addwarehouse.com>.

Children and Adults with Attention-Deficit/Hyperactivity Disorder. 8181 Professional Place, Suite 201, Landover, MD, 20785. Web site: <http://www.chadd.org>.

National Attention Deficit Disorder Association. 9930 Johnnycake Ridge Road, Suite 3E, Mentor, OH, 44060. Telephone: 440-350-9595. Web site: <http://www.add.org>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC, 9663, Bethesda, MD, 20892-9663. Web site: <http://www.nimh.nih.gov>.

Atypical Mycobacterial Infections *See Mycobacterial Infections, Atypical.*

Autism

Autism (AW-tiz-um) is a brain disorder that affects an individual's ability to develop normal communication skills and social responsiveness to other people. An infant with autism may seem to behave unusually from birth or may develop normally for a short time and then show autistic traits. To diagnose autism, symptoms must appear before the child is three years of age. Autism is part of a larger category of disorders called pervasive developmental disorders, all of which affect the brain's development.

A World of His Own

From a young age, Jamie was not very talkative and often looked down or away when someone talked to him. He also seemed to spend a lot of the time by himself. Although many people felt that he was just shy, Jamie was

diagnosed with autism. Children with autism may appear to be shy, but shyness and autism are very different. Shy children are quiet, but they do talk to people some of the time, especially to family members and friends with whom they feel comfortable, and they like to be around people some of the time. Autistic children prefer to be alone and isolated.

The symptoms of autism can range from mild to severe. Children with the most extreme forms of autism are almost totally isolated socially. Lacking the ability to relate normally to others, they always prefer to be alone. Even within their own family, they seldom make eye contact or try to share their interests in toys or other objects. Many children with autism never learn to talk. If they do, they use language in unusual ways, such as by constantly repeating rhymes or jingles. They may refer to themselves by their own name, or as “you,” instead of using “I” or “me.” Sometimes they repeat what someone has said to them rather than replying in a more typical way. Some children with autism may have above-average language skills, but often they do not use this ability to have conversations with others.

Like many children with autism, Jamie was concerned with order. Even as a young child, he kept his toys in the exact same spot on his shelves and would become angry if anything was moved. He might throw toys, break dishes, or even kick his mother. Most of the time, though, Jamie ignored other people. He seemed to live inside his own head. When his immediate environment became noisy or confusing, Jamie would bite himself until he bled. When Jamie started school, he was put in a special class where the atmosphere was calm and his activities were carefully planned. By the time he was 14, Jamie seemed more relaxed. He would talk to others if they talked to him first. He was also taking medicines that helped him control his anger. However, he still liked everything to be orderly.

What Is Autism?

Autism is a brain disorder that isolates individuals in worlds of their own. It can lead to a wide range of unusual behaviors. People with autism have trouble communicating with and relating to others. They are unable to understand other people’s thoughts, feelings, and needs. In many cases, language and intelligence are affected, and people with autism may have a limited number of interests and activities.

Many people with autism repeat the same actions, such as rocking or twirling their hair, for long periods. Some hurt themselves by banging their heads or biting their arms. Others seem painfully sensitive to touch, sound, taste, or smell. They may find any form of physical contact repugnant. Children with autism may refer to themselves by name instead of “I” or “me.” Some speak in a singsong voice.

What Are Some Other Signs of Autism?

Children with autism often behave in unusual ways. Their activities are limited, and they may become extremely upset if there is some change in their environment or daily routine. For example, some may have temper

Thinking in Pictures

Temple Grandin, the gifted animal scientist, invented equipment for handling livestock, wrote books, and gave lectures. Yet as a child, Grandin had many of the signs of autism. As a baby, she stiffened when picked up and struggled to be put down. By age 2, she was sometimes overpowered by her ultra-sharp senses. She screamed, flew into rages, and threw objects. At other times, she found that focusing intently on one object, such as an apple or her hand, made her feel calmer and safer. Her mother put Grandin in a special class with strict routines designed for children with speech problems. By age 4, Grandin had started to speak, and by age 5, she could go to regular school. As an adult, she recalled her experiences in a book called *Thinking in Pictures*. The book begins: “I think in pictures. Words are like a second language to me.” Grandin used the way her brain worked to imagine how the parts of complicated equipment she invented fit together.

* **mental retardation** is a condition in which people have below average intelligence that limits their ability to function normally.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **Asperger's syndrome** is a pervasive developmental disorder. Like autism, Asperger's syndrome is a developmental condition in which a child does not learn to communicate and interact socially with others in a typical way. Children with Asperger's syndrome have normal intelligence and generally good language development.

* **neurotransmitters** (nuro-trans-MIH-terz) are chemical substances that transmit nerve impulses, or messages, throughout the brain and nervous system and are involved in the control of thought, movement, and other body functions.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **identical twins** are twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.

tantrums if a piece of furniture in their room is moved or if they are put at a different place at the dinner table.

Characteristic behaviors may include repetitive motor acts such as arm flapping, finger twisting, rocking, and walking on tiptoes. Some of these motions may be repeated for continuously for hours. Children with autism may also exhibit hyperactivity, fits of screaming, or self-injury, such as head banging. Often children with autism fear harmless objects, such as a vacuum cleaner, but fail to perceive real dangers, such as crossing a busy highway. They may also be oversensitive to noises, lights, and odors, and they may dislike being touched. Many children with autism also have mental retardation*. About one in four individuals with autism may develop seizures* by the time they reach their teens.

How Common Is Autism?

Autism occurs in people all over the world of every race and background. Estimates are that 2 to 10 out of every 10,000 people have autism. However, it may affect as many as 20 per 10,000 (or 1 in 500) if Asperger's syndrome* and other pervasive development disorders are included. Prevalence estimates have tended to increase along with increased public awareness of autism and Asperger's syndrome. Rates of autism are three to four times higher in boys than in girls. However, girls with autism tend to have more severe symptoms and lower intelligence.

What Causes Autism?

Autism is not transmitted from one person to another like a cold, so it is impossible to catch it from someone else. However, no one knows what causes autism. One incorrect explanation popular until the 1970s stated that autism resulted from a poor mother-child relationship in infancy. Later, researchers suspected that autism is caused by abnormal development of the brain before birth. However, as of the early 2000s, scientists had not discovered the exact cause of the abnormality.

Some studies suggested that autism may result from defects in the action of brain neurotransmitters*. Other studies indicated that brain cells and their connecting fibers may not grow properly in infants who develop autism. It is likely, however, that genes* have some role in causing autism. Parents who have one child with autism are more likely to have other children who have it (when compared to families who do not have children with autism). Identical twins* (who share the same genes) have a high rate of similarity regarding the problem. In other words, if one twin has the condition, the other is likely to have it too. If there is an autistic child in the family there is a higher rate of other developmental problems such as language and learning disabilities in siblings. Also, autism is more common among people with the chromosomal disorder known as fragile X syndrome*. Autism does not seem to be caused by one particular gene. Some scientists have speculated that autism may be due to a cluster of faulty genes. In most cases, these genes cause only mild symptoms, such as reading problems, but under certain conditions, autism may result.

What Other Disorders May Occur?

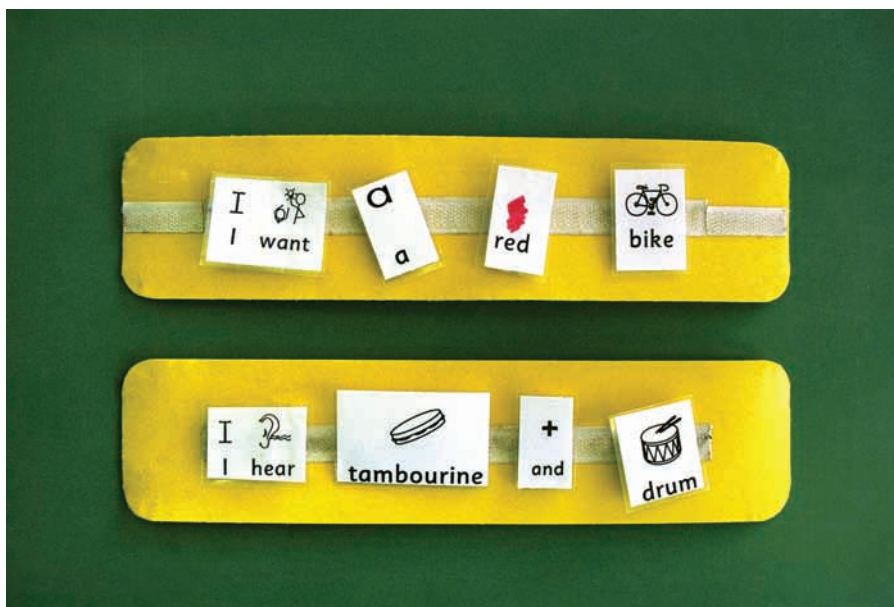
Other disorders often go along with autism:

- **Mental retardation.** Many people with autism are mentally retarded to some degree, which means that their intelligence is below average.
- **Seizures.** A seizure is a sudden burst of uncontrolled electrical activity in the brain that can range from brief blackouts to convulsions (intense, uncontrolled muscle spasms throughout the body). About one-third of children with autism have seizures, which can be controlled with medicine.
- **Fragile X syndrome.** This disorder is associated with a faulty X chromosome. About one out of 10 people with autism, mostly males, have fragile X syndrome, which causes mental retardation.
- **Asperger's syndrome.** Children with Asperger's syndrome, considered a mild form of autism, have a consuming interest in, or obsession with, one subject—often something unusual for their age. They generally have average or above-average intelligence and impressive verbal skills but lack nonverbal and social skills.

* **fragile X syndrome** is a disorder associated with a faulty X chromosome (a chromosome is a structure inside the body's cells that contains DNA, which is the genetic material that helps determine characteristics such as hair and eye color; females have two X chromosomes whereas males have only one). Fragile X syndrome is associated with mental retardation, especially in males.

What Are the Symptoms of Autism?

The symptoms of autism can range from mild to severe. In some children, hints of future problems are apparent at birth and become more noticeable as the child's development lags behind that of other children. In others, everything seems fine at first, but between 18 months and 3 years of age, the child starts to reject others and may seem to slip backward in development.



There are many tools like this picture exchange communication system which help the language skills of autistic children. *Adrian Sherratt/Alamy.*

Autism Is Not Schizophrenia

The term “autism” was introduced by the psychiatrist Eugen Bleuler (1857–1939) in 1911 to refer to a group of symptoms observed in people with schizophrenia. Bleuler described the symptoms as “detachment from reality,” with a “pre-dominance of inner life” withdrawn from the external world.

The Johns Hopkins psychiatrist Leo Kanner (1894–1981), founder of child psychiatry as a medical specialty, first identified autism as a disorder distinct from schizophrenia. Kanner believed that people with autism had not withdrawn from participation in the external world but that autism was a fundamental inability to relate from the beginning of life. In 1944 he designated the condition as “early infantile autism.”

Communication Healthy babies look at other people’s faces and react to sounds. Babies with autism avoid eye contact and seem unable to hear. They may start making speech sounds, then suddenly stop. About half of people with autism are never able to speak; others may start talking as late as age 5 to 8 years of age.

Those who do speak often use language in unusual ways. For example, they may repeat the same word or phrase or speak only in single words. Some children with autism have echolalia (ek-o-LA-lee-a), which means they repeat what they hear. Some speak in a singsong or robot-like voice.

People with autism also have trouble communicating with body language. Most people smile when talking about subjects they like or shrug when they cannot answer a question. People with autism often do not use their faces and bodies in these typical ways, and their tone of voice may not indicate their true feelings.

Relationships Usually, babies smile at familiar faces, and past the age of 7 to 9 months they show signs of fear around strangers. Babies with autism act as if they are unaware of the comings and goings of other people. They may seem impossible to reach. Some resist hugs and cuddling. Others accept physical contact but do not hug back. Older children with autism rarely seek love and comfort from others.

Children with autism also have trouble understanding what other people are thinking or feeling, and they are unable to imagine the point of view of someone else.

Interests Babies are fascinated by the world around them. They reach for objects and play with toys, constantly moving from one to another. Babies with autism often seem stuck on one activity. They may repeat one movement, such as rocking back and forth or flicking their fingers. Children with autism may also become obsessed with certain objects. For example, a child who is obsessed with watches might grab strangers’ arms to look at their wristwatches.

Senses Many people with autism seem painfully sensitive to touch, sound, taste, or smell. They might cover their ears and scream at the sound of a vacuum cleaner. Other senses may be extremely dull. Some children with autism do not seem to notice extreme cold or pain, to the point where they might break an arm and never cry.

Talents Some people with autism have remarkable talents. For example, at an early age, when other children are drawing lines and scribbles, some children with autism can draw detailed, realistic pictures. Other children learn to read before they even start to speak. Still others can play a song on the piano after hearing it once. A few people with autism can even memorize whole television programs or pages of the phone book. These people are sometimes called autistic savants (“savant” comes from the French word for “knowing”).

How Is Autism Diagnosed and Treated?

There is no specific test for autism. Parents may first suspect that something is wrong if the child does not respond to them and dislikes cuddling or being held. Physicians need to rule out other disorders that have similar symptoms, such as deafness or mental retardation. To diagnose autism, doctors and psychologists* ask parents about the child's early development and observe how the child behaves, communicates, and relates to others.

Treatment is most effective when it is begun at an early age. Educational treatment is often intense, time-consuming, and highly individualized in order to fit the varied skills and disabilities in individuals with autism. Behavioral treatments use rewards to establish new skills. Developing a communication system is important for successfully treating autistic behavior. Special education programs tailored to individual needs teach ways to better communicate and interact with others. For children with mild autism, educators reinforce existing skills and interests and build on them. Basic living skills, such as personal cleanliness and crossing the street safely, are also taught. Medications can decrease seizures, if present, and ease anxiety* and repetitive behaviors.

Behavioral treatments Some treatments focus on using rewards to teach new skills, then using the new skills to replace problem behaviors. Others build on the particular interests, skills, and needs of a child. Studies have shown that such treatments are more likely to work if they involve a regular routine and planned activities and teach tasks as a series of simple steps. It also helps if the parents are involved, and with training, parents can continue the treatment at home.

Medicines No medicine can fix the brain problems that seem to cause autism. However, doctors may prescribe medications to reduce symptoms such as head banging or violent outbursts. Some medications also decrease seizures and lessen problems related to paying attention. Most such drugs affect the amount of signaling chemicals, such as serotonin* in the brain.

Special education Special education classes can help a child with autism learn as much as possible. Some master simple skills such as dressing and handling money. Others learn to read, write, and do math. Many people with autism finish high school, and a few even earn college degrees. The sooner a child gets help, the greater the chance for learning to occur.

Living with Autism

Autism is not outgrown; children with the disorder usually are affected by it to some degree when they grow up. With special education and communication training, many people with autism can learn to lead a more nearly normal life. Some with milder autism may even finish high school and go on to college. Many, however, are unable to live and work independently and always need special care.

The Real “Rain Man”

In the movie *Rain Man*, actor Dustin Hoffman portrays an autistic savant, a person with mental deficiencies who is exceptionally gifted in one area. To prepare for the role, Hoffman studied real-life “rain man” Joe Sullivan. Like Sullivan, Hoffman's character insists on eating cheese puffs with toothpicks and repeatedly mutters the same comments to himself. Also like Sullivan, the character can do complicated math in his head and name the day of the week for any date past or future. When the movie came out in 1988, Sullivan was a high school graduate who held a job shelving books at a library.

* **psychologists** (sy-KOL-o-jists) are mental health professionals who treat mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth. Psychologists also study the brain, behavior, emotions, and learning.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.

* **serotonin** (ser-o-TO-nin) is a neurotransmitter, a substance that helps transmit information from one nerve cell to another in the brain. It is associated with feelings of well-being.

▶ See also **Pervasive Developmental Disorders: Overview**

Resources

Books and Articles

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Organizations

- Autism Research Institute.** 4182 Adams Avenue, San Diego, CA, 92116. Telephone: 619-281-7165. Web site: <http://www.autism.com>.
- Autism Society of America.** 7910 Woodmont Avenue, Suite 300, Bethesda, MD, 20814-3067. Toll free: 800-3AUTISM. Web site: <http://www.autism-society.org>.
- Centers for Disease Control and Prevention.** 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncbddd/autism>.
- National Institute of Mental Health.** Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464.

Web site: <http://www.nimh.nih.gov/health/publications/autism/complete-publication.shtml>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD 20824. Web site: http://www.ninds.nih.gov/disorders/autism/detail_autism.htm.

Avian Influenza

Avian influenza is found chiefly in birds, but can occur in humans.

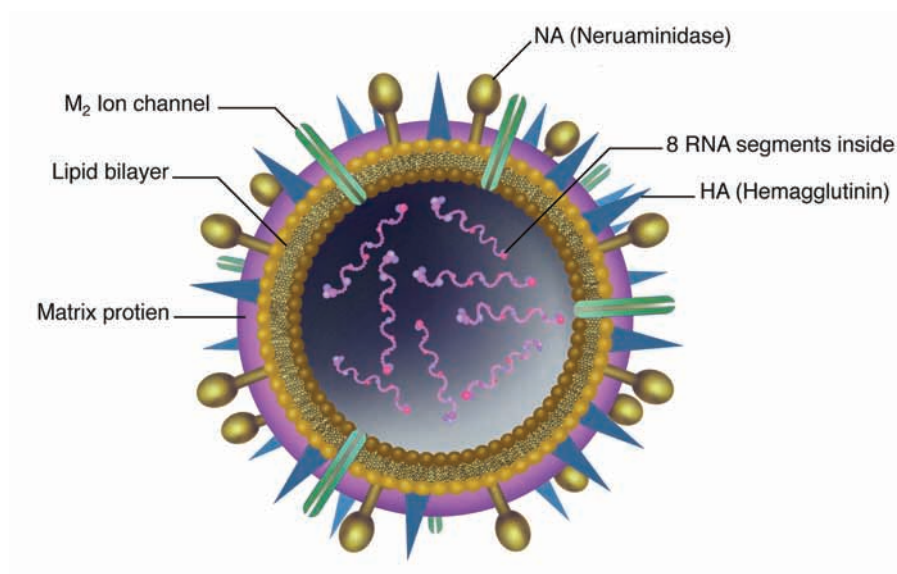
Marti's Story

Marti had wanted a pet parrot for years, and she was delighted when her parents gave her one for her birthday. Excited, she called her friend Jen and asked her to come over to see the bird.

Jen refused. "I don't want to get sick," she said.

"What are you talking about?" Marti asked.

"Don't you watch the news? People in Asia are getting sick just from touching birds. Some are even dying. I'm not going to take that chance. And if you were smart, you'd get rid of that bird before you get sick, too." Jen had seen reports about avian influenza, but she didn't have all the facts. She didn't have anything to fear from Marti's new pet.



A model of the H5N1 virus that causes avian influenza. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. Viruses can only reproduce within the cells they infect.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

* **nasal** (NA-zal) of or relating to the nose.

What Is Avian Influenza?

Avian influenza, which was first isolated from a duck in Guangdong Province in China in 1996, is an infection caused by viruses* that occur naturally among birds. Wild birds carry these viruses in their intestines, and if domestic birds come into contact with wild bird feces*, saliva, or nasal* secretions, the virus can infect the domestic birds. As a result, the domestic birds can become ill and die. Avian influenza infection is very easily spread among birds if they come into contact with other infected birds or with surfaces or feed that has become contaminated with the virus. Bird handlers are at risk if they are exposed to sick or dead birds. During the 1990s and early 2000s, several outbreaks of avian influenza occurred in which the virus was passed from poultry to humans, resulting in more than 200 deaths.

Where Have Outbreaks Occurred?

The outbreaks occurred primarily in Asia. Between 2003 and 2008, Indonesia reported the most cases, 137, with 112 people dying from the virus. Vietnam was second, with 106 cases and 52 deaths. Egypt reported 50 cases of avian influenza in humans, and 22 people died there. In total, there were 387 confirmed cases of avian influenza in humans, with 245 people (about 63% mortality).

As of 2009, 48 nations had reported finding the highly pathogenic avian influenza virus H5N1 among domestic poultry, including Afghanistan, Benin, China, the Czech Republic, Denmark, Egypt, Germany, Hungary, India, Iraq, Israel, Japan, Korea, Poland, Russia, Saudi Arabia, and the United Kingdom. As of early 2009, it had not yet been found in the nations of the Western Hemisphere, including the United States.

How Are Humans Infected?

There are three types of influenza viruses: A and B (each of which is divided further into strains), and C. In general, the avian influenza virus is a type A virus, and it may be highly pathogenic type (HPAI) or low pathogenic (LPAI). HPAI and LPAI are differentiated through testing.

Most avian influenza viruses are LPAI and cause only mild illnesses in poultry. The opposite is true of most HPAI infections, which can lead to serious illness and a high death rate in an infected flock.

Humans can become infected with either HPAI or LPAI viruses by touching sick or dead birds, usually chickens, ducks, or turkeys, that are infected with the virus, or having contact with their feces or secretions either directly or on surfaces that remain contaminated even if the feces or secretions may no longer be present. There is no evidence that human beings can contract avian influenza by eating the cooked meat of poultry or cooked eggs; however, to be safe, meat and eggs should be thoroughly cooked, and meat should reach an internal temperature of at least 170 degrees F before being eaten.

Human beings have little natural resistance to H5N1, the strain of avian influenza that is of greatest concern. H5N1 can be deadly to birds.

People who have become infected with avian influenza may have inhaled the virus, or it may have entered their body through their mouth or eyes. Individuals who have handled a sick or dead bird or its feces and then touched their eyes is likely to transmit the virus from their hands into their eyes and thus into their body.

Why Is Avian Influenza Important?

Chickens, ducks, turkeys, and other domesticated poultry are important food sources for people around the world. Avian influenza can spread quickly among birds, killing them or making them sick so they must be killed to prevent further spread of the disease. The potential economic loss to the poultry industry and the loss of an important human food source is high. Another concern is the fact that the virus can infect humans as well as birds.

Pandemics, or worldwide outbreaks, of influenza in the past have killed millions of people. The great influenza pandemic of 1917 and 1918 claimed the lives of between 20 million and 40 million people around the world. Should an influenza pandemic of similar case-fatality ratio (the number of people reported to have the illness compared to the number of people who die from it) strike in the 21st century, more than 2 million Americans could die. Health officials think that the avian influenza strain H5NI has potential to become a pandemic; therefore, international organizations, such as the World Health Organization (WHO) and the World Organization for Animal Health work together to monitor, control, eradicate, and prevent further spread of the disease.

What Are Signs that a Bird Has Avian Influenza?

Although symptoms vary between different bird species and birds of different ages, the following signs may indicate an infection with the avian influenza virus:

- Coughing or sneezing
- Purplish discoloration of the legs, comb, or wattles
- Swelling of the head, eyelids, hocks, comb, or wattles
- Lack of energy
- Nasal discharge
- Misshapen or soft-shelled eggs or a decrease in the number of eggs laid
- Loss of coordination
- Sudden death

What Are the Human Symptoms of Avian Influenza?

In humans, symptoms of infection with the avian influenza virus include flu-like symptoms, such as cough, sore throat, muscle aches, and fever; conjunctivitis (pink eye); and respiratory ailments such as pneumonia and respiratory distress. These signs can be accompanied by vomiting, nausea, and diarrhea. In some cases, neurological* changes are also seen.

* **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

WHAT IS A VIRUS?

A virus is an infectious agent that consists of a coil of DNA* inside a protective coat or shell. A virus attaches itself to a cell and injects its own genetic code, taking over the cell's machinery and beginning the production of more viruses. At the end, the cell explodes and dies, releasing new viruses to infect other cells.

While bacterial infections can be treated with antibiotics, they are ineffective against viruses. Special drugs called antivirals must be used to treat viral infections, although mild infections are often allowed to run their course until the patient recovers naturally.

Are Only Birds and Humans Susceptible to Avian Influenza?

Viruses are continually changing and adapting, and the H5N1 virus is no exception. Studies have shown that the virus can infect other mammals, including pigs (China), domestic dogs (Thailand), domestic cats (Thailand, Germany, Iraq, and Austria), martens (Germany), civets (Vietnam), and even zoo leopards and tigers (Thailand). H5N1 virus may continue to change as time passes and thus become able to infect additional mammals.

What Should People Do in Areas Affected by Avian Influenza?

The World Health Organization (WHO) prepared suggests people who live in areas affected by avian influenza take the following precautions:

- Avoid contact with poultry unless absolutely necessary
- Avoid touching feathers
- If contact cannot be avoided, wear protective clothing (such as a mask, rubber boots, and gloves), and wash thoroughly with soap and water afterwards
- Do not keep pet birds
- Do not sleep near poultry
- Keep children away from poultry

How Is Avian Influenza Treated?

The recommended treatment for avian influenza is the antiviral medication oseltamivir. This particular antiviral seems effective against most H5N1 viruses, which is not the case with the antivirals rimantadine or amantadine. However, because viral resistance is a serious concern, monitoring for resistance was ongoing in the early 2000s.

What Should a Poultry Farm or Processing Facility Do to Guard against an Outbreak?

Although as of 2009 there had not yet been an outbreak of avian influenza in the United States, poultry farms and processors were urged to take preventative measures to protect their workers and the general public. The viruses thrive in warm, moist conditions, especially when organic matter is present. However, the use of detergents and disinfectants, along with heating and drying, has been shown to kill the virus.

The Occupational Health and Safety Administration (OSHA) suggested that people who work with poultry wear protective equipment, including a respirator (worn by many poultry workers routinely). Safety glasses are not sufficient protection against aerosols or fine particles; OSHA suggested that a better choice is indirectly vented or nonvented safety goggles (such as eyecup goggles). Workers should remove their goggles and respirators carefully to avoid passing any viruses on the surface to the mucous membranes of the eye, nose, or mouth. Thorough washing of hands should be performed frequently. If workers notice flu-like symptoms or signs of conjunctivitis, they should consult a physician as soon as possible.

Any outbreaks should be reported to the animal health authorities in the area. Workers should take an antiviral under the supervision of a doctor.

Should Pet Birds Be Avoided?

In the United States, pet birds that are legally imported are held in quarantine* by the Department of Agriculture for 30 days to ensure that they do not have avian influenza or other potentially infectious diseases. These birds are tested for avian influenza and are not allowed to enter the country unless they test negative. Birds from U.S. sources should be healthy; however, people should request certification from the seller that the bird is of American stock and is healthy. In any case, a pet bird should be examined by a veterinarian soon after it arrives at its new home.

Good bird husbandry practices help keep pet birds healthy. The USDA suggests keeping pet birds away from other birds and away from people who own birds that live outdoors, such as chickens; cleaning cages daily; washing hands before and after handling birds, and cleaning and disinfecting clothing after visiting a bird fair or any site where there is live poultry, such as a county fair.

Bird owners should watch for the symptoms of avian influenza in their birds. If a bird shows symptoms or dies suddenly, the owner should contact an avian veterinarian immediately.

If a bird is healthy and has been determined to be free from avian influenza, owners and visitors should have no fear about enjoying these companion animals.

* **quarantine** is the enforced isolation (for a fixed period) of apparently well persons or animals who may have been exposed to infectious disease.

Is a Vaccine Available?

In 2007 the Food and Drug Administration approved a vaccine for humans that is effective against the H5N1 avian influenza virus. Clinical tests showed that the vaccine, which was derived from a human strain, was generally well tolerated by people who participated in the study. Reported side effects include muscle pain, headache, pain at the site of the injection, and a general feeling of being unwell. The vaccine was not available commercially, however; it was purchased by the federal government for the National Stockpile, and it was intended to be distributed if needed.

▶ See also **Influenza**

Resources

Books and Articles

“Avian Influenza: Protecting Poultry Workers at Risk.” *OSHA Safety and Health Information Bulletin* December 13, 2004. Available online at <http://www.osha.gov/dts/shib/shib121304.html>.

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Organizations

World Health Organization. Avenue Appia 20, 1211 Geneva 27, Switzerland. Telephone: + 41 22 791 21 11. Web site: <http://www.who.int>.

World Organization for Animal Health. 12 rue de Prony, Paris, France 75017 Telephone: +33 (0)1 44 15 18 88. Web site: <http://www.oie.int>.

B

Babesiosis

Babesiosis is a rare disease carried by ticks infected with the Babesia parasite. The disease most often affects cows, horses, sheep, dogs, and cats, but it can be transmitted to people through tick bites.

What Are Babesia?

Ticks carry many different diseases, including babesiosis (ba-bee-ze-O-sis), Lyme disease, and Rocky Mountain spotted fever.

Babesia (ba-BEE-ze-a) are protozoa, or one-celled organisms, that often live as parasites*, infecting cows, horses, sheep, goats, dogs, cats, and other animals. Deer ticks pick up *Babesia* when they feed on infected animals. The protozoa then multiply in the tick, and when the tick bites a person or another animal, the protozoa travel from the tick into the new host, where they begin multiplying again.

What Happens When People Get Babesiosis?

The *Babesia* parasite invades the body's red blood cells and can destroy them. If left untreated, babesiosis may destroy red blood cells faster than the body can replace them.

Symptoms Many doctors believe that many cases of babesiosis do not cause any symptoms. However in some instances, symptoms may start one to four weeks after the tick bite occurs, and may last for several weeks or months. People with babesiosis may experience fever, chills, sweating, fatigue, and anemia. These symptoms are similar to those of malaria.

Diagnosis and treatment Doctors diagnose babesiosis by examining blood under a microscope. When they detect the parasite, they prescribe medications to fight the infection and to rid the body of the parasite. Babesiosis is usually curable, although repeated courses of treatment may be necessary.

Most patients recover with few, if any, lasting effects. The most serious and sometimes fatal cases are found in elderly people, in pregnant women, in people who have had their spleen* removed, or in people with immune deficiencies.

How to Remove a Tick

Using thin-tipped tweezers, grasp the tick as close to the person's skin as possible.

Pull straight upward firmly and steadily until the tick lets go (do not squeeze or twist the tick body).

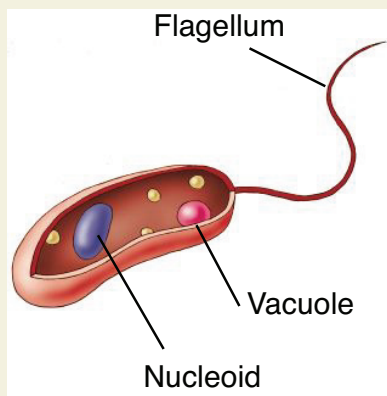
Clean the skin with soap and warm water, alcohol, or other antiseptic.

Save the tick for identification.

Petroleum jelly, lit matches, nail polish or other products do not help in tick removal and should not be used.

* **parasites** (PAIR-uh-sites) are organisms such as protozoa (one-celled animals), worms, or insects that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. Parasites live at the expense of the host and may cause illness.

* **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.



▲ Anatomy of an individual bacterium. Its DNA (genetic material) is in the nucleoid area, but it is not enclosed within a membrane. This bacterium uses its flagellum (tail) to move around. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **DEET** (abbreviation for N,N-Diethyl-meta-toluamide) is the active ingredient in many insect repellants.

* **microorganisms** are tiny organisms that can only be seen using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

How Do People Prevent Babesiosis?

The best methods of prevention are using insect repellent containing DEET* and wearing protective clothing when people are outdoors. People in deer tick-infested areas should wear light colored, long-sleeve shirts and long pants tucked into socks or boots. Doing so can help to keep ticks from reaching the skin. People should look for ticks on the body, including the scalp, after returning from gardening, camping, hiking, or playing outdoors in wooded areas, grass or brush.

If ticks do attach themselves to the skin of people or pets, the ticks should be removed with tweezers as soon as they are discovered. Generally, infected ticks have to be attached to the body for at least 24 hours before they pass on the parasite.

▶ See also **Tick-borne Illnesses • Zoonoses**

Resources

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/Features/StopTicks>, http://www.cdc.gov/ncidod/dvbid/lyme/ld_tickremoval.htm.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-66123. Telephone: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/babesiosis>.

Bacterial Infections

Bacterial infections occur when harmful forms of bacteria multiply inside the body. These infections range from mild to severe. Although they include such deadly diseases as plague, tuberculosis, and cholera, these and many other bacterial diseases can be prevented with good sanitation and/or cured by antibiotics.

What Are Bacteria?

Bacteria are microorganisms*, and they exist everywhere: in the air, in water, and in every animal and person. Bacteria are by far the most numerous organisms on Earth.

Most bacteria are harmless. Often bacteria are beneficial, even essential, to plant and animal life. Bacteria decompose (break down) dead plants and animals. This process allows a chemical element such as carbon to return to the soil to be used again. In addition, some bacteria enable plants to get nitrogen from the soil (and some enable plants to

use atmospheric nitrogen). Without bacteria, plants could not grow. In the human body, bacteria help keep the digestive tract working properly.

Bacteria can also cause disease. Like viruses*, bacteria can cause hundreds of illnesses. Some bacterial infections are common in childhood, such as strep throat (caused by streptococcus bacteria) and ear infections. Others cause major diseases, such as tuberculosis*, plague*, syphilis*, and cholera*. The infection may be localized (limited to a small area), as when a surgical wound gets infected with a staphylococcus (staf-i-lo-KOK-us) bacterium. It may involve an internal organ, as in bacterial pneumonia (infection of the lungs) or bacterial meningitis (infection of the membranes covering the brain and spinal cord).

Some bacteria, such as *Streptococcus pneumoniae*, also known as pneumococcus (noo-mo-KOK-us), almost always cause illness if they get into the body. Others, such as *Escherichia coli*, usually referred to by the short form *E. coli*, often are present in the body without doing harm. If the immune system* is weakened, however, these bacteria can grow out of control and start doing damage. Such illnesses are called “opportunistic infections.” In the 1990s and early 2000s, they became more common, in part because AIDS*, organ transplants, and other medical treatments have left more people living with weakened immune systems.

How Are Bacteria Different?

Unlike other living cells, a bacterium does not have a membrane that encloses its nucleus, the part of the cell containing DNA, the cell’s genetic material. Unlike viruses, most bacteria are complete cells that can reproduce on their own without having to invade a plant or animal cell. Some bacteria, however, do need to live inside another cell just as viruses do.

How do bacteria spread? Different bacteria spread in different ways. People get bacteria in the following ways:

- Through contact with contaminated water (cholera and typhoid fever)
- Through consumption of contaminated food (botulism, *E. coli* food poisoning, salmonella food poisoning)
- Through sexual contact (syphilis, gonorrhea, chlamydia)
- Through respiratory droplets expelled into the air, when infected people sneeze or cough (tuberculosis)
- Through contact with animals (anthrax, cat scratch disease)
- Through touching infected people (strep throat)
- Through skin via tick bites, lice, and cat bites
- Through open sores on the body
- Through infections such as Lyme disease, Rocky Mountain spotted fever, and typhus

Food Poisoning

Food poisoning is often the result of bacterial contamination. Important precautions for preventing food poisoning include the following:

- Avoiding raw or undercooked meat, poultry, seafood, and eggs
- Avoiding non-pasteurized dairy products
- Throwing out food items that are old or have an “off” smell
- Keeping foods cold until ready to serve
- Storing and cooking foods properly
- Washing knives, cutting boards, cooking utensils, and food preparation areas after every use
- Washing hands before preparing food, before eating, and after using the bathroom

* **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. Viruses can only reproduce within the cells they infect.

* **tuberculosis** (too-ber-kyoo-LO-sis) is a bacterial infection that primarily attacks the lungs but can spread to other parts of the body.

* **plague** (PLAYG) is a serious bacterial infection that is spread to humans by infected rodents and their fleas.

* **syphilis** (SIH-fih-lis) is a sexually transmitted disease that, if untreated, can lead to serious life-long problems throughout the body, including blindness and paralysis.

* **cholera** (KAH-luh-ruh) is an infection of the small intestine that can cause severe diarrhea.

Flesh-Eating Bacteria

A virulent strain of *Streptococcus A* bacteria caused illness in 117 people in Texas between December 1997 and March 1998. Of those 117 infections, 26 (17 adults and 9 children) resulted in death. Described in media coverage as “flesh-eating bacteria,” these pathogens induced hemolysis (he-MOL-y-sis), or the lysis (dissolution) of red blood cells. The Texas outbreak was short-lived, and experts remained uncertain about how it started.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **toxins** are substances that cause harm to the body.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

- From one part of the body, where they are harmless, to another part, where they cause illness (as when *E. coli* spread from the intestines to the urinary tract)
- Because of the after-effects of chronic debilitating conditions such as alcoholism. The alcoholic who has a diminished cough reflex inhales foreign material (usually food, liquids, or vomit) from the mouth into the lungs. Bacteria then enter into the lungs causing aspiration pneumonia.

How do bacteria cause illness? Bacteria can cause illness in several ways. Some destroy tissue directly. Some become so numerous that affected tissue cannot work normally. And some produce toxins* that kill cells. Exotoxins are toxins that are actively secreted by bacteria into the surrounding medium. Endotoxins are part of the bacterial architecture: They are usually part of the cell walls of bacteria and can be extremely toxic to people. Most bacterial toxins are exotoxins.

How Are Bacterial Infections Diagnosed and Treated?

The symptoms of bacterial infections vary widely but often include fever.

Diagnosis Doctors may test the patient's blood, sputum, or urine for evidence of harmful bacteria. If a lung infection is suspected, the doctor may take a chest x-ray or do a biopsy*, taking cells from an infected area to be examined. If meningitis is suspected, the doctor may do a spinal tap, using a needle to extract a sample of the spinal fluid that surrounds the spinal cord for testing so that the sample can then be studied.

Treatment Most bacterial infections can be cured by antibodies*, which were one of the great medical success stories of the twentieth century. These drugs either kill the bacteria or prevent them from reproducing. Penicillin, the first antibiotic, continued to be used in the 21st century to treat some infections. Other widely used antibiotics are amoxicillin, bacitracin, erythromycin, and tetracycline. Examples of antibiotic classes include cephalosporins and fluoroquinolones. Sometimes antitoxins are also given to patients to counter the effects of bacterial toxins, as in the case of tetanus or botulism toxins.

How Are Bacterial Infections Prevented?

Young children are vaccinated against diphtheria, whooping cough, tetanus, and *Hemophilus influenza B*, which are all bacterial infections. In addition, there are vaccines for cholera, meningococcal and pneumococcal infections, plague, and typhoid fever.

For many bacterial infections, good living conditions are the best prevention. That means clean water supplies, modern sewage systems, well-ventilated housing that is not overcrowded, and prompt medical treatment for people who do get sick.

Other precautions include the following:

- Washing hands (before handling food; after handling raw meat; after using the toilet; after touching animals; after having had contact with infected people)
- Washing fruits and vegetables before eating them
- Cooking meat thoroughly
- Abstaining from sexual contact or using condoms during sexual activity

How Do Bacteria Become Drug Resistant?

Virtually every kind of bacteria can be killed by specific antibiotics, and virtually every kind is naturally resistant to others. Some bacteria develop resistance to the antibiotics that are used to kill them. This is one of the big problems in controlling infectious diseases.

How does resistance occur? In some cases, resistance occurs by chance. As bacteria reproduce, mutations (variations) in their genes occur all the time. One of these chance mutations may happen to make a single bacterium in a person's body less vulnerable to a drug. This bacterium multiplies along with other bacteria. Whereas other bacteria are killed off by the drug, the mutated or resistant bacterium and its descendants, or daughter cells, thrive, and they may spread to other people.

Why does resistance occur more often? The use of antibiotics made the phenomenon of bacterial resistance far more prevalent than it would have been in their absence. The problem of resistance was made worse by people taking antibiotics that were not needed or by their taking antibiotics that were needed but then choosing to stop take them too soon.

Here is an example of how the use of an antibiotic can increase resistance: Let us say that a man has a bacterial infection. He takes an antibiotic, feels better, and stops taking the drug in five days, even though the doctor instructed him to take it for 10 days. Inside the man's body, the drug may have killed 80 percent of the bacteria. That was enough to make the man feel better. But the bacteria still alive are the 20 percent that were toughest, the ones best able to survive the drug. If the man had kept taking the antibiotic, the toughest bacteria might have been killed after he had been taking it for the remaining days. But now, having avoided the medication, they start to multiply. Soon the man feels sick again. But this time, all the bacteria in his body are the tougher kind. A scientist would say that the person's behavior had "selected" the most resistant bacteria for survival.

A similar process occurs when doctors prescribe antibiotics that are not needed. Let us say that a girl has a cough and fever. The doctor prescribes antibiotics on the chance that the girl has a bacterial infection. But

she actually has a virus, and viruses cannot be treated with antibiotics. The girl's immune system, her natural defense system, fights off the virus as it would have without the drug. Meanwhile, the antibiotic kills off some bacteria that usually live harmlessly in the girl's throat. The bacteria in her throat that survive are those that are better at resisting the antibiotic. Later, if those bacteria get into her ears, her lungs, or some other part of her body where they can cause illness, the antibiotic may not work as well against them.

If events like these happen repeatedly among many people, eventually strains of bacteria may arise that partially or completely resist a drug that is used to kill them.

▶ *See also* **Antibiotic Resistance • Botulism • Campylobacteriosis • Cat Scratch Disease • Chlamydial Infections • Cholera • Diphtheria • Food Poisoning • Helicobacter Pylori Infection • Infection • Legionnaires' Disease • Leprosy (Hansen's Disease) • Meningitis • Otitis (Ear Infections) • Pertussis (Whooping Cough) • Plague • Pneumonia • Rheumatic Fever • Salmonellosis • Sexually Transmitted Diseases (STDs) • Streptococcal Infections • Tetanus (Lockjaw) • Tick-borne Illnesses • Toxic Shock Syndrome • Tuberculosis • Typhoid Fever • Typhus • Zoonoses**

Resources

Books and Articles

Gavigan, Christopher. *Healthy Child, Healthy World: Creating a Cleaner, Greener, Safer Home*. New York: Dutton Adult, 2008.

Sachs, Jessica Snyder. *Good Germs, Bad Germs: Health and Survival in a Bacterial World*. New York: Hill and Wang, 2008.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

Food and Drug Administration, Center for Food Safety and Applied Nutrition. 5100 Paint Branch Parkway, College Park, MD, 20740. Toll free: 888-SAFEFOOD. Web site: <http://www.cfsan.fda.gov>.

Bad Breath *See Halitosis.*

Baldness (Alopecia) *See Hair and Hair Loss.*

Bedsores (Pressure Sores)

Bedsores, also called pressure sores or decubitus (de-KU-bi-tus) ulcers, are skin sores caused by prolonged pressure on the skin, usually in people who are paralyzed, bedridden, or too weak to move around much.

What Are Bedsores?

Bedsores develop when the skin is compressed for a long time between a protruding bone, such as a hipbone or elbow, and an external surface, such as a wheelchair or mattress. This compression limits the flow of blood in blood vessels that bring nutrients and oxygen to the skin and remove wastes. Without oxygen or nourishment, the underlying tissue may deteriorate, and a hole may open in the skin. If left untreated, bacteria* can infect the skin opening and lead to septicemia* or infection of muscle or bone.

Because protein and fluids help keep skin healthy and supple, elderly people with a poor diet often are at risk for skin-damaging bedsores. Other people at risk include those who cannot move much or shift their positions, perhaps because they are paralyzed or have a long-term illness, or are in a coma*. People who are confined to wheelchairs, particularly those who cannot sense pain clearly, are also vulnerable to skin sores because they may not feel the ulcer forming. Bedsores are not contagious*.

What Are the Symptoms of Bedsores?

A typical bedsore starts as a red area on the skin that may feel hard or warm to the touch. In people with darker skin, the sore may show as a shiny spot on the skin. If pressure is removed at this point, complications can be prevented. If the pressure is not removed, a blister, pimple, or scab may form over this area, which is a sign that the tissue beneath is dying. Eventually, a hole, or ulcer, will form in the skin. The dead tissue may appear small on the skin surface, but it may be larger in deeper tissues. The damage may extend all the way to the bones.

To diagnose bedsores, healthcare providers examine the skin for redness, blisters, openings, rashes, or warm spots, paying particular attention to bony areas. Any spots previously broken or healed over also are checked, as scar tissue can break open.

How Are Bedsores Treated and Prevented?

Bedsores can be prevented and treated in their early stages by relieving pressure on the body. Doing so requires changing a person's position in bed at least every two hours and in a wheelchair every 10 to 15 minutes. People at risk for bedsores should check themselves carefully at least twice daily or ask their caregivers to do so. Doctors recommend using long-handled mirrors to help with these exams because these tools help caregivers examine hard-to-see areas.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **septicemia** (sep-ti-SE-me-a) means a bacterial infection in the blood that spreads throughout the body, with potentially fatal results.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be woken up, and cannot move, see, speak, or hear.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

Other helpful methods to prevent bedsores are:

- using soft pillows to cushion the legs, back, and arms from pressure
- using special mattresses or egg-crate foam mattresses to reduce pressure
- keeping bedclothes unwrinkled and free of crumbs
- keeping skin clean and dry, free of sweat, urine, and stool
- making sure the patient is eating a balanced diet and drinking lots of fluids to help skin stay healthy

If a bedsore does develop, treatment may include antibiotics to treat infections and special gels or dressings to promote healing. In more serious cases, doctors may need to surgically remove the dead tissue and close the sore. If the bedsore reaches the bone, then the affected bone tissue may have to be removed as well.

▶ See also **Paralysis • Skin Conditions**

Resources

Books and Articles

Romanelli, Marco, Michael Clark, George W. Cherry, et al., eds. *Science and Practice of Pressure Ulcer Management*. London: Springer-Verlag, 2006.

Organization

National Institutes of Health. 9000 Rockville Pike, Bethesda, MD, 20892. Toll free: 301-496-4000. Web site: <http://www.nih.gov/index.html>.

Bedwetting (Enuresis)

Bedwetting (also known as enuresis) is the involuntary release of urine past an age when control usually is expected.*

Bobby's Story

Bobby woke up and felt that, once again, his pajamas and sheets were wet and smelled of urine. Wetting the bed is why he had turned down Ramon's invitation to a sleepover birthday party planned for the following weekend. At ten years old, Bobby was ashamed that he still wet the bed. It was not as if he did it on purpose. It just happened. He knew most children his age did not urinate in their sleep, and he was tremendously afraid that his friends would make fun of him if they found out that he did. Better, he thought, to miss the party than to have everyone learn about his problem.

What Is Bedwetting?

Bedwetting is also called nocturnal enuresis (nok-TER-nal en-yu-REE-sis) Enuresis is the involuntary, unwanted release of urine either in the day or at night in people who are developmentally old enough (around ages 5 to 6) to have gained bladder* control. Bedwetting is a specific kind of enuresis that occurs at night during sleep

Most children are toilet trained by age three, although some continue to use diapers or training pants while sleeping. Past that age, it is normal for children to wet their beds occasionally, especially if they are sick or particularly tired. About 30 percent of four-year-olds wet the bed. This rate drops to about 10 percent of six- and seven-year-olds, while but only about 1 percent of adolescents and adults have problems with bedwetting. In young children, more boys than girls wet the bed. Some men and women develop incontinence* as they age, often because of medical conditions or medications they take. Bedwetting becomes a problem when it happens repeatedly in older children. In older children, bedwetting limits social activities and can be stressful and humiliating. It can contribute to psychological and emotional problems such as low self-esteem* and depression*.

What Causes Bedwetting?

Doctors are not exactly sure why some people experience problems with bladder control and others do not. They do know that bedwetting tends to run in families. Children who have a parent who wet the bed as a child are between 40 percent and 75 percent more likely to wet the bed themselves, depending on whether one or both their parents had problems with bedwetting. As of 2009, however, no specific genetic cause for bedwetting had been found.

Many children who wet the bed seem to sleep so deeply that they are not awakened by the urge to urinate. Other children have bladders that develop more slowly than most. Bedwetting is sometimes related to medical problems such as infections of the urinary tract, sickle-cell anemia*, diabetes*, or epilepsy*. However, most people who wet the bed do not have medical problems.

Bedwetting also is a common reaction to stress, especially if a person has previously stayed dry at night. For example, some younger children who are toilet trained resume wetting their beds after a new baby is born or parents separate. Starting a new school or moving to a new town can also trigger the condition or make it worse. Still, most bedwetting does not have an easily identifiable cause.

Research suggests that some people who wet the bed may produce less antidiuretic hormone (anti-di-u-RET-ik HOR-mone), or ADH, than do people who do not. ADH regulates how concentrated the urine is. People generally produce more ADH at night, allowing them to produce a smaller volume of more concentrated urine while they sleep. People who produce less ADH at night produce a greater volume of urine that is less concentrated (more diluted).

* **bladder** (BLAD-er) is the sac that stores urine produced by the kidneys prior to discharge from the body.

* **incontinence** (in-KON-ti-nens) is loss of control of urination or bowel movement.

* **self-esteem** is the value that people put on the mental image that they have of themselves.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **sickle-cell anemia** also called sickle-cell disease, is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **epilepsy** (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.

What If My Child Gets Invited to a Sleepover?

Like Bobby, many children who wet the bed fear sleeping anywhere but at home. They worry that they will urinate during a sleepover or at camp and that they will be teased about it. These feelings can cause them to withdraw from certain social activities. Nevertheless, studies show that many children who wet the bed at home do not do it while sleeping elsewhere. Doctors theorize that this pattern might result because these children are not sleeping as soundly as they do at home. Deep sleep is a common reason children do not wake up when they need to urinate.

The parents of children who wet their bed sometimes can ease the situation by discussing the matter with the parents of the friend before the sleepover. Alerting the friend's parents might help the child overcome any uneasiness if bedwetting occurs.

Children can also be coached on not drinking liquids before bedtime and setting an alarm to get up at night for a bathroom break. In extreme cases, parents might want to consult their pediatrician about the temporary use of drugs that help eliminate bedwetting. Some medications are quite effective and work almost immediately.

How Is Bedwetting Treated?

Most children stop bedwetting without any treatment. Bedwetting in older children can be treated in different ways depending on what is causing it. First, a doctor does a complete physical examination to determine if bedwetting is caused by a medical condition. If it is, the underlying condition is treated medically with drugs or corrective surgery. However, only a very small number of adolescents who experience bedwetting have an underlying medical condition that is responsible for the problem.

If the bedwetting appears to be caused by emotional or psychological stress or depression, then consultation with a mental health professional is the first step to resolving the problem. Counseling to help deal with the source of stress, combined with behavior modification techniques to bring about nighttime bladder control, are often very effective.

Most people wet the bed for no identified reason. These people are usually helped by behavioral strategies aimed at staying dry during the night. Behavioral modifications such as holding urine for a short time when there is an urge to urinate, rewards for dry nights, and relaxation techniques aimed at reducing stress sometimes help. So do limiting drinking liquids after dinner and avoiding caffeinated beverages, such as colas. Sometimes parents wake their children after a few hours of sleep to encourage them to go to the bathroom and empty their bladder. The most effective behavioral technique, however, is the urine alarm. This pad with a bell or alarm attached to it is placed on the bed and individuals sleep on top of the pad. With this technique, an alarm rings at the first sign of wetness in their pajamas or the sheets. The alarm awakens sleepers and allows them to get up and finish emptying their bladder. In time, their brain comes to recognize the sensation of a full bladder and wakes them before urination occurs and the alarm goes off.

Nighttime dryness sometimes can be achieved by the use of medication. Some medications work to increase urine concentration. Others seem to work by making it easier for a person to wake up when the bladder is full. Some medications are quite effective and work almost immediately, whereas others may become effective over time. However, many people return to wetting the bed as soon as they stop taking the medication. As with all medicines, sometimes mild side effects occur.

Although bedwetting is not medically serious, it can have strong negative psychological effects on young people. It restricts their social lives and is embarrassing, upsetting, and frustrating. Fortunately most people can be helped to stay dry at night through a combination of the strategies mentioned above. It is important for parents to offer encouragement to children and help them understand that bedwetting is a common medical condition, not a personal weakness. Children should also be helped to realize they are not alone in their bedwetting. They probably know other people who secretly share their problem, but bedwetting is not something many children discuss with their friends or classmates.

Resources

Books and Articles

Bennett, Howard J. *Waking Up Dry: A Guide to Help Children Overcome Bedwetting*. Washington, DC: American Academy of Pediatrics, 2005.

Mercer, Renee. *Seven Steps to Nighttime Dryness: A Practical Guide for Parents of Children with Bedwetting*. Ashton, MD: Brookeville Media, 2004.

Organizations

American Academy of Child and Adolescent Psychiatry. 3615 Wisconsin Avenue NW, Washington, DC, 20016-3007. Telephone: 202-966-7300. Web site: http://www.aacap.org/cs/root/facts_for_families/bedwetting

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://familydoctor.org/online/famdocen/home/children/parents/toilet/366.html>.

Bell's Palsy

Bell's palsy is a sudden weakness or loss of function of certain facial muscles, usually on one side of the face, caused by swelling of a facial nerve.

Half a Face

Fifteen-year-old Shelly woke up one morning feeling like she had just received a shot of Novocain from the dentist. When she looked in the mirror, she saw that her face seemed limp on one side. She could not smile, and only one side of her face seemed to work. Shelly screamed for her parents and they came running. When they saw her face, they became worried that she had had a stroke* or had developed a brain tumor. They rushed her to the hospital emergency room.

At the hospital, the doctor examined Shelly and asked her and her parents about Shelly's medical history. Then the doctor performed several diagnostic tests to find out whether she had high blood pressure or Lyme disease. At that point, the doctor was able to explain that the symptoms indicated Bell's palsy, a fairly common and harmless condition.

It took three weeks for Shelly's condition to go away, and those three weeks felt more like three years to Shelly, but she was grateful that the condition was not something more serious.



▲ Bell's Palsy causes muscle weakness or loss of muscle function on one side of the face, which can result in a lopsided appearance. *Dr. P. Marazzi/Photo Researchers, Inc.*

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

What Is Bell's Palsy?

Bell's palsy is a condition that occurs when the facial nerve becomes irritated. The facial nerve runs from the brain through a small hole in the skull. Sometimes the facial nerve becomes irritated or swollen. The irritated nerve does not send normal signals to the muscles on one side of the face. The result is partial or complete loss of muscle function (called "palsy").

The symptoms of Bell's palsy begin suddenly and usually worsen over two to five days. The sudden numbness or weakness characteristic of Bell's palsy gets worse during the day, and the face feels stiff and pulls to one side. People with Bell's palsy typically have problems closing one eye and cannot wrinkle their forehead. They may feel pain behind the ear, they may experience involuntary facial movements called "tics," and hearing in the ear on the affected side may be very sensitive. They also may drool and have trouble eating and talking.

People with a stroke can look like they have Bell's palsy, so it is important to visit a doctor to find out what is causing facial paralysis. People with Bell's palsy often fear a brain tumor, but the symptoms of a brain tumor usually occur more gradually than the sudden start of Bell's palsy.

Ramsey Hunt syndrome is similar to Bell's palsy with symptoms that are so much alike, patients with Ramsey Hunt syndrome may be misdiagnosed as having Bell's palsy. There are, however, some key differences that differentiate it from Bell's palsy. These symptoms include severe pain inside the ear region (which may begin even before the onset of facial paralysis); a spinning sensation of dizziness; hearing loss; blisters (also known as shingles) in or around the ear, mouth, or throat; and sore lymph nodes.

Ramsey Hunt syndrome is caused by the varicella zoster virus (VZV). This virus, a strain of the herpes virus, also causes chicken pox. This virus may remain dormant in the body for decades, which explains why individuals over the age of 50 are most often afflicted.

BELL AND THE BRAIN

The Scottish scientist Sir Charles Bell (1774–1842) studied anatomy (the structure of organisms). His investigations of the brain have been called the "Magna Carta of Neurology." The Magna Carta or "great charter," is a famous document in English history that spelled out governmental law and people's rights, so this comparison is quite a compliment to Sir Charles Bell, who received the first medal awarded by the Royal Society of Great Britain for his book, *Idea of a New Anatomy of the Brain*.

Bell was the first to describe how sensory neurons (nerve cells) carry messages to the brain and how motor neurons carry messages to muscles and glands. Because of his work with nerve anatomy, Bell's palsy was named after him.

What Causes Bell's Palsy?

As of 2009, Bell's palsy was considered an idiopathic (id-e-o-PATH-ik) disease, which means that its cause is unknown or uncertain. One possible cause of Bell's palsy is irritation of the facial nerve after a viral infection, such as herpes zoster (which causes shingles) or herpes simplex (the cold sore virus). It also may be related to a blow to the face that damages the nerve or to conditions such as Lyme disease, diabetes, and high blood pressure.

Bell's palsy may happen to men and women of all ages but is most common between the ages of 30 and 60. Pregnant women and people who have diabetes, a cold, or the flu are more susceptible than others. One person in 60 to 70 develops Bell's palsy during his or her lifetime, which translates to about 40,000 people per year in the United States.

How Is Bell's Palsy Treated?

Eighty percent of people with Bell's palsy begin to recover several weeks after the onset of symptoms, and they recover completely within several months without treatment. A few people never recover completely and some of their symptoms continue permanently.

During recovery, the biggest concern is protecting the exposed eye from dryness and injury. Doctors sometimes prescribe antiviral medications during the first five to six days of the onset of Bell's palsy, and anti-inflammatory drugs sometimes help reduce swelling of the nerve.

▶ *See also* **Diabetes • Herpes Simplex Virus Infections • Hypertension • Lyme Disease • Paralysis • Varicella (Chicken Pox) and Herpes Zoster (Shingles)**

Resources

Books and Articles

Parker, James N., and Philip M. Parker. *The Official Patient's Sourcebook on Bell's Palsy*. San Diego, CA: Icon Health, 2003.

Organizations

American Academy of Otolaryngology, Head and Neck Surgery.

1650 Diagonal Road, Alexandria, VA, 22314-2857. Telephone: 703-836-4444. Web site: <http://www.entnet.org/HealthInformation/bellsPalsy.cfm>.

Bell's Palsy Research Foundation.

9121 East Tanque Verde, Suite 105-286, Tucson, AZ, 85749. Telephone: 520-749-4614.

National Institute of Neurological Disorders and Stroke.

P.O. Box 5801, Bethesda, MD, 20824. Web site: <http://www.ninds.nih.gov/disorders/bells/bells.htm>.

* **caisson** (KAY-son) is a watertight container that divers or construction workers use under water.

Bends

The bends is a painful condition that can occur in scuba divers, in aviators flying at high altitudes, in people working in pressurized settings, and in some other situations. Also called decompression sickness, the bends results when rapidly decreasing pressure causes normally dissolved gases to bubble out from bodily fluids and tissues and enter the bloodstream. This effect may occur, for example, when divers return to the surface too quickly from the higher pressure of underwater depths.

What Are The Bends?

The bends is also called decompression sickness or caisson* sickness. Water pressure increases with depth. When a person is scuba diving, as the person goes deeper under water, the pressure of the air the person breathes also increases. This increase in pressure causes more air to dissolve in the bloodstream.

How Is the Body Affected?

The main components of air are oxygen and nitrogen gases. Oxygen is continuously used by the body, but nitrogen is not. In the case of a scuba diver, the ascent from depths results in a decrease in pressure. Consequently, the blood can no longer hold all the nitrogen dissolved in it. If a diver ascends slowly, the nitrogen escapes into the lungs and is breathed out harmlessly. If the diver ascends rapidly, however, the nitrogen bubbles into the blood—much as bubbles escape from a newly opened, and likewise rapidly depressurized, bottle of carbonated soda or a soft drink. These bubbles can lodge at joints, such as the elbow or knee, and cause pain. In severe cases, extreme pain may arise and cause the sufferer to double over. This symptom led people to give the sickness its common name of “the bends.” Similar scenarios apply to construction personnel in caissons, miners working deep underground, and others who are exposed to conditions of changing pressures. In fact, the first medical report on the condition came in 1754 from two physicians who were treating what they called “mal de caisson,” or caisson disease, in men toiling in a pressurized coal mine in France. Other reports soon followed from physicians attending caisson workers in the United States, and eventually the connection between the sudden changing of pressure and these symptoms became apparent.

Symptoms of the bends usually appear within 90 minutes of diving but may take as long as two days to appear. In minor cases, symptoms include itching, rash, joint pain, or skin discoloration. In severe cases, symptoms may include extreme pain at the joints, headache, seizures, hearing problems, nausea and vomiting, back or abdominal pain, vision disturbances, or chest pain.

How Do Doctors Treat the Bends?

Minor cases of the bends usually require no treatment, although the patient should still consult a doctor. Severe cases, by contrast, require treatment with a hyperbaric (hy-per-BARE-ik) chamber, a device that creates pressure to dissolve the gas bubbles. The patient is placed under high-pressure conditions, and the pressure is slowly and safely decreased. Prompt treatment increases the chances for a complete recovery. Unfortunately, these chambers are not available everywhere, and a person with the bends may have to be transported and possibly airlifted significant distances to receive proper treatment.

What Do Scuba Divers Need to Know?

About 5 million people scuba dive. Scuba divers must be certified by taking training classes in which they learn how to dive and resurface safely to avoid decompression sickness. The bends is a preventable condition when safety rules are followed carefully.

▶ See also **Altitude Sickness**

Resources

Organization

National Association of Rescue Divers. P.O. Box 590474, Houston, TX, 77259-0474. Web site: <http://www.rescuediver.org/med/bends.htm>.

Benign Prostatic Hyperplasia See *Prostate Problems*.

Bilharziasis See *Schistosomiasis*.

Biliary Tract Cancer See *Liver and Biliary Tract Cancers*.

Binge Eating Disorder

Binge eating is excessive, out-of-control eating. A person with binge-eating disorder exhibits a repetitive pattern of eating significantly more food in a limited time (usually one to two hours) than most people typically would eat. Doing so often results in overweight or obesity.*

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

Binge-eating Disorder or Bulimia?

People with bulimia eat excessively, but afterward they induce vomiting, take laxatives, or exercise excessively to purge their body of extra calories. People with binge-eating disorder eat compulsively but do not try to get rid of the extra calories. This practice prevents some of the health problems associated with bulimia but results in other health problems related to being overweight.

* **anorexia nervosa** (an-o-REK-se-a ner-VO-sa) is an emotional disorder characterized by dread of gaining weight, leading to self-starvation and dangerous loss of weight and malnutrition.

* **bulimia** (bu-LEE-me-a) is an eating disorder in which a person has episodes of out-of-control overeating, or binges, and then tries to make up for them by making themselves vomit, by taking laxatives, or by exercising to excess to avoid gaining weight.

* **body image** is a person's impressions, thoughts, feelings, and opinions about his or her body.

What Is Binge Eating?

People who eat uncontrollably on a regular basis (at least twice a week for at least three months) are binge eaters. These people eat abnormally large quantities of food (sometimes thousands of calories) in one sitting. (Depending on body weight a person may require 1200 to 2000 calories per day.) Binge eating is sometimes referred to as compulsive overeating. The eating disorders anorexia nervosa* and bulimia* are officially considered psychiatric disorders. Binge eating was, as of 2009, acknowledged to be a psychological and physical problem, but it was not a separate psychiatric disorder as defined by the American Psychiatric Association.

Binge eaters eat abnormally large amounts of food at one sitting, often consuming as much as four times their daily calorie needs calorie needs (1200–2000 calories) in a short period. They tend to eat much faster than usual and continue eating even when they are no longer hungry. Often they eat until they feel uncomfortably full because during a binge they feel out of control and unable to stop eating even when they want to quit.

Binge eaters often develop the habit of eating alone so that others do not see them gorging themselves, hiding empty food containers to disguise how much they eat, and hoarding food in preparation for another binge. People who binge almost always feel embarrassed and ashamed of their eating. After bingeing, compulsive eaters often feel guilty, upset, disgusted, and/or depressed about how much they have eaten. They may vow to themselves never to binge again, but they are not able to keep this promise.

About 2 percent of Americans are binge eaters, and estimates are that between 30 and 50 percent of obese individuals binge. Women who binge outnumber men in a ratio of 3:2; however, binge eating is the most common male eating disorder. Unlike the anorexia nervosa or bulimia that usually starts in the teenage years, binge-eating disorder is more likely to develop in adults between the ages of 45 and 55.

What Causes Binge-eating Disorder?

Binge eating is thought to be caused by a combination of social, psychological, and genetic factors, and for many binge eaters, stress is the factor that triggers a binge. Social factors that encourage binge eating include the easy availability of inexpensive food in developed countries that makes it possible to binge eat and to hide this activity. Societies that value thinness can also promote depression and guilt among binge eaters, especially when the media send mixed messages that place food at the center of social events but also present thinness as necessary to be socially acceptable.

Psychologically, binge eaters share certain traits:

- Binge eaters tend to be obsessed with body image* and weight. People who diet continuously or who repeatedly gain and lose large amounts of weight (weight cycling) are more likely to become binge eaters.

- Binge eaters tend to have problems with impulse control and managing anger appropriately; some have difficulty appropriately expressing other emotions.
- Binge eaters almost universally have low self-worth and a negative self-image.
- Most binge eaters are depressed. It is not clear whether depression causes binge eating or if binge eating causes depression, but the two are likely to co-occur (be found together).
- People who are binge eaters report being sexually abused as children at a higher rate than the general population.

Research published in the early 2000s suggested that there is also a genetic component to binge eating. The appetite control system is complex and involves the interaction of multiple genes*, hormones*, and neurotransmitters*. The way appetite is controlled is not completely understood. However, researchers have found that some obese people have a mutation, or change, in a gene that suppresses the urge to eat once a person has eaten enough calories. Although researchers found that while only about 5 percent of obese people have mutations in this gene (meaning that this mutation is not the only cause of obesity), all the people with this mutated gene were binge eaters. The physiological basis for appetite and appetite control was under research in the early 2000s, and it was hoped that this work would lead to a breakthrough in treating obesity.

How Is Binge Eating Diagnosed and Treated?

Symptoms of binge eating may be difficult to detect because binge eaters tend to hide their behavior. Although many people are obese, not all obese people are binge eaters. Secretive eating, constant dieting without

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **neurotransmitter** (NUR-o-tranz-mit-er) is a brain chemical that lets brain cells communicate with each other and therefore allows the brain to function properly. In other words, a neurotransmitter transmits (carries) a chemical message from neuron to neuron.

Possible health consequences of binge-eating

- Anxiety
- Depression
- Obesity
- Obesity-related diseases
- Poor self-esteem
- Sleep problems
- Stress
- Substance abuse
- Suicidal thoughts
- Weight gain
- Weight obsession

Illustration by GGS Information Services.
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of Cengage Learning.

* **antidepressant medications** are used for the treatment and prevention of depression.

* **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.

losing weight, obsessive concern about weight, and depression suggest that a person may be a binge eater, but none of these patterns proves binge eating. People who are obese and fail to lose weight may seek help from a healthcare professional due to concern about health problems related to obesity. An evaluation that involves questions about family and personal history, physical health, eating and dieting habits, psychological concerns, and personality issues may reveal binge eating behavior. However, people with binge-eating disorder often lie about their eating habits.

Medical professionals do not agree on how to treat binge eating, but they do agree that the earlier binge eating is detected and treated, the easier it is to break the pattern and control bingeing behaviors. As of 2009, no drugs were available specifically to treat binge eating, but antidepressant medications* often proved helpful, although they are not without potential side effects. The anti-obesity drug sibutramine (Meridia) may also be prescribed. This drug enhances the sensation of fullness and helps to suppress hunger. It does, however, have potentially serious side effects.

Psychotherapy* can be used either alone or in combination with medical treatment to treat binge eating. Cognitive behavior therapy, a type of psychotherapy that is designed to confront and then change the individual's thoughts and feelings about his or her body and behaviors toward food, is one of the more effective psychotherapeutic approaches. Psychotherapy may also address issues of self-control, emotional expression, and the triggers that set off binges. Nutritional counseling and support groups can be helpful supplements to other forms of treatment. Since stress is a common trigger for binge eating, finding ways to reduce or control stress helps give some individuals better control over binge eating.

Can Binge Eating Be Prevented?

Binge eating cannot always be prevented, but there are ways of reducing the likelihood that it will develop. These include the following:

- Making it clear that all family members are loved and appreciated the way they are. Parents should not obsess over their children's weight or appearance.
- Not using or offering food for comfort in times of stress
- Becoming aware of stresses that could lead to a binge
- Eating regularly and avoiding getting too hungry
- Eating meals together as a family
- Avoiding extreme or fad diets
- Seeking help promptly for social or emotional situations that lead to low self-worth, alcohol or substance abuse, or depression

▶ See also **Bulimia Nervosa • Eating Disorders: Overview • Obesity**

Resources

Books and Articles

Carleton, Pamela, and Deborah Ashin. *Take Charge of Your Child's Eating Disorder: A Physician's Step-by-Step Guide to Defeating Anorexia and Bulimia*. New York: Marlowe, 2007.

Heaton, Jeanne A., and Claudia J. Strauss. *Talking to Eating Disorders: Simple Ways to Support Someone Who Has Anorexia, Bulimia, Binge Eating or Body Image Issues*. New York: New American Library, 2005.

Organizations

National Association of Anorexia Nervosa and Associated Eating Disorders. P.O. Box 7, Highland Park, IL, 60035. Telephone: 847-831-3438. Web site: <http://www.anad.org>.

National Eating Disorders Association. 603 Stewart Street, Suite 803, Seattle, WA, 98101. Toll free: 800-931-2237. Web site: <http://www.edap.org>.

Overeaters Anonymous. P.O. Box 44020, Rio Rancho, NM, 87174. Telephone: 505-891-2664. Web site: <http://www.overeatersanonymous.org>.

Bioterrorism

Bioterrorism is the intentional use of harmful biological, or living, organisms (bacteria, viruses, or toxins) to cause injury or death in humans, animals, or plants.

The Weapons of Fort Detrick

As of 2009, on the grounds of the U.S. military base at Fort Detrick, in Frederick, Maryland, a massive biodefense laboratory housed a cluster of sealed chambers built to contain the world's deadliest bacteria and viruses. Work to develop bioweapons began at Fort Detrick in 1943. By 1969 the United States had several weaponized agents, such as anthrax, botulism, and Venezuelan equine encephalitis, and at that time President Nixon ordered a stop to U.S. programs in bioweapons. In the early 2000s, during the Bush administration, the U.S. work in biological weaponry was begun again under the auspices of the National Biodefense Analysis and Countermeasures Center (NBACC). The activity involved making and testing small amounts of weaponized microbes* and perhaps genetically engineered viruses* and bacteria* and also called for team exercises that simulated (faked) attacks by hostile groups. Although the United States

* **microbes** (MY-krobes) are microscopic living organisms, such as bacteria, viruses and fungi.

* **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. A virus can only reproduce within the cells it infects.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **microorganisms** are tiny organisms that can only be seen using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

* **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.

* **anthrax** (AN-thraks) is a rare infectious disease caused by the bacterium *Bacillus anthracis*.

signed the Biological and Toxin Weapons Convention (BWC) agreement in 1972 that prohibits the use of such agents in global warfare, federal authorities in the early 2000s justified this military activity as defensive against others who might engage in bioterrorism.

What Is Bioterrorism?

Also known as biological warfare, bioterrorism is a form of warfare that uses specific microorganisms* to deliberately cause illness or death in people, animals, or plant crops. When organisms are used in this way, they become weapons.

The History of Bioterrorism

Biological warfare was not new to the 21st century; it has a long and deadly history. Persian, Greek, and Roman writers tell of the use of animal cadavers to contaminate water supplies. In 1155 at the battle of Tortona, Barbarossa dumped the corpses of soldiers into wells to poison the water. In 1346, the Mongols catapulted the corpses of plague victims into the port city of Kaffa (later called Theodosia, also spelled Feodosia, in Ukraine) on the Black Sea in the Crimea causing an epidemic; the city surrendered. During the French and Indian Wars in the 18th century in North America, the British gave blankets contaminated with smallpox to Native Americans, leading to an epidemic* of the disease among the Indians.

The Mongols and the British troops did not know that certain microorganisms cause disease. They only knew that disease was rumored to have spread from dead bodies or, in the case of smallpox, even from the blankets that touched victims. People did not know that microorganisms caused infectious disease until 1876, when the German scientist Robert Koch (1843–1910) proved that anthrax (AN-thraks) bacteria causes the disease anthrax*. After World War II the United States and other nations experimented with harmful biological organisms and various methods of transmitting them. In 1972 more than 140 countries, including the United States and the Soviet Union, signed the Biological Weapons Convention treaty to stop research and production of biological organisms as weapons of war. Although the Soviets signed the treaty, they continued a high-intensity program through the early 1990s. At least 60,000 people were employed at BioPreparat in the USSR in the research and production of biological weapons, and hundreds of tons of anthrax spores, smallpox, and plague were stored. When the Soviet Union dissolved in 1991, many of its scientists went to work for other countries.

Many people believe that well funded terrorists can afford to purchase equipment to build biologic weapons or that it will be sold when ordered. Some countries—especially those harboring or supporting known terrorist groups—continue to manufacture and store stockpiles of dangerous microorganisms. The use of bioterrorism to wage warfare is favored among terrorists or fringe groups because it requires few resources compared with traditional warfare and can potentially harm large numbers of people.

How Can Biological Agents Be Spread?

Deadly microorganisms (also known as biological agents or bioweapons) can be spread purposely through air or food and water supplies or by intentionally infecting someone with a highly contagious agent and letting that person circulate in a community, starting a massive wave of disease. The agent could be disseminated in any busy public place with the intention to infect many people who then travel to various destinations unintentionally spreading the disease.

Some organisms can be aerosolized (AIR-o-suh-lized), meaning that they are processed into the tiniest of particles, in a wet or dry form, that can be sprayed or released into the air so that large numbers of people can inhale them. Aerosolized organisms can be dispersed by aerosol containers, small crop-dusting planes, ventilation systems, or contamination of an object that can carry disease throughout a region, such as the anthrax-tainted letters received by various government and media employees in the United States in late 2001.

The handling and release of many of these organisms are dangerous and could be deadly for potential terrorists trying to use them. Some harmful biological organisms become weakened, however, as they spread into water or food supplies, making them less likely to cause significant harm to anyone who comes into contact with them. For example, a person would have to inhale thousands of anthrax spores* to become sick. A terrorist group trying to use anthrax as a bioweapon would have to use a highly concentrated form to be able to harm large numbers of people via contaminated packages or envelopes. Some bioterrorism agents, such as the smallpox virus, can be spread from person to person.

What Are Potential Biological Agents?

The Centers for Disease Control and Prevention (CDC) separates biological organisms into categories according to their virulence (VEER-uh-lents), or ability to cause disease. Potential biologic agents used for terrorism are divided into three categories.

Category A agents Category A or high priority agents can be easily disseminated or transmitted from person to person, cause high death rates, cause public panic and social disruption, and require special action for public health preparedness. Category A agents include the following:

- Anthrax: Anthrax is caused by the bacterium *Bacillus anthracis*. The bacteria form spores, which are found in soil and have a hard coating that allows them to survive in harsh environments. The disease is not contagious from person to person, and natural human infection is rare. There are three types of anthrax: cutaneous (kyoo-TAY-nee-us) anthrax, which infects the skin; inhalation (in-huh-LAY-shun) anthrax, which results from breathing in large numbers of concentrated spores; and gastrointestinal* anthrax, which is

* **spores** are a temporarily inactive form of a germ enclosed in a protective shell.

* **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

- * **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.
 - * **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.
 - * **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.
 - * **toxin** is a substance that causes harm to the body.
 - * **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.
 - * **respiratory failure** is a condition in which breathing and oxygen delivery to the body are dangerously altered. This may result from infection, nerve or muscle damage, poisoning, or other causes.
 - * **antitoxin** (an-tih-TOK-sin) counteracts the effects of toxins, or poisons, on the body. It is produced to act against specific toxins, like those made by the bacteria that cause botulism or diphtheria.
 - * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
 - * **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.
- caused by ingesting (eating) spores. An anthrax vaccine does exist but requires many injections and has side effects. Antibiotics may be given for prevention.
- **Smallpox:** Smallpox, a deadly viral infection, is caused by the variola virus and is found only in humans. Smallpox is the most contagious disease known and is transmitted through direct contact with the lesions* of an infected person, by inhaling infected droplets of moisture released into the air by coughing patients, and even by handling contaminated clothing that contains fluid from smallpox sores. The symptoms of smallpox are high fever, headache, backache, vomiting, and a painful rash of lesions that covers the face, arms, and body and often leaves scars. The disease is fatal in up to 30 percent of cases. In the early 20th century smallpox claimed millions of lives, but in 1980 the World Health Organization (WHO) declared the disease was eradicated from the human population following an aggressive worldwide vaccination* program. Routine vaccination against smallpox in the United States ended in 1972. The Centers for Disease Control and Prevention (CDC) keeps an emergency supply of smallpox vaccine* in the event that bioterrorism attacks with smallpox occur in the United States. In 2002, some vaccine-making companies received approval from the CDC to make an additional supply of the vaccine should it be needed on a more widespread basis.
 - **Botulism toxin:** Botulism is caused by the toxin* produced by the bacterium *Clostridium botulinum*. The bacteria can be inhaled or swallowed, or they can enter the body through a wound, but the disease is not contagious from person to person. The toxin produced by the bacteria affects the nervous system, causing nerve damage and temporary paralysis*, including the muscles for speaking, swallowing, and breathing. Botulism can lead to respiratory failure* and even death. The bacterium and its toxin could be used to produce bioweapons. An antitoxin* against the *Clostridium botulinum* toxin was available from the CDC as of 2009, but at that time there was no vaccine available.
 - **Plague:** Plague, caused by the bacterium *Yersinia pestis* (yer-SIN-ee-uh PES-tis), can take three forms: bubonic (byoo-BAH-nik), septicemic (sep-tih-SEE-mik), and pneumonic (noo-MOH-nik). Bubonic plague, the most common form, involves the body's lymph nodes*; septicemic plague enters the bloodstream, causing internal bleeding and shock*; and pneumonic plague infects the respiratory tract*. The last form is potentially important in biological warfare because *Yersinia pestis* bacteria can remain alive in the air for up to an hour, making aerosolized transmission possible.
 - **Yersinia pestis** is found in rats and other rodents in all parts of the world, including the United States. Plague can spread from infected rats to humans by direct bites or from fleas. The pneumonic form of

plague is the only kind that is contagious among humans; transmission takes place when someone has close contact with an infected person who is coughing or sneezing. Symptoms of the plague include fever, chills, headache, abdominal pain, painful and swollen lymph nodes (called buboes, BYOO-boze), chest pain, coughing, bloody sputum*, and septic shock*. As of 2009 there was no vaccine available in the United States, but antibiotics could treat the disease successfully if it was diagnosed early.

- Tularemia: Tularemia, also known as rabbit fever, is caused by the bacterium *Francisella tularensis* and is highly infectious. The disease is not contagious among humans, and human infection is rare. Tularemia can be transmitted through contact with infected animals or contaminated water or soil. The disease is potentially dangerous as a biological weapon because even small numbers (fewer than 10 to 50) of the aerosolized bacteria can cause serious disease, such as life-threatening pneumonia*. Symptoms include fever, chills, headache, cough, and extreme tiredness. Patients also may have painful ulcers on the skin; swollen, painful eyes; and abdominal pain. Early treatment with antibiotics may prevent or limit the severity of the disease.
- Hemorrhagic viruses: Ebola, a hemorrhagic viral disease, which means that it causes bleeding from body openings, is a virulent viral disease. Fatality rates range from 50 to 90 percent. The United States and Soviet Union have investigated the use of ebola for biological warfare. Another viral hemorrhagic fever virus was first discovered in Marburg, Germany. The Marburg virus had fatality rates ranging from 25 to 100 percent, and although a vaccine was in development, no treatments as of 2009 existed aside from supportive care. Hantavirus is transmitted through the air from infected rodent dung. This hemorrhagic virus affects the kidneys. As of 2009, there was no vaccine for this disease.

Category B Category B agents are moderately easy to disseminate, can cause moderate morbidity (rates of disease) and low mortality (rates of death), and require specific action from the CDC. The following are Category B agents:

- Brucellosis: Bacteria of the genus *Brucella* cause disease in different vertebrates such as sheep, goats, cattle, deer, elk, pigs, and dogs. Contact can infect humans and cause a range of symptoms similar to the flu, although central nervous system (CNS) and heart infections are common. Brucellosis is only one example of a zoonotic disease, one that can be passed from animals to humans.
- Tetanus toxin: The epsilon toxin of *Clostridium perfringens*, the organism that causes tetanus*, is a Class B toxin.
- Food safety threats: Bacteria such as salmonella, shigella, and *E. coli* could be used to deliberately contaminate foods as a bioterrorist act.

* **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

* **sputum** (SPYOO-tum) is a substance that contains mucus and other matter coughed out from the lungs, bronchi, and trachea.

* **septic shock** is shock due to overwhelming infection and is characterized by decreased blood pressure, internal bleeding, heart failure, and, in some cases, death.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **tetanus** (TET-nus) is a serious bacterial infection that affects the body's central nervous system.

- **Q fever:** Q fever is a rickettsial zoonotic disease caused by *Coxiella burnetii*. Animals affected are sheep, goats, and cattle, but humans can inhale particles contaminated with the organism, which is resistant to heat and highly infectious by the aerosol route. A single inhaled organism can cause illness.
- **Venezuelan Equine Encephalitis (VEE):** Horses contract VEE through bites from infected mosquitoes. It is highly infectious but not particularly stable when spread by aerosol, and it does not persist for a long period of time.
- **Psittacosis:** Psittacosis, also called parrot fever, is a bacterial disease caused by *Chlamydia psittaci*, and it is transmitted from birds to people when people inhale dried bird feces. This disease could be easily aerosolized as a biowarfare agent.
- **Water supply threats:** Cholera is a well-known diarrheal disease caused by *Vibrio cholera*, acquired through drinking contaminated water. It could be spread by aerosols, but more likely it would be through contaminated food or water supplies.
- **Ricin toxin:** Ricin toxin is made from castor beans. It has high terrorist potential due to its ready availability, easy processing, and widespread reporting.

Category C Category C are third-priority agents that may be easily available and could be genetically engineered to have high potential for a public health impact. Examples are as follows:

- **Nipah virus:** Nipah virus infects pigs and humans, and in people it can cause a sometimes fatal form of viral encephalitis. The transmission is not understood, but it may be transmitted from pigs to humans by infected mosquitoes.
- **Hantavirus:** Hantavirus refers to a group of viruses transmitted to humans through the saliva or excrement of rodents, such as field mice, and which causes hemorrhagic fever and pneumonia.
- **Multi-drug resistant tuberculosis:** These forms of tuberculosis are resistant to one or more antibiotics and are highly contagious.

How Can People Protect Themselves?

Throughout the late 20th century, most biological defense strategies were geared to protecting soldiers on the battlefield rather than ordinary people in cities. In 1999 the University of Pittsburgh deployed the first automated bioterrorism detection system, called Real-Time Outbreak Disease Surveillance (RODS). RODS was designed to collect data from places such as hospital clinics, laboratories, 911 calling centers, veterinary clinics, ranching and feedlot operations, food processors, drinking water systems, school attendance records, and over-the-counter drug sales and use them to detect a terrorist event at the earliest possible moment. Following the terrorist incidents and anthrax scare of 2001, the Bush administration

proposed that billions of dollars be channeled into improving national and state resources with biosurveillance systems.

The Office of Homeland Security was formed in late 2001 to oversee the government's preparation for and defense against potential acts or threats of bioterrorism that might occur in the United States. The Bush administration authorized an increase in federal stockpiles of antibiotics to treat anthrax, plague, tularemia, and other potential bio-weapons, as well as the production of additional supplies of smallpox vaccine. Research continued in the development of better medical treatment and the creation of vaccines to protect people against biological agents. Medical professionals and emergency response teams were trained to diagnose diseases and respond quickly to epidemics that could result from bioterrorism. The following situations were believed to indicate the possibility of an outbreak:

- Notice of a disease or strain that is not normally within the population
- Patterns of resistance to antibiotics
- Evidence of symptoms among patients that is not typical of any disease or disorder
- Distribution that is inconsistent with the typical geographical location of a disease; for example, a tropical disease occurring in a northern city
- Other inconsistent elements such as a large number of cases, high illness or death rates, and changes from normal disease occurrences

Researchers experimented with high-tech devices such as tiny electronic boxes that contain living nerve cells to detect the presence of bacterial toxins and fiber-optic tubes lined with antibodies coupled to light-emitting molecules that can identify specific pathogens, such as anthrax. The technology of genetic engineering could produce a bacterial agent to target a particular genetic group or geographical population.

The Biological and Toxin Weapons Convention established in 1972 was signed by 162 nations as of 2009, and efforts were made to enforce the treaty. However, although diplomats might agree, some worried that so-called rogue nations (nations that in their international actions do not respect other nations) might resort to biological warfare in order to threaten and inflict harm, incite mass panic, and disrupt society.

▶ See also **Anthrax • Botulism • Plague • Smallpox • Tularemia • Zoonoses**

Resources

Books and Articles

Romano, Amy. *Germ Warfare*. New York: The Rosen Publishing Group, 2004.

* **euphoria** (yoo-FOR-ee-uh) is an abnormally high mood with the tendency to be overactive and overtalkative, and to have racing thoughts and overinflated self-confidence.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **mood disorder** is a mental disorder that involves a disturbance in the person's internal emotional state. Depressive disorders, bipolar disorders, and mood disorders are associated with the use of drugs or medical illnesses.

* **psychosis** (sy-KO-sis) refers to mental disorders in which the sense of reality is so impaired that a patient cannot function normally. People with psychotic disorders may experience delusions (exaggerated beliefs that are contrary to fact), hallucinations (something that a person perceives as real but that is not actually caused by an outside event), incoherent speech, and agitated behavior, but they usually are not aware of their altered mental state.

Rudy, Lisa Jo. *Bioterror: Deadly Invisible Weapons*. New York: Franklin Watts, 2008.

Urbano, Mary Theresa. *The Complete Bioterrorism Survival Guide: Everything You Need to Know Before, During and After an Attack*. Boulder, CO: Sentient Publications, 2006.

Organizations

Center for Civilian Biodefense Strategies, Johns Hopkins University. 111 Market Place, Suite 830, Baltimore, MD, 21202. Telephone: 410-223-1667. Web site: <http://www.hopkins-biodefense.org>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

World Health Organization. Avenue Appia 20, 1211 Geneva 27, Switzerland. Telephone: 011-41-22-791-2111. Web site: <http://www.who.int>.

Bipolar Disorder

Bipolar (by-POLE-ar) disorder is a condition in which periods of extreme euphoria, called mania (MAY-nee-uh), alternate with periods of severe depression*. Bipolar disorder is sometimes also called manic (MAN-ik) depression.*

What Is Bipolar Disorder?

Bipolar disorder is a type of mood disorder*. People with bipolar disorder experience two (thus the prefix “bi”) extremes in mood; they have periods of extremely elevated mood and boundless energy that are followed by periods of depression. Bipolar disorder can range from severe to mild. Different forms of bipolar disorder are distinguished from one another by the severity of the mood extremes and how quickly mood swings take place.

For example, full-blown bipolar disorder, or bipolar I, involves distinct manic episodes followed by depression. People with this form of bipolar disorder often experience trouble sleeping, changes in appetite, psychosis*, and thoughts of suicide.

In bipolar II, the mania is less severe and the person does not lose touch with reality but does have periods of depression that can be as severe as the depression in bipolar I disorder. Some people also experience mixed states in which symptoms of mania and depression exist at the same time; this form may be more common in younger individuals and children. Other people may experience a form of bipolar disorder in which there is a rapid cycling between “up” and “down” moods with few,

if any, normal moods in between. Cyclothymia is a condition in which there are mood swings but with milder highs and lows.

Who Has Bipolar Disorder?

Ernest Hemingway, winner of the Nobel Prize in literature, showed signs of having bipolar disorder. So did presidents Abraham Lincoln and Theodore Roosevelt and the composer Ludwig von Beethoven. All of these men were intelligent, creative, successful individuals, but they all fought the two faces of bipolar disorder. At one moment they would be on top of the world, full of ideas and creative and physical energy. Then a few days, weeks, or months later they would sink into the despair and lethargy of depression.

Bipolar disorder affects about 1 out of every 100 people, or at least 3 million Americans. It affects people of all races, cultures, professions, and income levels. Men and women are affected at equal rates. Bipolar disorder tends to run in families and is believed to have an inherited genetic component. Studies of twins show that if one member of a pair of identical twins* (twins who have identical genes*) has bipolar disorder, the other twin has about a 70 percent chance of also having the disorder. If one of a pair of fraternal twins (twins who do not have identical genes, but do have many of the same genes) has bipolar disorder, the risk of the other twin having it is only 15 to 25 percent.

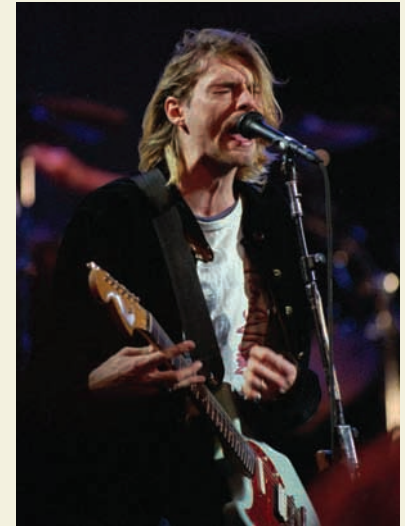
What Are the Symptoms of Bipolar Disorder?

Bipolar disorder has two distinctive sets of symptoms.

Depression During the depression phase, a person may experience the following:

- persistent feelings of sadness and anxiety
- feelings of worthlessness or hopelessness
- loss of interest in activities that were formerly enjoyable
- fatigue and decreased energy
- sleeping too much or too little; difficulty getting up or going to sleep
- eating too little or too much
- unexplained periods of restlessness, irritability, or crying
- difficulty concentrating or remembering things
- difficulty making decisions
- thoughts of suicide or suicide attempts
- increased difficulties in relationships with friends, family, teachers, or parents
- alcohol or substance abuse

Mania During the manic or euphoric stage, a person may experience the following:



▲ Rock star Kurt Cobain (1967–1994), seen here at a December 13, 1993, concert, suffered from bipolar disorder. *AP Images.*

* **identical twins** are twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **Attention Deficit Hyperactivity Disorder** or ADHD, is a condition that makes it hard for a person to pay attention, sit still, or think before acting.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.

* **separation anxiety** is the normal fear that babies and young children feel when they are separated from their parents or approached by strangers.

* **psychologists** (sy-KOL-o-jists) are mental health professionals who treat mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth. Psychologists also study the brain, behavior, emotions, and learning.

* **psychiatrists** (sy-KY-uh-trist) are medical doctors who have completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can diagnose mental illnesses, provide mental health counseling, and prescribe medications.

- high energy; ability to go with little sleep for days without feeling tired
- severe mood changes from extreme happiness or silliness to irritability or anger
- overinflated self-confidence; unrealistic belief in one's own abilities
- talking much more than usual; talking that is hard to stop
- increased activity, restlessness, distractibility, and the inability to stick to tasks
- racing, muddled thoughts that cannot be turned off
- decreased judgment of risk and increased reckless behavior
- substance abuse, especially cocaine, alcohol, and sleeping pills
- extremely aggressive behavior

How Is Bipolar Disorder Diagnosed?

Bipolar disorder usually begins in early adulthood, although many experts assert that younger children and teens may also have the disorder. Some children who are diagnosed with Attention Deficit Hyperactivity Disorder* (ADHD) may actually have bipolar disorder or may have both disorders. These children not only have symptoms of ADHD but often also have symptoms such as significant and sustained tantrums, periods of anxiety* (including separation anxiety*, periods of irritability, and mood changes. With many children, mood states change rapidly and without warning. Children with bipolar disorder are studied by psychologists* and psychiatrists* who previously did not believe that such disorders occurred in early childhood.

Doctors often ask family members about the person's symptoms, as people with bipolar disorder are often not aware of the changes they are experiencing. To be diagnosed with bipolar disorder, the person must have had at least one period of mania. However, because people with bipolar disorder spend more time in depression than mania, the diagnosis can easily be missed, and it often takes a long time before bipolar disorder is correctly diagnosed. Often after the first episode of mania or depression, five or more years may pass before another manic or a depressive period occurs. Despite the stretches of normal moods, bipolar disorder does not go away. Instead, the time between mania and depression gets shorter and shorter, and the symptoms may become more severe. Not infrequently, bipolar disorder can lead to psychosis or to suicide. About 19 percent of people who have required hospitalization for bipolar disorder commit suicide.

How Is Bipolar Disorder Treated?

Many people with severe mood swings can be helped by treatment. The drug lithium has been one of the medications of choice for treating bipolar disorder, and it is often very effective. Other medications are also helpful in controlling mood swings. These include various antiseizure medications (for example, valproate and carbamazepine) and antipsychotic medications (for example, aripiprazole, olanzapine, quetiapine, risperidone, and ziprasidone).

People with bipolar disorder need to continue to take their medications even when they feel normal to prevent the reoccurrence of mood swings.

Living with Bipolar Disorder

Living with a loved one who has bipolar disorder can be very hard on family members.

Perhaps the most effective step that family members can take is help the person with the disorder to get treatment and encourage him or her to stick with the treatment. Family members can also learn more about the warning signs that suggest a new mood episode may be coming and encourage the person to seek medical care to try to prevent a full-blown episode. Many family members find joining a support group or participating in family therapy is helpful in understanding and managing the impact of this difficult problem.

People who are taking about suicide need emergency help. Many telephone books list suicide and mental health crisis hotlines in their Community Service sections and help can be obtained by calling emergency services (911 in most communities).

▶ *See also* **Anxiety and Anxiety Disorders • Attention Deficit Hyperactivity Disorder (ADHD) • Depressive Disorders • Psychopharmacology • Psychosis • Suicide**

Resources

Books and Articles

Burgess, Wes. *The Bipolar Handbook: Real-life Questions with Up-to-date Answers*. New York: Avery, 2006.

Jones, Paul E., with Andrea Thompson. *The Up and Down Life: The Truth about Bipolar Disorder—The Good, the Bad, and the Funny*. New York: Perigee Book, 2008.

Organizations

Child and Adolescent Bipolar Foundation (CABF). 1000 Skokie Boulevard, Suite 570, Wilmette, IL, 60091. Telephone: 847-256-8525. Web site: <http://www.bpkids.org>.

Depression and Bipolar Support Alliance. 730 N. Franklin Street, Suite 501, Chicago, IL, 60610-7224. Toll free: 800-826-3632. Web site: <http://www.dbsalliance.org>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov>.

Birth Control *See Pregnancy.*

- * **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.
- * **anencephaly** (AN-en-SEF-uh-lee) is a condition present at birth in which most of the brain is missing.
- * **congenital** (kon-JEH-nih-tul) means present at birth.
- * **genetics** (juh-NEH-tiks) is the branch of science that deals with heredity and the ways in which genes control the development and maintenance of organisms.
- * **nucleus** is the part of the cell that contains its genetic information.
- * **chromosomes** (KRO-mo-somz) are threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.
- * **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

Birth Defects and Brain Development

Birth defects are abnormalities in the body structure or chemistry that occur while the fetus is developing in the mother's uterus. Hereditary or genetic causes, environmental influences, or a combination of factors may affect the embryo or fetus before it is born. Sometimes, the cause of a birth defect is unknown.*

What Are Birth Defects?

In 1994 and 1995, a number of infants along the Rio Grande in Texas and Mexico were born without a brain, a condition called anencephaly (an-en-SEF-a-lee). Some professionals suspected that the birth defects occurred when mothers were exposed to pollution in the environment. Although in the early 2000s there continued to be many unknowns about causes of birth defects, scientists knew that the human embryo is exceedingly vulnerable to drugs, viruses, and radiation during the first several months when critical systems are forming.

Some birth defects are inherited from parents, and others are acquired through the mother's contact with the environment or with disease. According to the March of Dimes, 3 to 5 percent of babies born in the United States have some type of birth defect. Some birth defects, such as anencephaly*, occur infrequently. Others, such as some congenital* heart defects, are more common. Some hereditary defects are more common in certain populations than in others.

Genetics, Embryology, and Birth Defects

The development of powerful electron microscopes has enabled the rapid increase in investigations in genetics* and embryology in the twenty-first century. Traditionally, geneticists have studied genes and chromosomes, and embryologists have studied the development of fetuses. However, in the early 2000s, areas of research combined genetics and embryology to understand why individuals develop birth defects. Study of the interplay between genetic and environmental factors of the uterus allowed scientists to understand these developmental abnormalities in humans.

Genetics In the nucleus* of most cells about six feet of deoxyribonucleic acid (DNA) are packaged into 23 pairs of chromosomes*, threadlike structures inside cells on which the genes* are located. Each gene is a segment of DNA that holds the recipe for making a specific molecule, usually a protein. These recipes are spelled out in varying sequences of the four chemical bases in DNA: adenine (A), thymine (T), guanine (G), and cytosine (C). A is always paired with T; G is always paired with C. The two are called base pairs. The DNA molecule looks like two ladders with

a side taken off and twisted together; the rungs of the ladders are the base pairs. Millions of these base pairs can make up a single gene. These genes direct the growth and characteristics of the organism through the production of chemical proteins. Proteins are made up of amino acids and are the essential components of all organs and chemical activities. Their functions depend on their shape and are determined by the 30,000 genes in the cell nucleus. The complete makeup of the genes of an individual is called the genome. Of course, with so many chemical reactions going on, various problems may develop.

Embryology The origin of the genetic material or DNA that a person inherits begins in the reproductive systems of parents. Sperm and egg (ova) or cells, called gametes carrying half of the parent's genes are created through a process called meiosis* or reduction division. In this complex process, the parent cells in the testes (sperm) of the male and the ovaries of the female (ovum) reduce their DNA by half so that they can join together and make a fertilized egg that contains one gene from the mother and one gene from the father. Human body cells or somatic cells have the full set of 46 chromosomes. However, each gamete has only half that number, or 23. In males, meiosis takes place in the testicles and occurs about every 74 hours, beginning at about 12 to 13 years of age and continuing through life. Millions of sperm are produced daily, but as many as 20 percent may be defective. A more complex process of meiosis occurs in females, beginning about the fifth month after conception when immature ova are formed. The ova remain in the premature form in the ovaries until hormones signal the release. The egg does not complete its development until conception when chemical changes occur as the main part of the sperm enters the ovum. Unlike the male, the female is born with all the ova she will ever have. At fertilization or conception, the 23 chromosomes of the father and 23 of the mother create a completely new individual with 46 chromosomes and a unique genetic makeup.

Scientists have come a long way in understanding the development of the embryo *in utero*, the Latin term for "in the uterus". This knowledge assists their understanding of genetic and birth defects. In the early stages of development, the fertilized egg (now called a zygote) divides to form a blastocyst; some of these cells become the three layers of the embryo:

- Ectoderm: the outer layer that gives rise to the hair, nails, skin, sense organs, brain, and spinal cord
- Mesoderm: the middle layer that gives rise to bones, muscles, circulatory and most of the reproductive organs
- Endoderm: the inner layer that eventually links the body cavity, the respiratory system, digestive tract, and many glands

During the first week the ovum that has been fertilized in the fallopian tube reaches the uterus and implants in the uterus. At about 12 days after conception, a band called the primitive streak appears along the back of the mass of cells; the neural tube, which develops into the spinal cord



▲ Butch Lumpkin uses an extra long driver to hit a tee shot at the BMW Charity Pro-Am on May 16, 2008. *Stan Badzi/PGA Tour/Getty Images.*

* **meiosis** (my-OH-sis) is the process of reduction division in which the number of chromosomes per cell is cut in half.

* **sickle-cell disease** is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.

and brain, begins to develop at about this time and continues to develop throughout pregnancy. At about five weeks the general form of the human body becomes evident with traces of hands, feet, clavicle, and lower jaw. During the first 12 weeks of development, the cells of the embryo are rapidly dividing and becoming muscles, bones, and organs. Although during the first three months, the embryo is most vulnerable, at any time during the remaining six months, the fragile fetus is susceptible to many factors that affect development.

How Do Hereditary Factors Cause Birth Defects?

Hereditary birth defects are caused when a mistake is made as DNA divides and forms a template to transcribe copies. Then a process called translation enters in to create the final product. Many disorders of genetic origin occur in translation; the final product will be a mutation or change from the normal final product. One might relate the process to a group of workers on an assembly line making peanut butter and jelly sandwiches. Each person has a job to do: Unwrapping the loaf of bread, spreading the peanut butter, spreading the jelly, putting the top and bottom slices together. The process moves like clockwork, but if the jelly spreader drops his knife and misses out on his job, no jelly will be on the next sandwich. This simple illustration shows how one small slip can change the outcome of a product. Likewise, even small changes in the primary structure of a protein may affect the protein's properties. For example, in sickle-cell disease*, a single molecule of valine replaces the glutamic acid molecule that makes hemoglobin, the protein that carries oxygen in the red blood cells. The tiny error, one incorrect amino acid in a series of 287 amino acids, causes a change in the chemistry of the hemoglobin molecule that results in a deformity in the red blood cell and causes all of the problems of sickle-cell anemia. When chemist Linus Pauling (1901–1994) discovered this fact in the early 1950s, the science of molecular biology began.

Some diseases develop through random mutation to act as protection against prevalent conditions in certain areas. In the 1940s Anthony Allison from Kenya studied the blood of people living in malarial areas of Africa. He found that those individuals who had sickle cells, and even those with only one defective gene and therefore have the sickle-cell trait and not the disease, were less likely to contract malaria. Thus those individuals with a mutant gene have a survival advantage when they live in malarial areas. This correlation explains why the mutant gene is so prevalent in those areas. However, the gene was carried to the United States by slaves and persists in the U.S. population in the early 2000s even though malaria is extremely rare in the United States. Likewise, Tay-Sachs disease evolved among the Ashkenazi Jews from a single town in Poland. The mutations offered the carriers protection against tuberculosis but had a lethal effect on some of the population. Current incidences of sickle-cell disease and Tay-Sachs disease are a high price to pay for diseases of the past. Fortunately, because of genetic testing and counseling, Tay-Sachs disease is very rare in the early 2000s. Because of preimplantation genetic

diagnosis, fertilized ova that lack the mutated gene for sickle cell can be selected for implantation thus ensuring a normal child.

Genetic birth defects can be dominant or recessive single-gene traits, X-linked disorders, multigene traits, or aberrations in chromosomes.

- **Single-gene dominant or Mendelian inheritance.** The simplest patterns of birth defect inheritance are named for the Austrian monk Gregor Mendel (1822–1884), who observed them in the nineteenth century. In Mendelian inheritance, traits (both normal and defects) can be transmitted by way of dominant or recessive genes. A child inherits two copies of each gene, one from the mother and one from the father. If a defective gene is dominant, a child who inherits even one copy will have the defect. That is because the defective copy “dominates,” or overwhelms, the normal copy inherited from the other parent. Many of these defects may not show up until later life. Examples are Huntington’s disease and Lou Gehrig’s disease (nervous system disorders). Marfan syndrome is characterized by tallness and heart disorders, and certain kidney and cholesterol diseases.
- **Single-gene recessive traits.** According to Mendelian law, if a defective gene is recessive, the child must inherit two defective copies—one from the mother and one from the father—in order to have the defect. A person who inherits only one defective copy is healthy but can pass the defective copy on to his or her own children. Many of these disorders are rare but can be traced to specific mutations in the genes that produce enzymes. For example, thalassemia, a condition common in populations bordering the Mediterranean Sea, affects the hemoglobin. Cystic fibrosis affects the lungs and pancreas and is one of the most damaging of genetic disorders.
- **X-linked disorders.** Genes located on the X chromosome (the X and Y chromosomes determine the sex of an infant: two X chromosomes produce a female and an X and a Y chromosome produces a male) can cause birth defects. Such abnormalities are said to be X-linked. Hemophilia, a blood disorder; X-linked severe combined immunodeficiency (SCID), an immune disorder; Duchenne muscular dystrophy; and color blindness are examples of X-linked birth defects.
- **Multigene traits.** Interaction of several genes can cause certain defects. Many of these occur later in life and include Parkinson’s disease, epilepsy*, and Alzheimer’s disease.
- **Chromosome abnormalities.** Extra, missing, incomplete, or misshapen chromosomes cause some birth defects. Down syndrome, a condition caused by three copies of chromosome 21 or Trisomy 21, is one of the most common birth defects. Down syndrome produces mental retardation*, short stature, and distinctive facial features. Defects involving the sex chromosomes can produce problems in sexual development, including sterility, which is an inability to have children.

* **epilepsy** (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person’s awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.

* **mental retardation** is a condition in which people have below average intelligence that limits their ability to function normally.

- **Inborn errors of metabolism.** Metabolic disorders are related to faulty genes that control chemical reactions of the body, producing energy from food or supporting the growth of the body. The two most common metabolic disorders are phenylketonuria (PKU), a disorder in which the child cannot handle the chemical phenylalanine; the child must be placed on a special diet for life. The second metabolic disease is hypothyroidism in which the thyroid gland under produces hormones necessary for body functions.

How Do Environmental Factors Cause Birth Defects?

Starting at conception, the developing embryo is susceptible to many factors that affect development. Birth defects also can be caused by environmental factors, either alone or together with faulty genes. Environmental factors include the environment in the mother's uterus, or womb, and the possible influence of poisons in the earth's environment. Following are some common types of serious brain defects and their possible causes:

- **Anencephaly.** This fatal defect occurs when the neural tube fails to close during early development, and the child is born with a missing brain or only the parts that control processes such as breathing. Although the exact cause is not known, the condition has been linked to the nutrition of the mother and lower than normal levels of the B vitamin folic acid; pollution is also suspected.
- **Spina bifida.** In this disorder the failure of the neural tube to close properly causes an opening in the spinal cord and spinal column. This birth defect is one of the most common involving the nervous system and may be related to folic acid deficiency.
- **Cerebral palsy.** Cerebral palsy causes damage to the motor control centers of the young developing brain and can occur during pregnancy (about 75%), during childbirth (about 5%), or after birth (about 15%) up to about age three. However, about 80 percent of causes are unknown but may be traced to infection, malnutrition, and head trauma.

During the first weeks of embryonic development, exposure to toxins may disrupt the development of the offspring and cause serious birth defects. Certain agents may have a teratogenic effect on the embryo. The word "teratogen" literally means "giving rise to monsters." There are several known teratogens:

- **Alcohol.** Women who consume excessive amounts of alcohol during the early stages of pregnancy risk having babies with fetal alcohol syndrome (FAS). Children with this disorder may have various defects in growth, facial appearance, and mental ability.
- **Tobacco.** Nicotine from cigarette smoke in the mother's bloodstream is passed to the developing fetus and causes a variety of problems, including low birth weight, birth defects, and sudden

infant death syndrome (SIDS). Also, smoking causes the oxygen level of the mother to fall causing a condition called fetal hypoxia, which may damage the developing fetus.

- **Medications and street drugs.** Illegal drugs such as amphetamines, cocaine, and heroin may damage the developing central nervous system of the fetus and lead to birth defects. Even prescription and over-the-counter drugs can affect the fetus. Thalidomide was prescribed to pregnant women to combat morning sickness, and the drug caused babies to be born with defective limbs. Accutane, a medication given for severe acne, was linked to birth defects.

Environmental hazards may act as teratogens. Exposure to chemicals or other toxins in the environment may contribute to birth defects. Pregnant women should avoid weed killers, insecticides, and even certain household cleaning agents. An increase in birth defects has occurred after atomic bomb attacks, bomb tests, and use of certain munitions, such as the following:

- **Atomic bomb blasts.** Extensive lab tests have shown that human DNA exposed to radiation may break apart and rejoin in patterns differing from the original forms, causing mutations. Stages of embryonic development are sensitive to radiation. In Nagasaki and Hiroshima, where the United States dropped the atom bomb in World War II, the probability of severe mental retardation is strongly associated with the degree to which the mother was exposed to radiation. Women exposed during the third and fourth months had children with deformities such as facial clefts or too many fingers and toes; interestingly, embryos in other stages of development did not exhibit deformities. In the late 1950s studies of IQ tests showed survivors lost approximately five points and performed at a decreased level in school.
- **Dioxin or agent orange.** Agent orange was designed to defoliate the jungle, thus destroying coverage to Vietcong guerrilla soldiers in the Vietnam conflict. The virulent poison killed the rainforest and then got into the food chain, which led to a number of birth deformities. In Vietnam, some 150,000 children with birth defects can be traced to the parents' exposure to Agent Orange or to consuming dioxin in contaminated food and water.
- **U-238 or DU.** Depleted uranium (DU) or U-238 is a toxic, heavy metal byproduct that is used in munitions, ballasts for airplanes, tank armor, and other products. Since 1991 cancer rates in Iraq have risen tenfold, and the number of birth defects has multiplied fivefold. Internalized DU has been found to induce DNA damage and cancerous lesions in cells that make up bones in the body.
- **Bombing practice in Vieques.** Since 1941 Vieques in Puerto Rico has been used by the U.S. Navy for target practice. When a DU round is fired, 60 percent of its mass ends up as microscopic aerosol particles in the air, which can be carried to other areas. Breathing

Thalidomide and Phocomelia

In Europe in the late 1950s and early 1960s thalidomide, a sedative, was prescribed for pregnant women until it was linked to phocomelia (fo-ko-MEE-lee-ah), a birth defect in which the arms and legs had a flipper-like appearance and were very short and underdeveloped. If taken in the early months of pregnancy, thalidomide affects the developing middle stem cell layer when the limb buds are forming. Twelve thousand children with deformities in 46 countries were traced to thalidomide. Fortunately for Americans, thalidomide was never sold in the United States because Dr. Frances Kelsey of the Food and Drug Administration refused to approve it, insisting thalidomide's safety had not been proven.

the material can cause a host of problems, including possible birth defects. The United States is not the only country to use DU munitions; 18 countries including Israel, Saudi Arabia, Turkey, and Taiwan have bought them.

What Diseases Cause Birth Defects?

A number of infectious diseases may also affect the developing embryo and fetus. Some of the diseases may not affect the mother but can be passed on to the unborn fetus. Infections that can have major effects on the fetus include the following:

- **Cytomegalovirus (CMV).** This common virus may pass from mother to fetus and usually causes few symptoms in the mother. However, the developing fetus may develop microcephaly or an abnormally small brain and head size and have a number of central nervous system (CNS) problems.

THE UNITED STATES AND THE WORLD

- One of every 33 babies in the United States is born with a birth defect.
- Each year 7.9 million children (6% of total births) are born with serious birth defects of genetic or partial genetic origin.
- Each year hundreds of thousands additional children are born with non-genetic birth defects.
- An estimated 3.3 million children under the age of five years of age die of birth defects each year. Of those, about 95 percent live in countries with low or middle income.
- More than 28 million people worldwide live with birth defects, and about 94 percent live in countries with low or middle income.
- Birth defects are the leading cause of infant mortality in the United States. In 2003, 5,621 children died before their first birthdays because they had one or more birth defects. That number is 20 percent of all children who died under the age of one year.
- More than a million worldwide each year have heart defects, the most common birth defect.
- Neural tube defects, including spina bifida, total nearly 324,000 births worldwide yearly.
- The death rate from birth defects in the United States dropped 37.7 percent between 1979 and 1997. One reason for the decrease is improved medical care for infants with birth defects.
- Children with birth defects who survive their first year still may die of complications from the defects later in life. In 1997, 11,912 people of all ages died of birth defects, with only about half under the age of one year.

- **Syphilis.** This sexually transmitted bacterial disease can be passed to the fetus. The risk is 60 to 80 percent if the mother is infected and does not receive treatment that the bacteria will affect the CNS, causing meningitis or hydrocephalus*.
- **Rubella (German measles).** An expectant mother who has not been vaccinated for rubella may pass the virus to the developing fetus, in which the brain and CNS are affected. The child may have cerebral palsy or mental retardation, among other problems. Rubella can cause deafness, blindness, and heart defects in the newborn.
- **Toxoplasmosis.** This infection is caused by a parasite found in undercooked meat and in cat stools. While there are no symptoms in the mother, the fetus is affected. The child may develop learning disabilities, movement problems, and vision loss. Pregnant women should avoid changing cat litter boxes.

* **hydrocephalus** (HY-droe-SEF-uh-lus) is a condition, sometimes present at birth, in which there is an abnormal buildup of fluid within the skull, leading to enlargement of the skull and pressure on the brain.

How Do Doctors Diagnose Birth Defects?

Some birth defects can be diagnosed while the unborn child is still in its mother's womb. A procedure called ultrasound, which uses sound waves to produce an image of a fetus on a screen, can detect some malformations. For example, a defect called spina bifida, in which a part of the spinal cord is exposed, can be discovered by ultrasound.

In a procedure called amniocentesis (am-nee-o-sen-TEE-sis), a small sample of fluid surrounding the fetus is removed through a needle and examined. This test is useful in detecting inborn metabolic (body chemistry) defects and abnormalities in the chromosomes.

Many birth defects can be diagnosed by a doctor's physical examination of a newborn baby. Other tests, including x-rays, may be ordered if doctors suspect a birth defect; blood tests can detect certain disorders of the blood or body chemistry. Many infants with defects can develop normally if they receive prompt treatment.

▶ *See also* **Anencephaly • Cerebral Palsy • Clef Palate • Clubfoot • Cystic Fibrosis • Deafness and Hearing Loss • Down Syndrome • Fetal Alcohol Spectrum Disorders (FASD) • Genetic Diseases • Huntington's Disease • Hydrocephalus • Marfan Syndrome • Phenylketonuria (PKU) • Radiation Exposure Conditions • Rubella (German Measles) • Sexually Transmitted Diseases (STDs) • Spina Bifida • Tay-Sachs Disease**

Resources

Books and Articles

- Kidd, J. S., and R. A. Kidd. *New Genetics: The Study of Lifelines*. New York: Chelsea House, 2006.
- Sheen, Barbara. *Birth Defects*. San Diego, CA: Lucent Books, 2005.
- Toriello, James. *The Human Genome Project*. New York: Rosen Group, 2003.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://cdc.gov/ncbddd/bd>.

March of Dimes. 1275 Mamaroneck Avenue, White Plains, NY, 10605. Toll free: 888-663-4637. Web site: <http://www.marchofdimes.com>, http://www.marchofdimes.com/professionals/871_18587.asp.

Birth Marks *See Skin Conditions.*

Bisexual Health *See Gay, Lesbian, Bisexual, and Transgender Health.*

Bites *See Animal Bites and Stings.*

Black Lung Disease *See Pneumoconiosis.*

Blackheads *See Acne.*

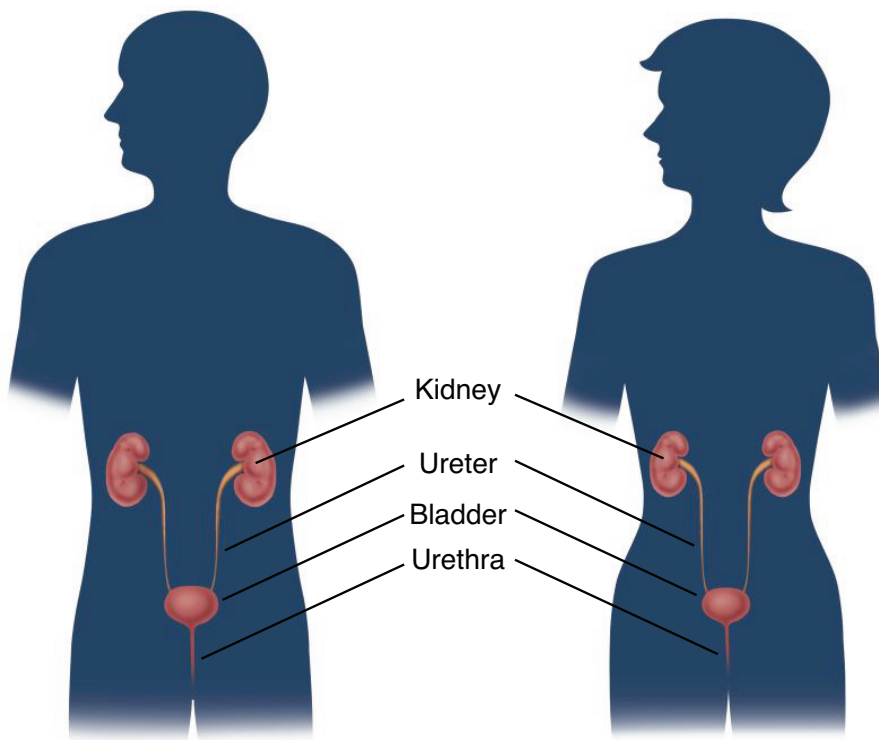
Bladder Cancer

Bladder cancer occurs when cells in the bladder, the muscular sac that stores urine, divide without control or order. Bladder cancer sometimes spreads to other parts of the body.

What Is Bladder Cancer?

The bladder is the hollow muscular sac in the lower abdomen* that stores urine, the liquid waste produced when the kidneys filter the blood. Cancer usually begins when cells on the surface of the bladder wall begin dividing without control or order, forming a growth called a tumor. Over time, this tumor can grow through the bladder wall and spread to nearby organs.

Each year, about 53,000 Americans—38,000 men and 18,000 women—learn that they have bladder cancer. Among men, it is the fourth



The bladder is the hollow muscular sac in the lower abdomen that stores urine (the waste produced when the kidneys filter the blood) prior to discharge from the body. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



leading cause of cancer. In women, it ranks eighth. Bladder cancer usually strikes between the ages of 50 and 70. Early symptoms typically include blood in the urine and frequent or painful urination. Other conditions can also cause these symptoms, making a visit to a doctor necessary.

Is There an Association between Smoking and Bladder Cancer?

Cigarette smoking is most commonly associated with lung cancer, but smokers are also two to three times more likely than nonsmokers to develop bladder cancer. Cigarette smoke contains harmful cancer-causing chemicals called carcinogens* (kar-SIN-o-jenz). People can greatly reduce their risk for bladder cancer by quitting smoking or not starting in the first place.

Some factories and industrial plants release chemical carcinogens, which may explain why bladder cancer is more common in urban areas than rural. Exposure to certain kinds of chemicals in the workplace also appears to increase risk, according to the American Cancer Society. These chemicals can be found in the rubber, chemical, and leather industries, as well as hairdressers, machinists, metal workers, printers, painters, dry cleaners, textile workers, and truck drivers. That does not mean that most workers in these professions will develop cancer. In fact, most will not. They should, however, be aware of their risk and take precautions to decrease their exposure to chemical carcinogens.

In many cases, though, bladder cancer seems to develop without an apparent specific cause.

* **carcinogens** (kar-SIH-no-jenz) are substances or agents that can cause cancer.

* **urethra** (yoo-REE-thra) is the tube through which urine passes from the bladder to the outside of the body.

* **biopsy** (Bl-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **chemotherapy** (KEE-mo-THER-ah-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

How Is Bladder Cancer Diagnosed and Treated?

Diagnosis When medical professionals want to evaluate someone for bladder cancer, they usually perform a physical exam and test a urine sample to check for blood and cancer cells. They also can insert a thin, lighted tube called a cystoscope (SIS-to-skope) through the urethra* to examine the lining of the bladder. If cancer is a possibility, they perform a biopsy*, the typical procedure involved when any type of cancer is suspected. A biopsy is the removal of a tissue sample, which is then examined under a microscope. The presence of cancer cells indicates the disease is present.

If cancer is found, doctors typically want to know the depth of penetration, which is a measure of how far the cancer has moved beyond the surface of the bladder; they also want to know whether the cancer has spread to other locations in the body. Both findings have an impact on prognosis, as well as on treatment options. To determine depth of penetration and cancer spread, medical professionals may perform tests that create images of the inside of the body. These include the following:

- **Intravenous pyelogram (IVP):** This is a sequence of x-rays of the kidneys and bladder performed following the injection of dye into a vein.
- **CT scans:** Also called computerized tomography scans, these are series of detailed pictures of areas inside the body and are created by a computer connected to an x-ray machine.
- **MRIs:** Magnetic resonance images are generated through a procedure that uses a large magnet linked to a computer.
- **Ultrasound:** These images are created by bouncing sound waves off tissues inside the body and converting the resulting echoes into pictures.
- **Bone scans:** Radioactive material is injected, and it eventually collects mostly in abnormal bones, and then a scanner detects these areas and images of the bones are created on a computer screen.
- **Chest x-rays:** These x-rays show abnormalities in the lung, heart, aorta, and the bones in the area between the throat and abdomen..

Treatment The usual treatments for bladder cancer are surgery, radiation therapy, chemotherapy*, biological therapy, or a combination of these. The selected treatment usually depends upon how much of the bladder is involved and whether the cancer has spread to other parts of the body. In almost all cases, a surgeon removes tumors and surrounding tissue that is affected.

If the tumors are only on the surface of the bladder wall, the doctor can burn them away through a process called fulguration (ful-gu-RAY-shun), which involves inserting a tool with a small wire loop on the end through the urethra.

If the cancer has grown into or through the bladder's muscular wall, a surgeon will remove part or all of the organ in a procedure called

cystectomy (sis-TEK-to-mee). Sometimes, nearby reproductive organs need to be removed as well.

Radiation therapy is another common treatment for bladder cancer. Internal radiation involves placing a small container of radioactive material, called a radiation implant, directly into the bladder to destroy the cancer cells. Radiation also can come from a machine outside the body that focuses high-energy rays on the affected area to kill cancer cells. Sometimes a patient receives radiation before or after surgery or along with anti-cancer drugs called chemotherapy.

Biological therapy, also known as immunotherapy, is a form of treatment that attempts to trigger the body's own disease-fighting immune system against the cancer.

Living with Bladder Cancer

People who have part or all of their bladder removed often have to make some adjustments in their activities of daily living. When people lose just part of the bladder, they may find that they need to go to the bathroom more frequently. When the entire bladder is taken out, they must learn a new way of emptying the urine from their bodies.

Urostomy Upon removing the bladder, surgeons construct a new passageway to take over the bladder's function in a procedure called a urostomy. They might use a piece of the small intestine to create a tube that carries the urine to an opening, called a stoma, in the stomach area where the urine can drain into an attached bag. The patient must empty the bag periodically. A later method uses part of the small intestine to create a storage pouch inside the body, collecting the urine there. Patients learn to use a tube called a catheter to drain the urine through either a stoma or the urethra. In some cases, patients may receive a replacement bladder called a neobladder, which is a pouch made out of intestinal tissue that patients can empty through muscular control. The surgery for neobladders is complex and may result in side effects, including incontinence (the inability to control urination).

Special therapists work with bladder cancer patients to teach them to care for themselves and their stomas after surgery. These therapists can answer questions, address emotional and physical concerns, and suggest sources of additional information about urostomy. People who have a urostomy usually can resume all the activities they enjoyed before the operation.

▶ See also **Cancer: Overview • Tumor**

Resources

Books and Articles

Ellsworth, Pamela, and Brett Carswell. *100 Questions & Answers about Bladder Cancer*. Sudbury, MA: Jones and Bartlett Publishers, 2006.

* **premature birth** (pre-ma-CHUR) means born too early. In humans, it means being born after a pregnancy term lasting less than 37 weeks.

Raghavan, Derek. *Bladder Cancer: A Cleveland Clinic Guide: Information for Patients and Caregivers*. Cleveland, OH: Cleveland Clinic Press, 2008.

Organization

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-ACS-2345. Web site: http://www.cancer.org/docroot/CRI/CRI_2_1x.asp?dt=44.

American Urological Association. 1000 Corporate Boulevard, Linthicum, MD, 21090. Toll free: 866-RING-AUA. Web site: <http://www.urologyhealth.org>.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://cancernet.nci.nih.gov/cancertopics/wyntk/bladder/page1>.

Bladder Infection See *Urinary Tract Infections*.

Bleeding See *Anemia, Bleeding, and Clotting*.

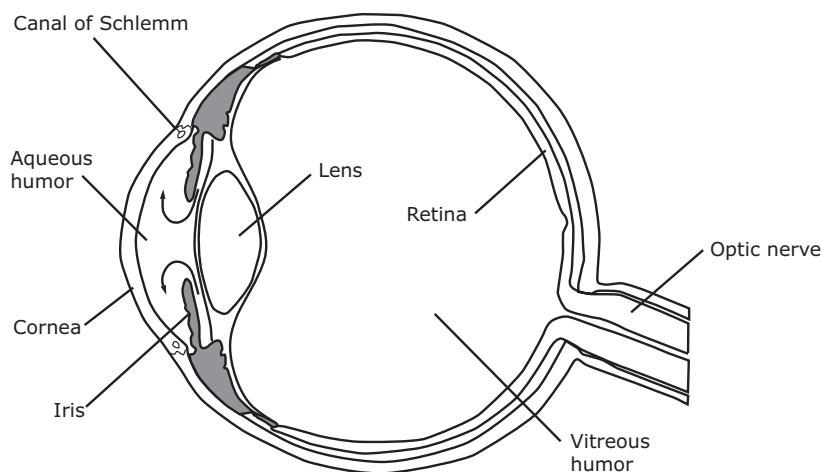
Blindness

Blindness is the absence of all or most vision.

Corrine's Story

Corrine tried to imagine how she would describe a bird to her sister Amy, who might never be able to see one. She could say that it is small, that it has feathers, and that it sings. At least those are the characteristics her sister can feel and hear. But how could she describe the red of a male cardinal and distinguish it from the reddish-brown of a female cardinal, when Amy might never see anything at all? And what about all the other things Corrine's sister might not see: the television shows and the movies, the picture books Corrine saved to give her, the blue sky, the faces of their mom and dad?

Corrine's sister Amy was born prematurely*. The doctors told Amy's family that she had retinopathy (ret-i-NOP-a-thee) of prematurity. This condition, which results when the blood vessels in the eyes of a premature



Anatomy of the eye. The optic nerve (also referred to as the second cranial nerve) sends messages from the eye to the brain, making it possible to see.

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



baby grow abnormally and cause bleeding and scarring, may result in total or partial blindness.

What Is Blindness?

Blindness is complete loss of vision, as well as seriously compromised vision as described in the section on diagnosis below. A variety of diseases and injuries can cause blindness. Some people can take advantage of treatments to restore partial or complete eyesight, but many others who are blind must remain so for the rest of their lives.

Blindness can result from several breakdowns in the visual system, which includes the eyes, the brain, and the nerve pathway that connects them. The first steps in vision occur when light enters the eye's pupil and passes through a transparent lens, which focuses it on the retina*. The retina contains millions of receptors called rods and cones. Rods help individuals see light and are especially useful in low-light conditions. Cones help people see light and colors and provide detail to the images they see. When light strikes the rods and cones, it activates chemicals that create electrical impulses. An optic nerve* tract transmits the impulses to a portion of the brain, known as the visual cortex*. The visual cortex translates the information from the nerves into the image that individuals ultimately see.

How Is Blindness Diagnosed?

Blindness is diagnosed through a standard eye test, called the Snellen test, that requires a patient to read from a test chart containing lines of increasingly smaller type. The notation for normal eyesight is 20/20 (or 6/6 in countries where metric measurements are used). Expressed as a fraction, this notation includes a numerator (the first number) that refers to the distance between the patient and the test chart, which is usually 20 feet (6 meters). The denominator (the second number) denotes the distance

* **retina** (RET-i-na) is the tissue that forms the inner surface of the back of the eyeballs; it receives the light that enters the eye and transmits it through the optic nerves to the brain to produce visual images.

* **optic nerve** is the nerve that sends messages, or conducts impulses, from the eyes to the brain, making it possible to see. The optic nerve is also referred to as the second cranial nerve.

* **visual cortex** is a portion of the brain's cerebrum that processes visual information transmitted from the eyes.

Helen Keller

Helen Keller (1880–1968) became a writer and activist despite losing her sight and her hearing before she was two years old. She was able to communicate using the manual alphabet after she learned to associate the movements of another person's hands with letters, words, and the objects around her.

During the 1930s Helen Keller lobbied the U.S. Congress to provide federally funded reading services for people who are blind. Her efforts resulted in the inclusion of Title X in the 1935 Social Security Act, establishing federal grant assistance for the blind.

The story of Helen Keller's life, and the role of her teacher, Anne Sullivan, was made into the movie *The Miracle Worker* (1962), which won Academy Awards for actors Patty Duke and Anne Bancroft. It is available on video and DVD and is often broadcast on television.

* **strabismus** is a condition that causes the eyes to cross or not work together correctly, which may lead to permanent loss of vision in one eye.

* **glaucoma** is a group of disorders that cause pressure to build in the eye, which may result in vision loss.

* **cataracts** (KAH-tuh-rakts) are areas of cloudiness of the lens of the eye that can interfere with vision.

at which a normal-sighted person could read the line with the smallest letters that the patient is able to decipher. For example, if the patient's visual acuity is 20/100, the patient can correctly read at 20 feet a line that a person with normal vision can read at 100 feet. People are considered to have visual impairment if their vision cannot be corrected with eyeglasses or contact lenses to better than 20/40.

Besides using the Snellen test to determine the acuity or sharpness of central vision, medical professionals also check for loss in patients' field of view, including their side or peripheral vision. In a typical peripheral-vision test, a doctor asks a patient to look straight ahead and to announce when an object that is moving along one side or the other disappears from view. A person is defined as blind if individual has a visual field of less than 20 degrees.

In all, about 130,000 people in the United States are totally blind, about 1.2 million are legally blind but have some vision capability, and more than 8 million Americans have a visual impairment, according to the American Federation for the Blind.

What Treatments Are Available?

Corrine's sister Amy might not lose her vision. As of the early 2000s doctors could use a probe to "freeze" parts of the eye or a laser to burn areas of the retina and prevent permanent damage from retinopathy of prematurity. Thousands of other people with potentially vision-threatening conditions, such as strabismus*, glaucoma*, and cataracts*, can also benefit from treatments, especially if the disorders are detected early. As of 2009 many patients and medical professionals were hopeful about ongoing attempts to use computerized sensing devices and various implants at the visual cortex, the retina, or other sites to replace damaged portions of the normal visual system. These attempts, some of which also included cameras, were believed to have the potential to restore sight, at least partially.

Other individuals whose conditions may not be reversed or improved through available treatment options may benefit from special devices such as voice-recognition software for computers and from programs that train guide dogs to assist with daily tasks such as walking, going to school, and working. A large percentage of people who are legally blind or visually impaired, however, still have sufficient visual capabilities to do many of the same activities that people with normal sight perform, including reading books and newspapers, participating in some sports, and navigating independently through their daily routines.

What Causes Blindness?

Many conditions may cause blindness. The most common cause of vision loss in infants and young children is amblyopia (am-ble-O-pe-a).

Amblyopia Amblyopia, sometimes called lazy eye, is reduced vision in one eye. Although it can result from several conditions, it most frequently

TRACHOMA

Trachoma is a chronic infection of the eye by *Chlamydia trachomatis* bacteria. The bacteria infect the linings of the eyelid, causing them to become thick and rough. If the condition is untreated or if the infection returns, the eyelashes can turn inward and cause small scars on the eyes' surfaces. Eventually, blindness results. Trachoma is the leading cause of preventable blindness in the world.

Trachoma is spread through contact with the discharge from the eyes of infected persons. For example, if infected individuals rub their eyes and then shake another person's hands, the bacteria that cause trachoma can be transmitted to the other person. The bacteria may also transfer to an uninfected person if that individual uses the handkerchief or towel of an infected person.

Trachoma is especially common in developing countries where people live in overcrowded conditions and have inadequate access to clean water and effective health care. According to the World Health Organization (WHO), 6 million people worldwide have become blind from the disease, and more than 2 percent of the global population—150 million individuals—need treatment, although it is often unavailable.

Treatment, including the use of antibiotic ointments and oral antibiotics, can stop trachoma before it causes blindness. Some individuals may also benefit from surgery on the eyelids. WHO has established a Global Alliance for the Elimination of Trachoma that hopes to stop trachoma by the year 2020 through treatment and prevention.

arises as a consequence of constant strabismus (stra-BIZ-mus), in which one eye consistently turns away from an object under view and may give a person a cross-eyed appearance. About 3 to 5 percent of children have either constant strabismus or intermittent strabismus (in which the eye's deviation only occurs occasionally). Of these, an estimated 30 to 50 percent develop amblyopia. In most cases, strabismus has no known cause. Early detection of amblyopia can often lead to successful treatment. Treatment may include an eye patch placed over the stronger eye to help strengthen the affected eye, or in some cases, surgery is performed to align the affected eye correctly.

Cataracts Some children are born with cataracts, which cloud the lens in the eye and prevent images from being seen clearly or at all. People also develop cataracts as they age, which makes it one of the most common causes of reduced vision. More than 400,000 new cases of cataracts develop each year in the United States. Surgery to remove cataracts is common for adults and for those few children with them. This procedure restores vision in more than 95 percent of cases.



▲ Guide dogs wear a special harness when they work, but may switch to a regular leash during their off-duty hours. It is important not to approach or play with a guide dog when it is working. *Peter Skinner/Photo Researchers, Inc.*

Diabetes Diabetes may lead to vision loss if diabetic retinopathy develops. Diabetic retinopathy, one of the leading causes of blindness in adults, results in vision loss if blood vessels supplying the eye's retina are damaged by the disease. The blood vessels sometimes leak or break open to damage the retina. More vessels may also grow and start to cover the retina or grow into the fluid that fills the eyeball, further reducing vision.

According to the National Diabetes Information Clearinghouse, doctors have diagnosed diabetes in 14.6 million people in the United States. In addition, 6.2 million likely have the disease, although it is still undiagnosed. Of this 20.8 million total, the clearinghouse reports that diabetic retinopathy is quite common and leads to an estimated 12,000 to 24,000 new cases of blindness annually. Almost all people with diabetes can show signs of damage to their retina after two or three decades of living with the disease. Diabetic retinopathy has no symptoms at first, but as the damage increases, vision becomes blurred. Doctors typically recommend that people with diabetes undergo annual vision exams, which include the use of a device that can spot damage to the retina.

The best treatment for diabetic retinopathy is prevention, which means managing diabetes (and high blood pressure, if present) with proper nutrition, exercise, and medications. In some cases, laser treatment may avert worsening of diabetic retinopathy. Besides this potentially blinding condition, people with diabetes also are at higher risk for cataracts and glaucoma.

Glaucoma Glaucoma is a disorder that causes fluid pressure to build up inside the eye and may cause optic nerve damage. The disorder may go undetected for many years before its effects on vision are noticed. Glaucoma is one of the leading causes of blindness in the United States, with elderly people and people of African ancestry at increased risk.

Macular degeneration Macular degeneration is similar to diabetic retinopathy. Changes in the blood vessels supplying the central portion of the retina, known as the macula, cause the vessels to leak and to damage cells that are needed for the central part of the field of vision. Peripheral or side vision usually remains, but without treatment, the damaged field of vision may expand. Doctors sometimes recommend laser surgery to treat the leaking blood vessels when people are in the early stages of macular degeneration in order to prevent or slow progressive vision loss. Others compensate for vision loss by using magnifying devices. According to the American Macular Degeneration Foundation, the disease affects more than 10 million Americans.

Infections Ocular (OK-yoo-lar) herpes may cause vision loss as a result of herpes virus infections, usually the herpes simplex virus that causes cold sores or the herpes zoster virus that causes chickenpox and shingles. The National Eye Institute estimates that ocular herpes affects approximately 400,000 people in the United States.

A BEST FRIEND

Dorothy Harrison Eustis (1886–1946) was an American living in Europe when she first saw German shepherd dogs used as guides for people with blindness. The dogs were part of a program to help former soldiers who had been blinded in World War I.

She was impressed. The dogs allowed the retired soldiers to live more independently. With the dogs as their guides, the blind men could walk through and across crowded streets. Eustis wrote in 1927 about one such man: “No longer a care and a responsibility to his family and friends, he can take up his life where he left it off; no longer dependent on a member of the family, he can come and go as he pleases. . . .”

Eustis returned to the United States in 1929 and founded the first school to train guide dogs in Nashville, Tennessee. Called the Seeing Eye, the school moved to Morristown, New Jersey, in 1931, where it remains.

Guide dogs are often German shepherds, although Labrador and golden retrievers, boxers, and even mixed breeds may also serve well. The dogs begin their training at about 18 months of age with a sighted trainer. After a careful match is made between the dog and a person who is blind, the person spends three or four weeks working with the trainer and the dog.

During this continued training, the dogs learn when to stop and when to proceed at street corners based on commands from their owners. The dogs do not read traffic signs or lights because dogs are color blind. Rather, the owner listens for traffic and, when the road sounds clear, tells the dog to cross. If danger is present, however, the dog’s training will override the order. Dogs also steer owners away from people and from objects in their path.

Infection of the eyes by the *Chlamydia trachomatis* organism is a leading cause of blindness in developing nations. The eyes of newborn babies may become infected during childbirth if the mother has chlamydia.

Accidents About 15 percent of cases of blindness in adults and 8 percent in children result from accidents, according to a 2004 report from the National Center for Policy Research for Women and Families.

How Do People with Vision Loss and Blindness Adapt?

Millions of people who have visual impairments, including more than 1 million people who are legally or totally blind, can engage in many of the same activities that people with normal vision perform. People with partial sight can use powerful eyeglasses and magnifying devices to improve their ability to read and to see objects. People with blindness can also do the following:

- listen to books, newspapers, and magazines on tape
- use computers that read text aloud and respond to spoken commands

The United States and the World

- According to the American Foundation for the Blind, 1.3 million people in the United States are legally blind, which means that even with correction, the better of their two eyes has central visual acuity less than 20/200.
- At least 37 million people are blind worldwide, and another 124 million have visual impairment, according to the World Health Organization.
- Approximately 100 million people in the United States need eyeglasses to see clearly, and 14 million have visual impairments that cannot be corrected with glasses.
- Blindness and eye disabilities are expected to increase substantially because the large number of people who were born shortly after World War II (1945–1964), and are called post-war baby boomers, are in the early 2000s reaching the age when many eye disorders are more likely to occur. A 2004 report in the Archives of Ophthalmology estimated that by 2020, 5.5 million Americans aged 40 years old and above would experience blindness or low vision. This represents a 66 percent increase from 2004 numbers.

- read Braille, a system that translates letters into patterns of raised dots that are read by touching them
- use guide dogs to increase their safe mobility
- take many of the same classes, jobs, and roles as people with sight
- become parents and teachers
- become famous entertainers (if they are talented), such as singers Stevie Wonder, Ronnie Milsap, Heather Hutchison, and the late Ray Charles.

▶ *See also* **Cataracts • Chlamydial Infections • Color Blindness • Diabetes • Farsightedness • Glaucoma • Herpes Simplex Virus Infections • Nearsightedness • Strabismus**

Resources

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Delta Gamma Center for Children with Visual Impairments. *A Look Into Our "I's": A Compilation of Introspective Writings from a Group of Extraordinary Young People with Visual Impairments*. [St. Louis, MO]: Delta Gamma Center, 2006.

Organizations

American Council of the Blind. 1155 Fifteenth Street NW, Suite 1004, Washington, DC, 20005. Toll free: 800-424-8666. Web site: <http://www.acb.org>.

American Foundation for the Blind. 11 Penn Plaza, Suite 300, New York, NY, 10001. Telephone: 212-502-7600. Web site: <http://www.afb.org>.

Lighthouse International. 111 East 59th Street, New York, NY, 10022-1202. Telephone: 212-821-9200 or 212-821-9713 (TTY). Web site: <http://www.lighthouse.org>.

National Eye Institute. 2020 Vision Place, Bethesda, MD, 20892-3655. Web site: <http://www.nei.nih.gov>.

National Federation of the Blind. 1800 Johnson Street, Baltimore, MD, 21230. Telephone: 410-659-9314. Web site: <http://www.nfb.org>.

Research to Prevent Blindness. 645 Madison Avenue, Floor 21, New York, NY, 10022-1010. Toll free: 800-621-0026. Web site: <http://www.rpbusa.org>.

Seeing Eye Inc. P.O. Box 375, Morristown, NJ, 07963-0375. Toll free: 973-539-4425. Web site: <http://www.seeingeye.org>.

Body Defenses See *Immune System and Other Body Defenses*.

Body Image

Body image is a person's impressions, thoughts, feelings, and opinions about his or her body. A person's perception of body image may be influenced by his or her mood, self-esteem, and relationships with other peers.

Questions Teens Ask Themselves

"I'm fat." "I wish I had curly hair." "Why haven't I had a growth spurt yet?" "No one else in my class has diabetes." "Will I ever be strong enough to play on the football team?"

Most teenagers have similar questions and concerns about their bodies. They think a lot about their appearance, which seems in a constant state of change during adolescence. All individuals have an "image" of their body and appearance and how well it fits in with what they consider normal, acceptable, or attractive. For adolescents, body image is a big part of their total self-image.

Am I Fat?

Too much focus on physical appearance can create body image problems, especially for females. Even those of normal healthy body weight can feel fat when comparing themselves to super-thin models and movie stars. Studies have found that 80 percent of adolescent girls feel fat, and up to 70 percent of adolescent girls are on a diet at any given time. Four out of five American women are dissatisfied with their appearance, and half of American women are on a diet. These attitudes and behaviors are showing up at younger ages. One study found that half of the girls in grades three through six want to be thinner, and 33 percent of them have already tried to lose weight. Dissatisfaction with body image and the quest for perfection can lead to feelings of failure, unhealthy dieting, and serious eating disorders.

Why Is Body Image So Important to Adolescents?

Teenagers' bodies undergo so many changes that it is easy to understand why they may be preoccupied with their appearance and their body image. Both boys and girls experience growth spurts and sexual development. Girls' breasts and hips enlarge, body hair grows, and menstruation* is beginning. Boys' muscles grow, their voices get deeper, and their testicles and penises get larger. Their facial features may change, and hormones may cause skin problems. It takes a while to get used to their new "image" or appearance.

Teenagers are very susceptible to criticism, teasing, or negative comments. Some teenagers lose confidence in their appearance if they receive

* **menstruation** (men-stroo-AY-shun) is the discharge of the blood-enriched lining of the uterus. Menstruation normally occurs in females who are physically mature enough to bear children. Most girls have their first period between the age of 9 and 16. Menstruation ceases during pregnancy and after menopause. Because it usually occurs at about four-week intervals, it is often called the monthly period.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

* **acne** (AK-nee) is a condition in which pimples, blackheads, whiteheads, and sometimes deeper lumps occur on the skin.

negative or insulting comments about their looks, racial or ethnic features, physical abilities, or body changes associated with puberty*. With all of the focus on the body's appearance, teenagers may need to be reminded to give equal value to other important aspects of themselves, such as personality, inner strengths, mental aptitudes, and artistic and musical talents, which, along with body image, contribute to overall self-image.

What Are Normal Concerns about Appearance?

Most people pay attention to their appearance. They may check themselves in the mirror, think about which clothes look nice on them, and try to look their best. Adolescents, whose bodies are changing dramatically, are notorious for paying special attention to their appearance. It is typical for adolescents to feel self-conscious about their looks at times, especially the appearance changes triggered by puberty.

Jack feels self-conscious about his lack of body hair, while his friend Ben thinks that he has too much. Both boys feel a bit uncomfortable when they first get on the court for basketball practice because their uniforms reveal their legs, upper chest, and armpits. Terry feels self-conscious about having some acne* and did not want his girlfriend to take his picture at the class picnic. Anna finds that her legs seem to be growing faster than the rest of her body, and her feelings were hurt when someone teased her by calling her a beanpole. Nick is sure he has not grown at all this year and does not like being shorter than most of the girls in his seventh grade class. Luckily, the awkward body changes of adolescence almost always even out eventually.

Some self-criticism involves aspects of appearance that have nothing to do with puberty. Megan dislikes the freckled skin on her arms. Darlene wishes her hair were straight instead of curly, while Angela wishes she had Darlene's waves. Andrea does not like her nose, and Paula wishes her lips were different. Jeanne thinks her complexion is too fair, and Derek thinks he is too dark-skinned.

Learning to like one's own body, coming to accept its imperfections, and growing to appreciate its unique beauty means having a healthy body image. Developing a healthy body image is an important task of adolescence.

What Are Extreme Concerns about Appearance?

Some people continue to have problems with body image long after adolescence is over. Body dysmorphic disorder (BDD) is a condition that involves extremely negative body image. BDD goes beyond self-criticism of one's features, concern with one's appearance, or poor body image. People who have BDD become overly preoccupied with what they see as flaws in their physical appearance, and they are often the only ones to perceive their features or characteristics as flaws. They may pick out tiny imperfections that others may not even notice and worry over these imperfections in a way that is out of proportion to their importance. Their self-criticism can leave them very distressed and too self-conscious to fully

enjoy life. People with BDD are plagued by critical thoughts about their appearance and have a distorted body image that causes them to believe that they are ugly.

Marianne spent hours each day worrying about whether the skin on her hands was too wrinkly. She looked at them over and over, checking to see if the wrinkles were deeper than they had been the day before. She used all types of lotions and creams but still felt that her hands were ugly. She never left the house without gloves, even in summer. She often called her sister to talk about the wrinkles, and her sister always said the same thing, “To me, your hands look the same as mine do, just like normal hands. I don’t know why you let this bother you so much. I wish I knew what to say to make you stop getting so worked up over your hands.”

Some experts estimate that BDD affects 1 to 2 percent of adults in the United States. Both males and females can have BDD. People with BDD, or “imagined ugliness”, often stay at home and often become depressed* or isolated, and many experience anxiety*. Some have unnecessary plastic surgery* or go to great lengths to change or hide aspects of their appearance. Preoccupation with their appearance can leave them distracted and unable to enjoy activities with family and friends. Experts say that people with BDD often engage in the following behaviors:

- complain about their appearance, focusing on particular traits
- look in the mirror frequently
- constantly try to fix, adjust, or hide their perceived flaws
- talk constantly about their perceived flaws
- ask others over and over for confirmation or reassurance about their appearance
- avoid situations where their flaws might be seen

What Leads to Body Image Problems?

Teenagers’ body images are strongly affected by what they see on television and in the movies. Magazines are filled with pictures of beautiful young women and lean and muscular young men. Teenagers are influenced by these images and may wish to look like their favorite models or stars. However, the degree of physical perfection that media images convey is largely an illusion created by professional makeup and styling, special lighting, and computerized alterations in photographs. When people compare themselves to these perfect-looking images, they are likely to be disappointed with their own appearance. Feeling the need to look perfect, or to have a perfect body, can lead to body image problems.

Body image problems affect both boys and girls, but they tend to bother girls more deeply than boys. One reason is that in American culture, girls’ and women’s value traditionally is linked closely to physical appearance. Boys’ appearance, while important, is not generally seen as their most important feature. Boys, however, often feel pressure to be tall, muscular, and strong.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person’s physical or mental well-being.

* **plastic surgery** is the surgical repair, restoration, or improvement in the shape and appearance of body parts.

WHAT DOES PERFECT MEAN?

Some girls are more influenced than others by the thinness craze. How much value a girl places on thinness may depend on how much value her cultural group gives it.

One study of about 300 American eighth and ninth grade girls suggested that certain cultural differences might affect girls' body image ideals. The study compared the body image of girls of European ancestry with the body image of girls of African ancestry.

Ninety percent of the girls of European ancestry in the study felt dissatisfied with their body weight and shape, whereas only 30 percent of the girls of African ancestry felt dissatisfied with their bodies. When asked to describe the "perfect girl," the descriptions by girls of European ancestry often focused on thinness as the key to popularity and happiness: For example, they described the perfect girl as someone who is 5 feet 7 inches tall and 100 to 110 pounds (a trim, healthy body weight for someone 5 feet 7 inches tall is about 125 pounds).

Girls of African ancestry were more likely to emphasize the importance of personality and to downplay the importance of physical traits and thinness when they described the perfect girl. They described the perfect girl as someone who is smart, enjoyable, easy to talk to, funny, and not conceited. They were more likely to describe beauty as an inner quality; in fact, two-thirds of them described beauty as the "right attitude." Their descriptions of the body weight and dimensions that they would like to have were more in line with healthy weights. Not surprisingly, studies have shown that there is lower incidence of anorexia and bulimia among girls of African ancestry than among girls of European ancestry.

Some teenagers have illnesses or disabilities that they cannot change. These conditions may challenge their body image at first. Teenagers who focus on what the body can do, rather than on what it cannot, learn that even with physical limitations, it is possible to develop a strong positive body image. Sometimes overcoming limitations caused by a disability can create an unexpected boost to body image. For example, Tyrie, who has used a wheelchair since age nine, began to race competitively as an adolescent. The upper body strength and physical endurance he has developed by training for races has given him new confidence in his body's capabilities. He is proud of his muscular arms and chest, not to mention his medals. Even though he does not walk, his friends see him as one of the strongest guys in the tenth grade.

When Are Body Image Problems a Sign of Other Problems?

Some teenagers are satisfied with how they look and feel confident about their appearance. Others are more self-critical and always come

up lacking when comparing themselves to others. Extreme dissatisfaction with body image can lead to depression, social isolation, or eating disorders*.

Sometimes body image can become distorted, and people may mistakenly believe themselves to be fat or ugly. These distorted or mistaken ideas can cause a person to feel extremely distressed, self-critical, and overly preoccupied with their physical imperfections. Someone who has a constant and distressing preoccupation with minor bodily imperfections may have BDD, an extremely distressing, obsessive preoccupation with perceived flaws in one's appearance.

What Causes Body Dysmorphic Disorder?

Although it may not be recognized and diagnosed until later, BDD usually begins before age 18. BDD usually starts during adolescence when the body undergoes many changes and when teenagers are forming ideas about what is acceptable or desirable in physical appearance. Media images that emphasize perfection, as well as a person's own extremely high expectations or perfectionism about appearance, can be factors in the development of BDD. Harsh critical comments or ridicule about appearance by family or friends can be destructive to a person's body image and may make a person more likely to develop BDD.

In addition to social influences that may cause body image to be negative or distorted, biological factors may make certain people more likely to develop BDD. Many experts believe that BDD is linked to obsessive-compulsive disorder* (OCD), which causes people to become extremely preoccupied with certain distressing thoughts. OCD also causes people to feel compelled to perform certain repetitive actions. BDD involves extreme preoccupation with appearance, harsh self-critical thoughts, and repeated checking or attempts to fix appearance.

How Is BDD Treated?

Because people with BDD are plagued by insecurity and self-consciousness and tend to isolate themselves, sometimes they alone know that they have this problem. Seeking treatment by a mental health professional can help relieve their distress. Treatment of BDD often involves psychotherapy that focuses on understanding the person's negative thoughts and opinions about his or her appearance, making needed adjustments in distorted thinking patterns about body image, and decreasing avoidance and repetitive thoughts and behaviors. Medications are sometimes used to relieve distress and to reduce anxiety or depression that can accompany BDD.

In some cases, a person's preoccupation with his or her appearance may actually be a symptom of another underlying disorder, such as an anxiety disorders*, an eating disorder, or OCD. Evaluation by a mental health professional can determine whether someone's BDD symptoms are connected to another problem. When that is the case, the person is treated for the other problem as well.

* **eating disorders** are conditions in which a person's eating behaviors and food habits are so unbalanced that they cause physical and emotional problems.

* **obsessive-compulsive disorder** is a condition that causes people to become trapped in a pattern of repeated, unwanted thoughts, called obsessions (ob-SESH-unz), and a pattern of repetitive behaviors, called compulsions (kom-PUL-shunz).

* **anxiety disorders** (ang-ZY-e-tee dis-OR-derz) are a group of conditions that cause people to feel extreme fear or worry that sometimes is accompanied by symptoms such as dizziness, chest pain, or difficulty sleeping or concentrating.

* **anorexia nervosa** (an-o-REK-se-a ner-VO-sa) is an emotional disorder characterized by dread of gaining weight, leading to self-starvation and dangerous loss of weight and malnutrition.

* **bulimia** (bu-LEE-me-a) is an eating disorder in which a person has episodes of out-of-control overeating, or binges, and then tries to make up for them by making themselves vomit, by taking laxatives, or by exercising to excess to avoid gaining weight.

* **psychotherapist** (sy-ko-THER-a-pist) is any mental health professional who works with people to help them change thoughts, actions, or relationships that play a part in their emotional or behavioral problems.

Can BDD Be Prevented?

Experts say that teenagers can help prevent BDD by getting help with body image concerns early. While it is normal for adolescents to feel self-conscious about their changing looks, it is also important that they learn to like and accept their body and appearance. In time, many adolescents find that the very features they once wished were different are actually the ones that make their looks uniquely attractive. Concerns about appearance that get in the way of enjoying activities, being with friends, or that cause distress, anxiety, or depression may be a sign of body image problems. By paying the right kind of attention to such concerns early, mental health professionals can help prevent body image problems from becoming more serious.

Some people develop an intense fear of gaining weight even though they do not have BDD. They may begin to diet or exercise excessively, lose weight rapidly, and refuse to eat enough food to maintain a healthy weight. A person with this pattern may have an eating disorder called anorexia nervosa*. People with anorexia develop a distorted body image and see themselves as fat when they are not. Even though they may get dangerously underweight and malnourished, they continue to feel fat and refuse to eat.

Bulimia* is another eating disorder that involves body image problems. People with bulimia have a distorted body image that causes them to be self-critical and to feel fat, and they place too much importance on weight and body shape. People with bulimia have episodes of out-of-control overeating, or binges, and then try to make up for them by making themselves vomit, by taking laxatives, or by exercising to excess to avoid gaining weight. People with excessive body image problems may need assistance from several mental health professionals, including a physician, a psychotherapist*, and a nutritionist.

What Leads to a Good Body Image?

There are certain changes people can make in their appearance or physical capabilities, but having a good body image does not require a perfect body. People develop a healthy body image by taking care of their body, appreciating its capabilities, and accepting its imperfections. Positive body image is linked to an awareness that appearance is only one part of a person's identity or character and to a mature sense of what really matters and what does not in evaluating an individual.

Most teenagers can control their appearance to some extent; for example, they may choose haircuts or clothing that reflect how they see themselves. By doing so, they can create an outer image that pleases them. Eating healthy foods and getting plenty of exercise can help teenagers develop strong, fit bodies of which they can be proud. Cutting down on junk foods helps them stay trim, and physical activities help them develop strength, coordination, and new capabilities. Healthy behaviors contribute to attractive appearance on the outside and add to positive inner feelings about body image.

▶ See also **Anorexia Nervosa • Anxiety and Anxiety Disorders • Bulimia Nervosa • Eating Disorders: Overview • Obesity • Obsessive-Compulsive Disorder**

Resources

Books and Articles

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Organizations

National Eating Disorders Association. 603 Stewart Street, Suite 803, Seattle, WA, 98101. Web site: <http://www.nationaleatingdisorders.org>.

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web site: <http://www.4woman.gov/bodyImage>.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

Body Odor

Body odor occurs when a person's sweat comes into contact with the bacteria that are growing on his or her skin. All people sweat and have the potential to produce body odor. There are several factors that contribute to body odor. Some people may suffer from conditions that create excessive sweating, and some people's body odor may be more offensive than others.

What Is Body Odor?

Body odor is the smell of bacteria* reproducing in the sweat that is present on a person's body. The scent and strength of body odor is influenced by many things including diet, hygiene, gender, health, and certain medications. Body odor is typically associated with the underarms, groin,

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

* **physiologic** (fiz-ee-o-LOJ-ik) refers to an organism's healthy and normal functioning.

* **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.

feet, genitals, pubic hair, and anus. These parts of the body contain apocrine sweat glands. Generally, human beings find most body odor to be an offensive smell, whereas other species, like dogs, simply use body odor as a means to identify other animals.

What Causes Body Odor?

The human body has millions of sweat glands that secrete fluid to cool the body when its temperature rises. Perspiration, or sweating, is one of the human body's most natural and healthy responses. People perspire when they are hot, when they are exercising, and when they are nervous or uncomfortable. Adolescents, especially boys, tend to sweat quite a bit more during puberty*. Perspiration is the body's built-in cooling system. In fact, two drops of sweat has the ability to cool up to a quart of blood by one degree Fahrenheit. Still, sweat encourages the bacteria that is present on the skin to multiply. The more bacteria that are present on the skin, the greater the degree of body odor.

There are two types of sweat glands. Eccrine glands are present all over the body, and apocrine glands are present in areas where there are hair follicles, such as the groin, armpit, and scalp. Eccrine glands secrete fluid directly onto the skin that is made up of water and salt. The fluid that apocrine glands secrete, however, is made up of fats and proteins. These fats and proteins are broken down by bacteria on the skin. During puberty, apocrine glands become much more active, causing even more body odor.

Hygiene While perspiration does not have a smell, the presence of sweat causes the bacteria that is normally present on the skin to multiply at a rapid rate. More numerous bacteria cause a person to have body odor. After activities that cause excessive sweating, such as working outside in

PHEROMONES AT WORK

Pheromones are chemicals that are released by the body that trigger a physiologic* response in another animal of the same species. These responses can be positive or negative and may produce responses that are sexual, aggressive, or territorial in nature.

While pheromone stimulation is most noticeably present in other species, studies have shown that human beings also subconsciously respond to pheromones released by other humans. For instance, some studies suggest that the menstrual cycles* of women who are close to one another often synchronize. This may be mediated by pheromones. Other studies have shown that human beings tend to choose their mates based on the pheromones that he or she emits. While many scientists dispute this claim, some perfume and cologne companies even add pheromones to their products in the hopes of convincing people that it will help them attract a mate.

the sun or engaging in strenuous exercise, people need to bathe with soap and water to remove the odor-producing bacteria. The use of deodorant and an antiperspirant is a helpful preventative measure.

Diet Certain diets can affect the type of bacteria that is present on a person's body, thereby affecting the amount or offensiveness of his or her body odor. For instance, a person who eats a lot of garlic will probably notice that his or her body odor has a pungent, garlicky smell. The spices cumin and curry also tend to have these pungent odor-producing properties.

Health and Medication Hyperhidrosis, or excessive sweating, is a medical condition that has effects that may amplify a person's body odor. It can be caused by multiple conditions, including heredity, menopause*, which causes hot flashes; hypoglycemia*, or low blood sugar; low levels of male hormones; and hypothyroidism*, or an overactive thyroid gland. Certain medications may also be the cause of excess sweating that leads to body odor. These include medications used to treat mental conditions, morphine, thyroxine, and analgesics such as aspirin.

In some cases, trauma may cause conditions that contribute to body odor. Rectovaginal fistulas are abnormal passageways between the rectum* and the vagina*. These fistulas can occur during childbirth or develop from conditions such as inflammatory bowel disease and infections. When this occurs, gas or stool may exit the body through the vagina, and sometimes fecal incontinence* may occur. This condition must be repaired surgically.

Social Issues and Treatment

People who have hyperhidrosis and body odor may suffer serious social consequences. These people often suffer with embarrassing body odor, wet marks or stains on clothes, and discomfort. Furthermore, they may have difficulty in school, work, social, business, and romantic situations. While proper hygiene is essential in preventing body odor, it sometimes cannot be controlled through bathing and the use of over-the-counter deodorants and antiperspirants. People who suffer from severe hyperhidrosis may need to talk to their doctor and pursue another treatment plan, which may include prescription antiperspirants, the use of nerve blockers that can prevent perspiration, medications, and in some cases, surgery.

Resources

Books and Articles

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Crump, Marguerite, and Elizabeth Verdick. *No B.O.! The Head-to-Toe Book of Hygiene for Preteens*. Minneapolis, MN: Free Spirit, 2005.

* **menopause** (MEN-o-pawz) is the end of menstruation.

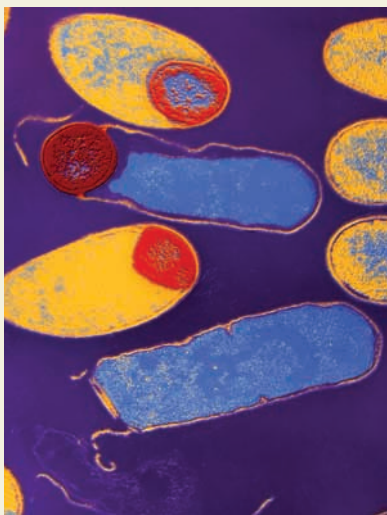
* **hypoglycemia** (hi-po-gly-SEE-mee-uh) is a condition that occurs when the amount of glucose, or sugar, in the blood becomes too low. Symptoms can include dizziness, trembling, sweating, and confusion.

* **hypothyroidism** (hi-po-THY-royd-ih-zum) is an impairment of the functioning of the thyroid gland that causes too little thyroid hormone to be produced by the body. Symptoms of hypothyroidism can include tiredness, paleness, dry skin, and in children, delayed growth and mental and sexual development.

* **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.

* **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.

* **incontinence** (in-KON-ti-nens) is loss of control of urination or bowel movement.



▲
Colored transmission electron micrograph of the bacteria *Clostridium botulinum*, cause of botulism food poisoning in humans, in the process of sporulation (spore formation). The yellow cell at center left is in the early vegetative stage and contains a spore (red). The yellow cell at top is in an advanced vegetative stage with a well-developed spore. Below it is a blue cell whose spore (red) is being released. The blue cell at bottom has released its spore.
A.B. Dowsett/Photo Researchers, Inc.

* **toxins** are substances that cause harm to the body.

* **spores** are a temporarily inactive form of a germ enclosed in a protective shell.

* **immune globulin** (ih-MYOON GLAH-byoo-lin), also called gamma globulin, is the protein material that contains antibodies.

Organizations

Binghamton University, State University of New York. PO Box 6000, Binghamton, NY, 13902-6000. Web site: <http://www2.binghamton.edu/news/the-newsroom/ask-a-scientist/index.html?date=2008-01-20>.

International Hyperhidrosis Society. Kellers Church Road, Suite 6121-A, Pipersville, PA, 18947. Web site: www.sweathelp.org.

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905. Web site: <http://www.mayoclinic.com/health/sweating-and-body-odor/DS00305>.

Body Temperature *See Fever.*

Boils *See Abscesses.*

Botulism

Botulism (BOH-chu-lib-zum) is an uncommon, nerve-paralyzing illness caused by toxins produced by Clostridium botulinum (klos-TRIH-de-um boh-chu-LIE-num) bacteria.*

What Is Botulism?

There are seven types of botulinum toxin, each designated by a letter from A through G. Only four types (A, B, E, and F) make people sick. There are three forms of naturally occurring human botulism: infant botulism, food-borne botulism, and wound botulism. Inhalation (in-huh-LAY-shun) botulism is an additional form of the illness that could possibly be intentionally spread through the air by someone intent on harming others. *Clostridium botulinum* is commonly found in soil and grows best in low-oxygen environments. The bacteria form spores* that remain dormant, or inactive, waiting for conditions that allow them to grow. The spores can exist anywhere, and people might eat food containing these spores without becoming sick. When conditions are right, however, the spores can activate and produce toxin.

Food contaminated with the toxin is the culprit in cases of food-borne botulism; most outbreaks stem from food that is improperly cooked or incorrectly canned or preserved. In food-borne botulism, the toxin itself is swallowed, but in cases of infant botulism an infant swallows the spores and they then activate in the intestine and produce toxin. It is believed that the infant intestine lacks enough protective intestinal bacteria, stomach acid, and immune globulin* to prevent the spores from activating.

Wound botulism is rare and develops when bacteria infect a wound and multiply, producing the toxin. Bioterrorists have attempted without success to aerosolize* botulinum toxin, but the threat of inhalation botulism as a biological weapon has raised concerns.

How Common Is Botulism?

More than 100 cases of botulism are reported in the United States each year. Infant botulism accounts for about 72 percent of reported cases and food-borne botulism for about 25 percent. Wound botulism is the rarest form, but health officials have noted an increase in this type in California, a rise they attribute to the intravenous* use of illegal drugs from Mexico.

How Can a Person Contract Botulism?

Botulism is not contagious. Outbreaks of food-borne botulism usually can be traced to improperly home-canned foods, especially those with low amounts of acid, such as asparagus, green beans, beets, and corn, which allow the *Clostridium botulinum* bacteria to grow. Various frozen foods have also been implicated in outbreaks of the disease. Many infants contract botulism by inhaling or swallowing spores; honey is one source of these spores. Wound botulism sometimes is linked to crush injuries.

What Are the Signs and Symptoms of Botulism?

The two or more of the following symptoms indicate botulism: sudden blood in the urine*, difficulty swallowing, blurred or double vision*, droopy eyelids, slurred speech, dry mouth, and muscle weakness. These symptoms appear when the toxin interrupts nerve impulses to the muscles, which paralyzes the muscles. If untreated, paralysis may progress to involve the arms, legs, trunk, and muscles of the respiratory tract*.

In food-borne botulism, symptoms generally begin 18 to 36 hours after eating the contaminated food, but they can occur after as little as 6 hours or as much as 10 days. Infants with botulism may appear drowsy or sluggish, not eat well, be constipated, and have a weak cry and muscle weakness. In infants, it can take 3 to 30 days for the symptoms to appear and progress.

How Do Doctors Make the Diagnosis?

Laboratory tests can detect the toxin in blood, stool (feces), or wound samples. Because the symptoms of botulism are similar to those of stroke* and several other nerve diseases, doctors also may order a brain scan, spinal tap*, or other nerve- and muscle-function tests to check for other possible causes. The doctor may ask whether the patient has eaten any home-canned foods and, if so, order tests on the suspect food.

How Is Botulism Treated?

The Centers for Disease Control and Prevention (CDC) has a supply of antitoxin* against botulism. The antitoxin can slow or halt the damage caused by botulinum toxin. The sooner it is given, the more effective it is

* **aerosolize** (AIR-o-suh-lize) is to put something, such as a medication, in the form of small particles or droplets that can be sprayed or released into the air.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

* **double vision** is a vision problem in which a person sees two images of a single object.

* **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

* **spinal tap** also called a lumbar puncture, is a medical procedure in which a needle is used to withdraw a sample of the fluid surrounding the spinal cord and brain. The fluid is then tested, usually to detect signs of infection, such as meningitis, or other diseases.

* **antitoxin** (an-tih-TOK-sin) counteracts the effects of toxins, or poisons, on the body. It is produced to act against specific toxins, like those made by the bacteria that cause botulism or diphtheria.

* **enemas** (EH-nuh-muhz) are procedures in which liquid is injected through the anus into the intestine, usually to flush out the intestines.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

in easing the symptoms. To help rid the body of the toxin, doctors sometimes cause vomiting or prescribe enemas*. In severe cases, patients who are unable to breathe well enough on their own might need a ventilator (VEN-tuh-lay-ter), a machine that can help a person breathe for several weeks. Wound botulism might require surgery to remove the source of the toxin-producing bacteria.

What Are the Complications and Duration of the Disease?

Most people with botulism require hospitalization, but they typically recover after weeks or perhaps months of care. Paralysis of the respiratory muscles can lead to pneumonia*. Even after recovery, some patients may be tired and feel short of breath.

How Can Botulism Be Prevented?

Although botulinum toxin is extremely potent, it can be destroyed easily. Heating food and drinks to an internal temperature of 185 degrees Fahrenheit for at least 5 minutes will detoxify them. Boiling home-canned foods before eating them also lessens risk. Health officials advise when

FOR GOOD AND EVIL

Botulinum toxin is the first biological toxin licensed for treatment of human diseases. The U.S. Food and Drug Administration (FDA) approves its use to relax painfully cramped or tight muscles and as an ingredient in medications for the treatment of migraine headache, chronic lower back pain, stroke, brain injury, and cerebral palsy. Botulinum toxin injections (called Botox) can paralyze muscles that cause the skin to wrinkle. Their use is popular among some people looking to maintain a youthful appearance.

Ironically, the same substance has the potential to cause mass destruction if it is dispersed into the air or introduced into the food supply. The U.S. government developed botulinum toxin for potential use as a weapon during World War II. Japan, Iraq, and the Soviet Union have also experimented with botulinum toxin as a biological weapon, and Iran, North Korea, and Syria were suspected of having done so as well.

However, scientists have been perplexed and terrorists thwarted by how difficult it is to prepare botulism toxin for use as a weapon. Terrorists in Japan attempted to unleash it on at least three occasions between 1990 and 1995, but their plan for wide-spread destruction failed each time. In addition to tracking the efforts of bioterrorists, the U.S. government developed elaborate methods to detect and respond to an attack with botulinum toxin. A national surveillance system involving doctors and hospitals was designed to alert the Centers for Disease Control and Prevention to botulism outbreaks, and stores of antitoxin were stockpiled to treat victims.

people can or preserve foods at home that they use a pressure cooker and high temperatures—about 250 degrees Fahrenheit—to kill the spores. It is also best to avoid eating commercially prepared foods from cans that are swollen, punctured, or leaking. Because honey can contain spores of *Clostridium botulinum*, doctors advise that infants younger than one year not be given this sweetener. Breast-feeding can help protect against infant botulism. Receiving prompt medical care for infected wounds and not injecting street drugs can help prevent wound botulism.

▶ See also **Food Poisoning • Intestinal Infections**

Resources

Books and Articles

Emmeluth, Don. *Botulism*. Philadelphia, PA: Chelsea House, 2006.

Organizations

Center for Food Safety and Applied Nutrition, Food and Drug

Administration. 5100 Paint Branch Parkway, College Park, MD, 20740. Toll free: 888-SAFEFOOD. Web site: <http://www.cfsan.fda.gov/~mow/chap2.html>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/botulism.html>.

New York State Department of Health. Corning Tower, Empire State Plaza, Albany, NY, 12237. Web site: http://www.health.state.ny.us/diseases/communicable/botulism/fact_sheet.htm.

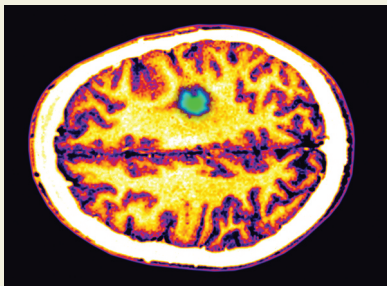
BPH See *Prostate Problems*.

Brain Cancer

Brain cancer is a malignant tumor that originates in the brain.

Billy's Story

Billy was 16, a high-school junior, when he first began experiencing headaches and blurry vision. Over a period of several months his symptoms worsened. Billy lost interest in sports and most everything



▲
Magnetic resonance image (MRI) of a brain showing a glioma tumor (colored green). *Scott Camazine/Alamy.*

* **MRI**, which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **radiation therapy** is a treatment that uses high-energy radiation from x-rays and other sources to kill cancer cells and shrink cancerous growths.

* **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.

* **tumors** (TOO-morz) usually refer to abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **benign** (be-NINE) refers to a condition that is not cancerous or serious and will probably improve, go away, or not get worse.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

else. All he wanted to do was sleep. Billy’s parents took him to the local hospital where he was rushed in for an emergency MRI*. It showed a tumor growing in Billy’s brain, causing a buildup of fluid that created pressure in his skull. That explained why Billy was having terrible headaches.

Billy was admitted to the hospital’s pediatric cancer ward. Surgeons inserted a temporary shunt to drain the excess fluid from his brain. Two weeks later a team of neurosurgeons removed the tumor. For the next year and a half Billy underwent radiation therapy* to kill the cancer cells that remained after surgery. Two years later Billy was back in school, doing well and playing sports again.

What Is Brain Cancer?

Brain cancers are primary malignant* tumors* that originate in brain cells. Often the term “brain tumor” is used instead of “brain cancer” because all brain tumors—whether malignant or benign*—destroy normal brain tissue as they grow and most continue to grow unless they are completely removed or destroyed. Given that the brain is enclosed within the skull, which allows no room to expand, any growth produces pressure that can destroy normal tissue. Most brain tumors in adults are secondary tumors rather than brain cancers, having spread to the brain from other parts of the body. In contrast, most brain tumors in children are primary tumors originating in the brain. Unlike most other cancers, brain cancer can spread through the brain but rarely metastasizes or spreads to other parts of the body.

There are approximately 130 different forms of brain cancer. They are broadly categorized according to the type of brain cell in which they develop. No matter what the cell type, however, the two most important issues to determine about any brain tumor are where it is located and how fast it is growing. Both of these determinations can be made with the help of computerized axial tomography* (CAT) and magnetic resonance imaging (MRI).

Glial-cell cancers Eight out of 10 brain cancers are gliomas that originate in glial cells of the central nervous system* (CNS). There are three types of glial cells:

- Astrocytes support and nourish neurons*.
- Oligodendrocytes produce the myelin sheaths that surround the axons of neurons.
- Ependymal cells line the ventricles—cavities in the brain that contain cerebrospinal fluid* (CSF).

Astrocytomas Most primary brain tumors, including about one-half of those in children, are astrocytomas originating in astrocytes. Whereas adult astrocytomas occur most often in the cerebrum*, childhood astrocytomas also arise in the cerebellum* or brain stem* and metastasize

throughout the brain, intermingling with normal brain tissue and making these tumors difficult to remove surgically.

Astrocytomas are classified according to how fast they grow:

- Low-grade or grade I astrocytomas are the slowest-growing and most common type in children.
- Intermediate or grades II or III are called anaplastic astrocytomas and are moderately fast-growing.
- Glioblastomas or glioblastoma multiforme (GBM) are grade IV astrocytomas. They are the fastest-growing and account for two-thirds of adult astrocytomas. GBM is the most common brain cancer and among the deadliest of all cancers.

Some types of childhood astrocytomas tend to have good prognoses:

- Juvenile pilocytic astrocytomas, which most often occur in the cerebellum
- Subependymal giant cell astrocytomas, which occur in the ventricles and are almost always linked to an inherited condition called tuberous sclerosis
- Optic gliomas, which are low-grade astrocytomas originating in the optic nerve* and are often associated with an inherited condition called neurofibromatosis type 1.

Oligodendrogliomas and ependymomas Tumors originating in oligodendrocytes are called oligodendrogliomas. They usually occur in the cerebrum, grow slowly, and do not spread to surrounding tissue. They account for only about 4 percent of brain tumors and are most common in middle-aged adults.

Tumors arising in ependymal cells are called ependymomas. They account for almost 10 percent of brain tumors in children and can cause the ventricles to swell, leading to hydrocephalus*.

Other brain cancers Many less-common brain tumors arise from cells other than glial cells:

- Meningiomas arise in the meninges*. Although they account for one out of three primary brain and spinal-cord tumors, primarily in adults, about 80 percent are benign.
- Schwannomas are tumors that arise from Schwann cells that line the inner-ear nerve.
- Brain lymphoma* is a highly malignant cancer originating in lymphocytes*. Brain lymphomas are common in people with AIDS* and other immune system* disorders.

Other types of brain tumors are much more common in children than in adults:

- Primitive neuroectodermal tumors (PNETs) begin in immature cells of the CNS. They account for about one-fourth of childhood brain tumors.

* **neurons** are nerve cells. Most neurons have extensions called axons and dendrites through which they send and receive signals from other neurons.

* **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.

* **cerebrum** (se-RE-brum) is the largest, front and upper part of the brain that is responsible for mental processes.

* **cerebellum** (se-re-BEL-um) is the back portion of the brain that is responsible for muscle coordination and balance.

* **brain stem** is the part of the brain that connects to the spinal cord. The brain stem controls the basic functions of life, such as breathing and blood pressure.

* **optic nerve** is the nerve that sends messages, or conducts impulses, from the eyes to the brain, making it possible to see. The optic nerve is also referred to as the second cranial nerve.

* **hydrocephalus** (HY-droe-SEF-uh-lus) is a condition, sometimes present at birth, in which there is an abnormal buildup of fluid within the skull, leading to enlargement of the skull and pressure on the brain.

* **meninges** (meh-NIN-jeez) are the membranes that enclose and protect the brain and the spinal cord.

* **lymphoma** (lim-FO-muh) refers to a cancerous tumor of lymphocytes, cells that normally help the body fight infection.

* **lymphocytes** (LIM-fo-sites) are white blood cells, which play a part in the body's immune system, particularly the production of antibodies and other substances to fight infection.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **leukemia** (loo-KEE-me-uh) is a form of cancer characterized by the body's uncontrolled production of abnormal white blood cells.

* **edema** (e-DEE-ma) means swelling in the body's tissues caused by excess fluids.

* **nausea** (NAW-zha) refers to a feeling of being sick to one's stomach or needing to vomit.

* **double vision** is a vision problem in which a person sees two images of a single object.

- Medulloblastomas are fast-growing PNETs in the cerebellum that account for about 15 percent of childhood brain tumors. They are more likely than other types to spread beyond the CNS.
- Gangliogliomas are tumors containing both neurons and glial cells. They can usually be cured by surgery, alone or combined with radiation therapy.
- Pleomorphic xanthoastrocytomas and dysembryoplastic neuroepithelial tumors are mixed-cell tumors that are usually curable by surgery alone.
- Craniopharyngiomas are slow-growing tumors at the base of the brain.
- Germinomas are the most common type of germ-cell tumor in the brain.

How Common Is Brain Cancer?

Brain and spinal-cord tumors account for about 1.5 percent of all cancers and 2.3 percent of cancer-related deaths. There were an estimated 21,810 malignant brain and spinal-cord tumors diagnosed in the United States in 2008, and CNS tumors caused an estimated 13,070 deaths.

Brain and spinal-cord tumors are the second most common cancer in children after leukemia*, accounting for 21 percent of all childhood cancers. In the United States, about 3,400 CNS tumors are diagnosed each year in children under 20, about one-fourth of which are considered benign. About 75 percent of children with brain tumors of all types survive at least five years.

How Do People Know They Have Brain Cancer?

Symptoms of brain tumors depend on the size, type, and location of the tumor. Symptoms can be caused by a tumor pressing on a nerve or damaging an area of the brain. Symptoms may appear suddenly or gradually worsen over time. Tumors often cause edema*—fluid buildup in brain tissue—leading to brain swelling and pressure. Headaches are one of the most common symptoms of a brain tumor, occurring in about 50 percent of patients.

In very young children, parents may notice an increase in head size and possibly bulging of the soft spots in the skull. Increased pressure in the brain can also cause the following:

- Nausea* and vomiting
- Blurred vision, crossed eyes, or double vision*
- Drowsiness
- Irritability
- Loss of appetite
- Developmental delay
- Decreased intellectual and motor skills

Other common symptoms of brain tumors include the following:

- Changes in hearing or speech
- Numbness or tingling in the arms or legs
- Muscle twitching or jerking
- Difficulty with balance or walking
- Weakness or paralysis* in a part of the body
- Difficulties with facial movements or swallowing
- Mood or personality changes
- Problems with concentration or memory
- Lethargy
- seizures* or convulsions*

About one-half of people with brain tumors have seizures at some point, and seizures are sometimes the first symptom of a brain tumor in children.

How Do Doctors Diagnose Brain Cancer?

Diagnostic procedures for brain cancer include the following:

- A complete physical exam and medical history
- A neurologic exam* to evaluate brain function, including alertness, muscle strength, coordination, reflexes, and responses to pain
- An eye examination to check for optic-nerve swelling, indicating increased intracranial pressure
- MRIs, which almost always reveal brain tumors and may pinpoint the location
- Magnetic resonance spectroscopy (MRS) to help determine the type of tumor
- Positron emission tomography* to help determine whether an abnormality seen on an MRI is cancerous
- Chest x-rays to look for cancer elsewhere in the body that has spread to the brain

Although MRIs have generally replaced CT scans for diagnosing brain tumors, CT scans are sometimes used with children because they are much faster and less confining.

A biopsy* is required to determine if a brain tumor is cancerous. If diagnostic imaging indicates that the tumor can be treated surgically, an operation called a craniotomy is performed to remove all or as much as possible of the tumor. A pathologist examines the tumor tissue during the operation, in what is called a surgical or open biopsy. If the risk of surgery is too great—for example, if the tumor is near a vital area or deep within the brain—a stereotactic or needle biopsy is performed. With certain types of brain cancers, a spinal tap* is performed to check for the spread of cancerous cells in the CSF.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

* **neurologic exam** refers to systematic tests of how well various parts of the nervous system are functioning.

* **positron emission tomography** (POZ-i-tron i-MISH-en toe-MAH-gruh-fee) also called PET imaging or PET scanning, uses a radiotracer that accumulates in an area of the body and emits gamma rays that are detected as diagnostic images.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **spinal tap** also called a lumbar puncture, is a medical procedure in which a needle is used to withdraw a sample of the fluid surrounding the spinal cord and brain. The fluid is then tested, usually to detect signs of infection, such as meningitis, or other diseases.

* **chemotherapy** (KEE-mo-THER-ah-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

How Do Doctors Treat Brain Cancer?

The treatment and prognosis for brain cancer depend on the following factors:

- The tumor type, grade, size, and location
- Whether surgery is possible and, if so, how much of the tumor can be removed
- The patient's age
- Whether the tumor interferes with brain function
- Whether cancer has spread through the CSF to other parts of the brain or spinal cord

Survival rates for brain cancer vary greatly. The prognosis is generally better for younger people than for older patients.

Surgery In the early 2000s, surgical removal of as much of the tumor as possible was the frontline treatment for brain cancer. Tumors that have spread widely cannot be cured surgically; however, surgery can reduce the amount of tumor that has to be treated with radiation or chemotherapy* and can prolong life. Surgery can also alleviate some symptoms of brain cancer or make them amenable to treatment with medications such as anti-seizure drugs.

Surgery alone or in combination with radiation therapy can cure many low-grade brain cancers, including non-infiltrating astrocytomas. When possible, surgery is also the primary treatment for infiltrating or diffuse astrocytomas. However, most astrocytomas and oligodendrogliomas spread through the brain, mixing with normal cells and are, therefore, very difficult to remove surgically. Intermediate- or high-grade astrocytomas, including GBM, cannot be cured by surgery alone. Ependymomas and meningiomas can sometimes be cured with surgery.

PNETs tend to grow fast and have a poorer prognosis. They are generally treated with surgery, followed by radiation and possibly chemotherapy. Medulloblastomas and gangliogliomas can often be cured with surgery alone or surgery plus radiation.

Radiation therapy External-beam radiation therapy is often used to destroy those cancer cells remaining after surgery. Sometimes tumors remaining after surgery for astrocytomas, oligodendrogliomas, and ependymomas can be controlled with radiation therapy. Brain stem gliomas are usually astrocytomas that grow throughout the organ, so surgery is not an option. They are usually treated with radiation; however, the prognosis is generally poor. Up to one-half of all medulloblastomas and most all germinomas are curable with radiation therapy alone.

Other types of radiation therapy for brain cancer include the following:

- Three-dimensional conformal radiation therapy (3D-CRT), in which several relatively weak x-ray beams are focused on the tumor from different directions

- Intensity modulated radiation, which uses a computer to move the patient around the x-ray beam
- Conformal proton beam radiation therapy, which is similar to 3D-CRT but uses a proton beam rather than x-rays
- Stereotactic radiosurgery for inoperable tumors, which delivers a high dose of radiation in a single treatment
- Brachytherapy, in which radioactive material is inserted directly in or near the tumor
- Whole brain and spinal cord radiation therapy for tumors that have spread through the CNS

Children younger than three years of age are not usually treated with radiation because of potential long-term effects on development. Chemotherapy may be used instead, radiation treatment may be postponed until the child is older, or surgery may be repeated if the tumor returns.

Chemotherapy Chemotherapy is less often used to treat brain cancer, because most chemotherapy drugs do not cross the blood-brain barrier*. However, chemotherapy is used to treat high-grade tumors in conjunction with surgery and/or radiation therapy. Sometimes chemotherapy drugs are placed directly on or near a tumor during surgery. For some brain tumors chemotherapy is administered directly into the CSF in the brain or spinal canal. Lymphomas, medullablastomas, and some oligodendrogliomas tend to respond better to chemotherapy than most other brain cancers.

Can Brain Cancer Be Prevented?

Brain cancer usually has no apparent cause; however, there are a few known risk factors*:

- Radiation treatment for previous cancers, particularly radiation to the head for childhood leukemia
- Certain types of brain cancers that occasionally run in families
- Immune system impairments that increase the risk of brain lymphoma
- Embalmers and pathologists who work with formaldehyde
- Plastic and textile workers exposed to vinyl chloride or acrylonitrile

▶ See also **Cancer: Overview**

Resources

Books and Articles

Dann, Patty. *The Goldfish Went on Vacation: A Memoir of Loss (and Learning to Tell the Truth about It)*. Boston: Trumpeter, 2007.

* **blood-brain barrier** is a biological shield in the body that helps prevent germs or other potentially harmful materials in the blood from entering the brain and spinal cord.

* **risk factors** are any factors that increase the chance of developing a disease.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **psychiatrist** (sy-KY-uh-trist) is a medical doctor who has completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can diagnose mental illnesses, provide mental health counseling, and prescribe medications.

* **neurotransmitter** (NUR-o-tranz-mit-er) is a brain chemical that lets brain cells communicate with each other and therefore allows the brain to function properly. In other words, a neurotransmitter transmits (carries) a chemical message from neuron to neuron.

Freedman, Jeri. *Brain Cancer: Current and Emerging Trends in Detection and Treatment*. New York: Rosen, 2008.

Gupta, Sanjay. "Battling Brain Cancer." *Time* 171, no. 22 (June 2, 2008): 52.

Healy, Bernadine. *Living Time: Faith and Facts to Guide Your Cancer Journey*. New York: Bantam Dell, 2008.

Organizations

American Cancer Society. P.O. Box 102454, Atlanta, GA, 30368-2454. Toll free: 800-ACS-2345. Web site: <http://www.cancer.org>.

National Cancer Institute. NCI Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov/cancertopics/types/brain>.

University of Texas M. D. Anderson Cancer Center. 1515 Holcombe Boulevard, Houston, TX, 77030. Toll free: 800-392-1611. Web site: <http://www.mdanderson.org/diseases/braincancer>.

Brain Chemistry (Neurochemistry)

The brain communicates with itself by sending chemical information from one neuron, or nerve cell, to another. Brain chemistry is the sum of all the chemical messaging that takes place in the brain, which allows it to carry out its daily functions, such as generating movement, speaking, thinking, listening, regulating the systems of the body, and countless others.

Out of Balance: Hector's Story

Now a tenth-grader, Hector had been experiencing severe depression* since he was in seventh grade. Everyone feels down or depressed every now and then, but Hector felt this way most of the time. He had a hard time making friends, he was not interested in his schoolwork, and he spent most of his time hanging out in his room alone. He had even thought about suicide. At first, his parents believed that this was just a phase, but as it persisted they became really concerned. What was happening to their son, who had been generally upbeat and friendly until a few years earlier?

At the insistence of his parents and teachers, Hector started seeing a psychiatrist*, who tried to help Hector talk about what he was feeling. Based on her meetings with Hector, the psychiatrist decided to prescribe a type of medication known as an antidepressant. This medication increases the amount of the brain neurotransmitter* called serotonin (ser-ah-TO-nin), which is associated with feelings of well-being and control.

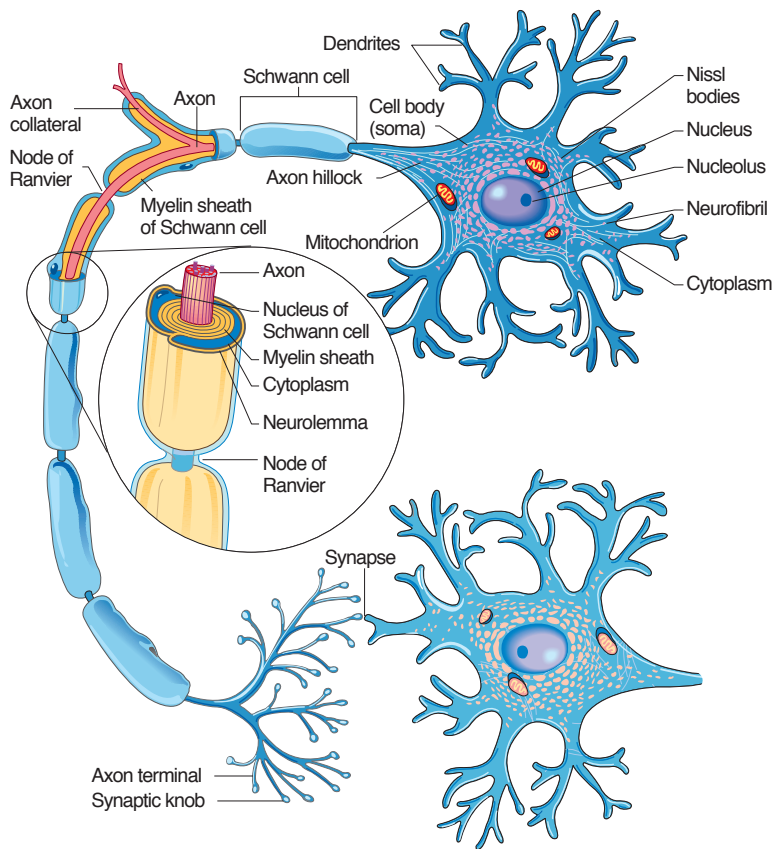


Diagram of a neuron. *Diagram by Hans & Cassidy. Reproduced by permission of Gale, a part of Cengage Learning.*

The medicine, a selective serotonin reuptake inhibitor (SSRI), works by inhibiting (preventing) neurons from reuptaking (reabsorbing) the chemical messenger serotonin once it is released into the brain. As a result, there is more serotonin available, and this change sometimes helps alleviate the symptoms of depression. If Hector's depression were being caused by too little serotonin, the medication likely would help him.

Sure enough, it did. Hector continued to see his psychiatrist while taking the medication. After about six months, his doctor decided to try taking Hector off the SSRI. Hector was afraid that his terrible feelings would return, but they did not. He found that talking through any problems with his doctor was enough to keep him on track.

A Cascade of Chemicals

From their laboratory studies researchers learn about the chemicals that the neurons (NUR-ons) in the human brain use to communicate with each other. They know that all the feelings and emotions that people experience are produced through chemical changes in the brain. The "rush" of happiness that a person feels at getting a good grade on a test, winning the lottery, or reuniting with a loved one occurs through complex chemical processes. So are emotions, such as sadness, anxiety, and stress. When the brain tells the body to do something, such as to sit down

* **enzymes** (EN-zimes) are proteins that help speed up a chemical reaction in a cell or organism.

* **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.

* **Parkinson's disease** is a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.

or run, a chemical process is set in motion. These chemical communicators, or neurotransmitters, are the “words” that make up the language of the brain and the entire nervous system.

The billions of tiny neurons in the brain communicate with each other across small spaces called synapses (SIN-ap-siz). When one neuron is charged into action, it releases its chemical messenger, which then moves across the synapse to the next neuron where it is accepted by a special receiving area, called a receptor, on the surface of the neuron. The chemical is accepted only by receptors that recognize it, in a kind of “lock and key” system; that is, certain keys work only in certain locks. Once attached to a receptor site on another neuron, different neurotransmitters either trigger “go” signals that prompt the neuron to pass certain messages on to other cells or produce “stop” signals that prevent certain messages from being forwarded.

Any one neuron may be receiving many chemical messages, both positive and negative (go and stop), from the other neurons surrounding it. These neurotransmitters may be competing to get the neuron to respond in different ways, or they may work together to produce a certain effect. Because all of this happens within a split second, the neurotransmitter must be cleared away quickly so that the same receptors can be activated again and again. This clearing away can happen in one of three ways. The chemical may be pumped back into the nerve ending it comes from, a process known as “reuptake,” it may be destroyed by enzymes* near the receptor sites, or it may simply spread out into the surrounding area of the brain and be destroyed there.

Modifying Neurotransmission with Drugs

Many neurological* conditions, ranging from emotional disorders, such as depression, to movement disorders, such as Parkinson's disease*, are associated with imbalances of certain neurotransmitters in the brain. Researchers have been able to develop many medications that work to correct these imbalances, improving people's symptoms and helping them lead more fulfilling lives. At the same time, many legal and illegal drugs, such as nicotine in cigarettes and the street drugs heroin and cocaine, work by changing neurotransmitter levels. People report feeling good or up when they start taking these drugs, but soon the neurons in their brains become accustomed to the change in chemical balance so that it takes more of a drug to get that same elevated feeling. Next, the brain starts to crave the substance. The result is chemical dependency or addiction. What happens when brain chemicals are modified is described in the three examples of neurotransmitters (serotonin, dopamine, and gamma-aminobutyric acid) below.

Serotonin Many studies have linked low levels of the neurotransmitter serotonin to depression, impulsive and aggressive forms of behavior, violence, and even suicide. The medications categorized as SSRIs, such as the one that was given to Hector, prevents the neurons that release this chemical from taking it back in once it is in the synapse. As a result, the

UP FOR DEBATE: MEDICATING MENTAL AND BEHAVIORAL DISORDERS

Depression, social anxiety, excessive shyness, and hyperactivity are examples of the conditions that might be treated successfully with medications that alter neurotransmitter levels in the brain. Before these medications became available, people with these and other problems either had to live with them or work with a psychiatrist or psychologist to deal with their feelings. Subsequent research in brain chemistry disorders led to the development of medications that can be used, allowing more people to overcome much of their social difficulty.

Some experts fear that people may be relying too heavily on these medications as a quick fix. While many experts do not deny that there are some people who need drug treatment, they also argue that there are people who think that feeling down or socially awkward occasionally is the same as having a disorder. These people then ask their doctors for medications that should be reserved for others who more severe conditions. When symptoms interfere with a person's life to a large extent, medication is considered. In many cases, whereas medications can help to decrease symptoms, more complete and long-lasting relief is achieved through therapy that helps with behavior change. Normal variations in feelings in response to various life changes and challenges are to be expected. Other forms of intervention, such as behavioral therapy and exercise, should be considered as alternatives to medication or in addition to medication when symptoms create suffering and present undue difficulties.

One debate surrounds treatment for a condition known as attention deficit hyperactivity disorder (ADHD), which usually is diagnosed in childhood. Children with this condition have a hard time paying attention and sitting still, and they tend to be impulsive and overactive. Often this diagnosis is given to children who misbehave in school. The exact cause of ADHD

is still unknown, but it may involve the interplay of neurotransmitters in brain function. From the 1980s into the early 2000s, increasing numbers of children were diagnosed with ADHD, and many of them took medications that enhance the activity of the neurotransmitters dopamine and norepinephrine. Both of these neurotransmitters are excitatory and help the individual be more alert, more focused, and therefore better able to stay on task. Studies have shown that children with ADHD have lower levels of these types of neurotransmitters in the brain. However, no one knows exactly how these drugs work to control ADHD symptoms.

The area of the brain thought to be altered in ADHD is the reticular activating system (RAS), which impacts attention. This system includes a group of nerve fibers located in several parts of the brain, including the thalamus. Within the RAS, the thalamus appears to play a key role in the moment-to-moment changes in the focus of attention. The thalami and cerebral cortex cooperate to register incoming sensory signals, evaluate their contents, and mobilize brain resources in response to the demands made. In this manner, the thalami receive messages that come through the senses and then relay the information to the proper receiving areas in the brain.

Although most children (possibly from 70 to 90%) diagnosed with ADHD are helped by medication, some experts believe that some parents and doctors may be too hasty in labeling children with a diagnosis of ADHD to justify what is simply bad behavior and then medicating children who do not really need to be given drugs. Others feel that children with ADHD were underdiagnosed for many years and only later were appropriately diagnosed and treated. There is no easy solution to this debate. However, many experts agree that ADHD is a real condition that can have serious consequences if it is not diagnosed and managed appropriately.

person has more serotonin available to attach to receptors in the brain, which can ease the symptoms of depression, as it did for Hector.

The illegal drug called Ecstasy, or MDMA, also changes the level of serotonin in the brain, but much more radically. It causes the serotonin-releasing neurons to dump their contents all at once, which floods the brain with the chemical and produces feelings of extreme happiness and

* **schizophrenia** (skit-so-FREE-nee-ah) is a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors, which distort their view of reality.

* **stimulant** (STIM-yoo-lunt) a drug that produces a temporary feeling of alertness, energy, and euphoria.

* **sympathetic nervous system** is the system of nerves that prepares the body for action by speeding up the heart and breathing rates and raising the blood pressure.

hyperactivity (excessive activity). This feeling comes with a price. Because Ecstasy uses up the brain's supply of serotonin, the person is likely to feel depressed when the immediate rush caused by the drug wears off after a few hours. This down period lasts until the brain can restore its supply of serotonin to normal levels. Repeated use of Ecstasy may lead to depression or other problems over time, because the neurons can bounce back only so often.

Dopamine Neurons in the core of the brain release dopamine (DO-pa-meen), a neurotransmitter that affects processes that control movement, emotional response, and the ability to experience pleasure and pain. In people who have Parkinson's disease, dopamine-transmitting neurons in this area of the brain die, which causes progressive loss of movement control. A medication called L-DOPA, which the brain can convert into dopamine, often helps control these symptoms. Some researchers have theorized that people with the mental disorder schizophrenia* are, in fact, overly sensitive to the dopamine in their brains. Some of these people seem to have been helped by medications that block dopamine receptors in the brain, thereby limiting the neurotransmitter's effect.

Another class of drugs known as amphetamines (am-FET-a-meenz) works by increasing the level of dopamine that neurons release and then preventing them from taking it back in through the reuptake process. These drugs have medical uses, such as the treatment of attention deficit hyperactivity disorder, but some people misuse amphetamines as stimulants* to increase energy levels or to lose weight.

Gamma-aminobutyric acid Gamma-aminobutyric acid, or GABA, is the main neurotransmitter that works to inhibit the brain's neurons from acting. Research suggests that certain types of epilepsy, disorder characterized by recurring seizures that affect a person's awareness and movements, may be the result of having too little GABA in the brain. The neuronal messaging system goes into overdrive, with tens of thousands of neurons sending messages intensely and simultaneously, which produces a seizure. Researchers believe that enzymes may be responsible for breaking down too much GABA, and they have developed medications that appear to help combat this process.

Hormones: Another Piece of the Brain Chemistry Puzzle

Norepinephrine (nor-e-pi-NE-frin) is a neurotransmitter that is involved in various arousal systems in the brain (systems that bring about alertness and attention) and in the sympathetic nervous system*. In the sympathetic nervous system, it is norepinephrine that causes the blood vessels to narrow, raising blood pressure, and speeds breathing and heart rates. Norepinephrine also functions as a hormone when it is released by the adrenal glands located just above the kidneys, with similar results. Norepinephrine, epinephrine, and other hormones produced by the

adrenal gland are involved in the fight-or-flight response of the body to stress.

Hormones are chemical substances that are sent into the bloodstream by the endocrine* (EN-do-krin) glands found throughout the body. They carry messages that produce certain effects in the body, much as the nervous system neurotransmitters do. In fact, there are many substances such as norepinephrine that function both as neurotransmitters and hormones. This connection illustrates the close relationship between these two body regulation systems. The brain plays an important role in regulating the release of hormones, and if hormone levels get out of balance (as neurotransmitter levels sometimes do), it can have an impact on how the brain functions and therefore on how a person feels.

The neurotransmitters, hormones, and other chemicals that function within the brain are kept under tight regulation that is very sensitive to even slight changes. The brain is able to maintain this level of control and is given protection by a physical guardrail known as the blood-brain barrier* (BBB). The BBB is made up of tightly fitted cells lining the blood vessels that lie up against the brain tissue, as well as their supporting brain cells. The supporting brain cells are known as astrocytes, called so because of their characteristic star-shaped appearance. The BBB keeps out bacteria and carefully restricts the passage of chemicals such as neurotransmitters between the brain and the rest of the body. Hormones produced by parts of the brain are able to act on other areas of the body outside the central nervous system and are transported to the bloodstream and specific endocrine organs to provide their function.

Learning and Memory

The processes of learning and memory are performed by specific parts of the brain using neurotransmitter signaling. The thalamus is greatly involved in learning and memory, as is another part of the brain known as the hippocampus*. In all parts of the brain (including the thalamus and hippocampus), a property of neurons known as neuronal plasticity (or neuroplasticity) contributes to the functioning of each physical area. Neuronal plasticity is the ability of neuronal pathways, the functional connections between specific sets of neurons, to change and form new connections with other neurons. Forming new pathways allows the brain to adapt and change with respect to the environment. In other words, neuronal plasticity is the ability of the brain to remap its pathways as a result of new experiences, including the input of new information. Neuronal plasticity plays a large role in the process of drug addiction, in which the brain forms new pathways that cause cravings and the need for the abused substance. Neuronal plasticity is also critical to the process of learning and memory. In fact, even as individuals read new information their brain is changing to accommodate the new information.

Learning and memory are among the most complex functions of the brain. Within a fraction of a second individuals may learn something that

* **endocrine** (EN-do-krin) refers to a group of glands, such as the thyroid, adrenal, and pituitary glands, and the hormones they produce. The endocrine glands secrete their hormones into the bloodstream, and the hormones travel to the cells that have receptors for them. Certain hormones have effects on mood and sometimes cause emotional swings.

* **blood-brain barrier** is a biological shield in the body that helps prevent germs or other potentially harmful materials in the blood from entering the brain and spinal cord.

* **hippocampus** a part of the brain that is involved in learning and memory

they may remember for the rest of their life. Their brain was somehow changed within that fraction of a second. In order to study the processes of learning and memory neuroscientist Eric Kandel (b. 1929) took the simple animal, the marine mollusk *Aplysia*, and framed it to withdraw from painful stimuli. Then he studied the biochemical changes that took place in the animal's primitive brain as a result of the training. These were the first studies of the molecular biology of learning and memory and initiated later attempts to understand the neurochemical aspects of these most complex brain functions.

▶ See also **Attention Deficit Hyperactivity Disorder (ADHD)** • **Psychopharmacology** • **Stress and Stress-Related Illness**

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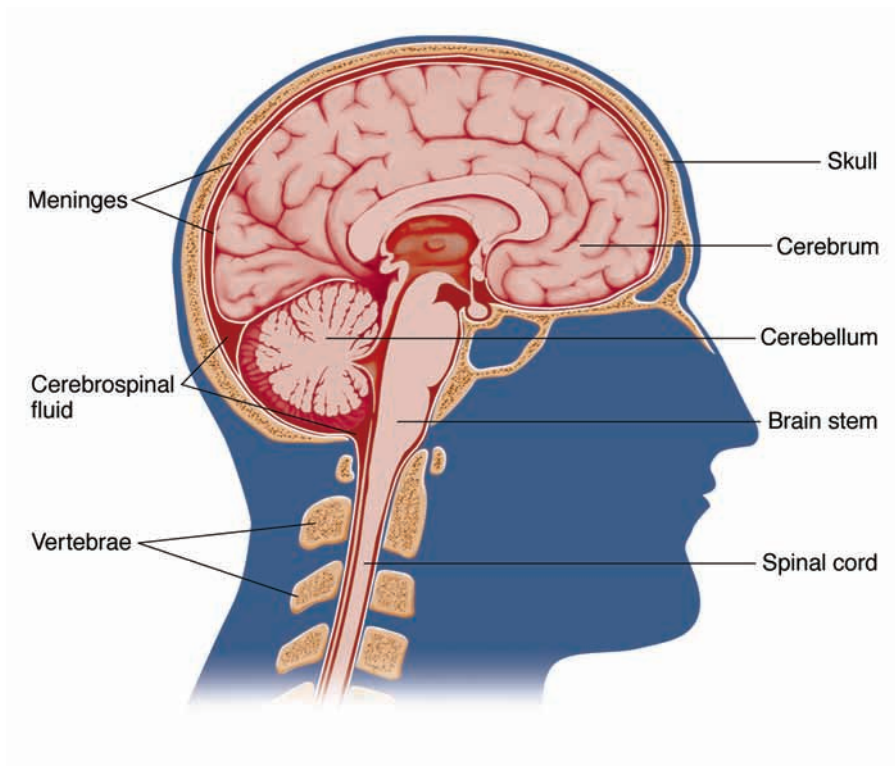
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Brain Injuries

Brain injuries usually result from impact or trauma to the brain that can lead to a variety of medical problems, depending on the nature of the injury.



Call a Doctor Right Away

Any significant impact or trauma to the head should be checked out by a doctor. Brain injuries may result from penetrating wounds or damage associated with impact. Penetrating wounds may be caused by foreign objects (for example, a bullet) or skull fragments that cause damage to brain tissue. Impact injuries might be the result of hitting the head with force against a hard object, such as the windshield of a car, or of being hit by a hard object, such as a baseball. Skull fractures may allow bacteria* access to the brain, leading to dangerous infections. The most common type of brain injury results from minor trauma. Such injuries usually do not involve loss of consciousness (being “knocked out”). More serious brain injuries may occur with or without a skull fracture as a result of impact trauma.

The brain is surrounded by a liquid called cerebrospinal (se-REE-bro-spy-nal) fluid (CSF). The CSF acts as a cushion to absorb some of the force of impact. Unfortunately, in the course of an impact injury to the head, the brain can shift, and tissue damage can occur, especially from rapidly speeding up or slowing down—much like what happens to Jell-O in a container that is dropped or suddenly yanked. The brain damage may be at the point of impact, opposite the point of impact, or spread across any area of the brain. The delicate nerve tissues, the blood vessels, or the membranes surrounding the brain, called the meninges (men-NIN-jeez) may be torn or injured. The damage may result in abnormal brain activity, cerebral hemorrhage* or cerebral edema*. Because the skull is rigid and

Impact to the head may cause leakage of fluid and blood from blood vessels in the scalp, forming a painful lump. A stronger blow can tear the meninges, the protective membrane surrounding the brain, or injure the brain tissue itself. The bleeding and brain swelling this type of injury can produce may lead to increased pressure within the skull, resulting in a variety of problems including concussion and permanent brain damage. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **hemorrhage** (HEH-muh-rij) is uncontrolled or abnormal bleeding.

* **edema** (e-DEE-ma) means swelling in the body's tissues caused by excess fluids.

there is only limited room inside it, the swelling brain causes increasing pressure inside the skull, which can force brain tissue to press directly against the inside of the skull, resulting in more damage.

What Are the Causes of Brain Injury?

There are many causes of brain injury. One of the most common causes is motor vehicle accidents. Impact to the skull may be caused by the head striking the windshield or dashboard as well as being struck by loose objects in the car. Whiplash, a sudden, quick movement of the head back and forth (like cracking a whip), also can produce the kind of forces associated with impact. Head injuries also may result from falls from bicycles, skateboards, roller skates, or roller blades or during sporting events, particularly when a helmet is not worn, or other slips, trips, or falls. Anytime there is trauma to the head, the possibility of brain injury is present, and a doctor should be consulted immediately if there is any change in level of consciousness, balance, ability to move, memory, or vision.

Not all brain injuries are the result of trauma. The brain can be damaged by lack of oxygen, as with drowning or near-drowning, or a particularly difficult birth. The brain can also be damaged through starvation, vitamin deficiencies, or certain other types of malnutrition. Toxins, such as heavy metals (e.g., lead), can irreversibly damage the brain. Additionally, a wide variety of medical illnesses can have an impact on the brain and central nervous system.

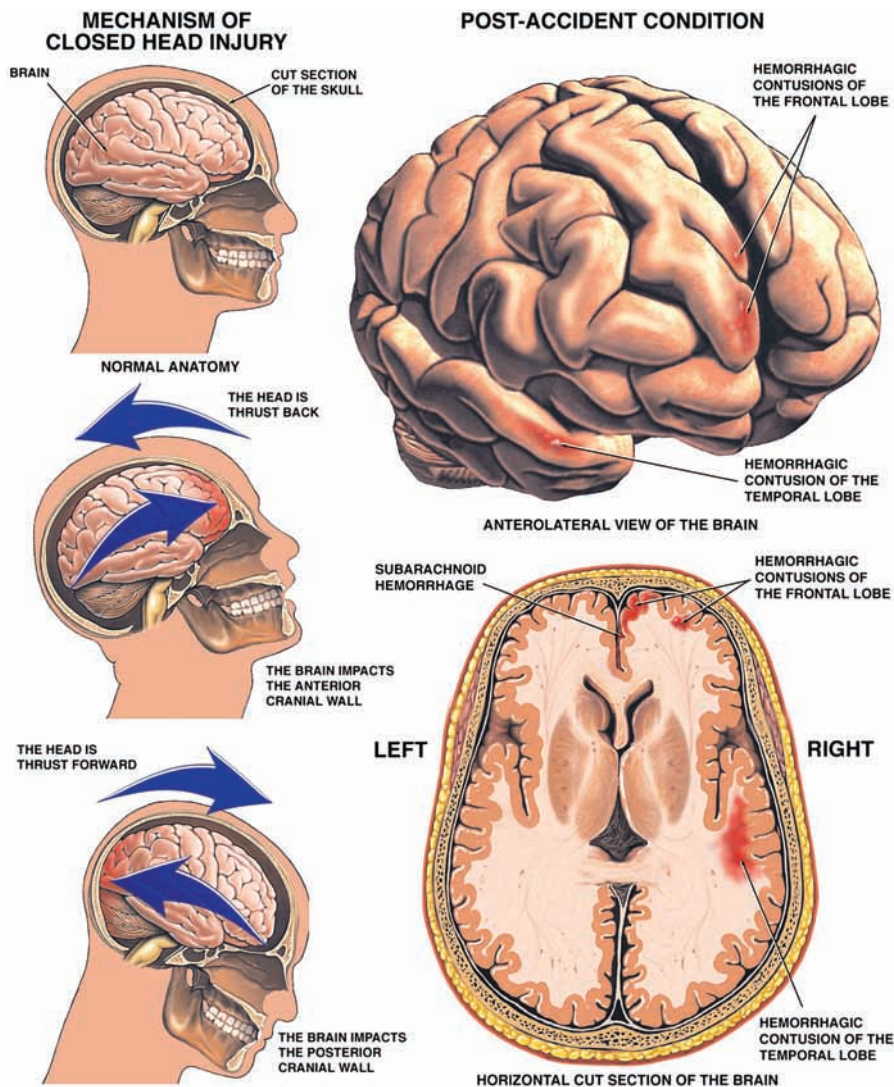
What Are the Signs and Symptoms of Brain Injury?

Brain injuries are difficult to diagnose because there may be many different signs or symptoms that are present immediately after injury or that may not show up for hours or days. In the event of any type of head injury, it is important to gather as much information as possible about the accident. Anyone who witnessed the accident may be able to provide details about exactly what happened and how the injured person acted after the accident.

Temporary amnesia (am-NEE-zha), or loss of memory, is common with many brain injuries. It is typical for the injured person not to remember what happened immediately before, during, and immediately after the accident. Brief periods of amnesia may occur during the recovery period after brain injuries. Longer-term amnesia is not common, except when a head injury is severe.

Brain injuries can affect a person cognitively (intellectually), physically, and emotionally. The following symptoms may be present at the time of the accident. While it is less common, some symptoms may appear hours, days, or even longer after the accident:

- Cognitive effects of brain injury may include short-term or long-term memory loss, inability to learn new information, trouble concentrating or staying focused, speech or communication difficulties, disorientation in space, problems in organizing aspects of



The mechanics of whiplash and the resulting brain injury. © Nucleus Medical Art, Inc./Alamy.

daily living, impaired decision-making, and inability to perform more than one task at a time.

- Physical effects of brain injury may include seizures*, rigid limbs, muscle spasms, double vision*, dim vision, blindness, loss of the sense of taste or smell, slow or slurred speech, minor or severe headaches, balance problems, and tiredness.
- Emotional effects of brain injury may include anxiety (ang-ZY-e-tee), depression or mood swings, denial of having any problems, impulsive behavior, agitation (a-je-TAY-shun), and changes in personality.

What Are the Different Types of Brain Injury?

Minor Head Trauma Anyone who suffers minor head trauma without loss of consciousness or other associated neurological* symptoms still should be watched closely. The injury may or may not be followed by

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **double vision** is a vision problem in which a person sees two images of a single object.

* **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **subdural** (sub-DOO-ral) means under the dura, the covering of the brain.

symptoms such as vomiting, paleness of the skin, irritability, or sluggishness. If any of the symptoms last more than six hours or if they worsen, the symptoms may indicate a more severe injury. A doctor should be consulted immediately for a thorough evaluation.

Skull fracture A skull fracture, or injury to the bony structures protecting the brain, may or may not result in any neurological symptoms. In some cases the skull may have a noticeable depression (a “pushed in” appearance, like a dent), or there may be significant swelling or bleeding from the overlying scalp. Fractures may cause bruising or tearing of brain tissue, or blood vessels on the meninges. The injured person may have seizures as a result of the injury. A doctor should examine the person if there is any possibility of skull fracture.

Concussion A concussion (con-CUH-shun) is a bruise-like injury to brain tissue caused by a direct blow or violent shaking. A concussion usually is associated with amnesia or a change in level of consciousness that lasts a few seconds to a few minutes after the trauma. The patient typically shows no other signs of neurological problems immediately after the trauma, but a condition known as postconcussion syndrome might follow a minor head injury. Patients with persistent postconcussion symptoms sometimes enter the hospital for observation. These symptoms include headache, dizziness, difficulty concentrating, varying degrees of amnesia, depression, apathy (a lack of interest or feeling), nausea, and anxiety. Repeated concussions are dangerous and may put the person at risk of sudden death.

Contusions and lacerations Contusions (con-TOO-zhuns) and lacerations (la-se-RAY-shuns), which are bruises and cuts to tissue, are serious problems when the brain is affected. Brain contusions and lacerations often are associated with serious head trauma that causes severe surface wounds and skull fractures. The symptoms a person shows depend on the part of the brain that is affected. Severe contusions and lacerations generally are associated with brain swelling. The initial trauma may also cause paralysis or even coma* for several days to weeks.

Hematomas A hematoma is a localized mass of blood in tissue. The swelling and the black-and-blue appearance of a bad bruise are caused by just such a leakage of blood from damaged blood vessels in the injured area. Unlike most of the rest of the body, the skull restricts swelling, so the increased pressure caused by the bleeding is transferred to delicate brain tissues. In the brain, hematomas cause different symptoms depending on where they are located. Bleeding from injury to blood vessels within the brain tissues may cause an acute subdural* hematoma. This kind of hematoma begins forming immediately after injury and is common in severe head injuries. It causes growing pressure within the skull that eventually can lead to coma and even death. Some subdural hematomas are formed by very slow blood vessel bleeding, and so they may not produce

symptoms for several days or even weeks after the injury. The symptoms may be overlooked because of the time lapse between the injury and the appearance of symptoms. Symptoms may include daily headaches that slowly increase in severity, impairments in aspects of thinking and memory, changing levels of drowsiness and confusion, and gradual paralysis on one side of the body.

Epidural* hematomas occur when blood coming from arteries is trapped between the membranes covering the brain and the skull. The symptoms of an epidural hematoma usually develop within hours of the injury. Symptoms may include worsening headache, growing loss of consciousness, loss of motor skills*, and fixed gaze of one or both eyes, with dilated (widened) pupils. Epidural hematomas are less common than subdural hematomas, but they require prompt medical attention because the bleeding can quickly compress the brain and cause permanent or fatal brain damage.

How Do Doctors Diagnose and Treat Brain Injuries?

The severity of brain injuries may be difficult to determine accurately. Doctors must evaluate all the symptoms, listen to descriptions of the accident from both the injured person and witnesses, and rely on a variety of tests and procedures to make a diagnosis. The problems of diagnosis are even more complicated when the patient is unconscious or suffers from amnesia.

The diagnosis begins with physical examination. The doctor checks the state of consciousness, breathing patterns, pupil size and the pupils' reaction to light, and movement of the eyes and limbs. Doctors may perform x-rays to find fractures of the skull. In addition to x-rays, doctors use special imaging studies, such as computerized tomography* (CT) scans or magnetic resonance imaging* (MRI), to reveal detailed information about the brain itself. CT and MRI tests show whether there are structural changes in the brain, such as hematomas. A procedure called an angiogram, which is a kind of x-ray of the blood vessels, sometimes is used to see where blood vessels may be ruptured, or torn. In some cases, carefully observing the patient over several hours is important because in some neurological conditions symptoms can be delayed and then appear suddenly. A neurologist or neurosurgeon (a doctor who specializes in injuries and surgical problems of the brain) may review all of this information. Based on the details surrounding the accident and the results of the physical assessment and the various medical tests, the doctor chooses the best course of treatment.

Skull fractures themselves seldom require special treatment. In most cases, the fracture heals by itself over time. In severe or penetrating cases of skull fracture, surgery may be required to remove fragments of the skull that may have been pushed into the brain.

Surgery is one method of treatment for injuries such as hematomas. Attempts to stop the bleeding associated with epidural hematomas usually

* **epidural** (ep-I-DOO-ral) means above or outside the dura, the covering of the brain.

* **motor skills** are muscular movements or actions.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

Sports-Related Brain Injury

Every year more than 750,000 people in the United States are injured while playing recreational sports. About 82,000 of these are traumatic brain injuries. Players of almost any sport can be injured, but those who play football, soccer, or ice hockey and those who wrestle or box may be most in danger of severe brain injuries. In just one playing season, as many as 10 percent of college football players and 20 percent of high school football players may have serious head injuries. Sports participants who are hit in the head repeatedly, such as boxers, may have permanent disabilities as the result of many injuries to the brain.

Members of the American Medical Association assert that the danger is so grave that they have repeatedly called for a ban on boxing. Some professional boxers have a condition called punch-drunk syndrome, which slurs their speech and makes them unsteady on their feet. Boxers who are punch-drunk may also have memory impairment and difficulties in concentrating or communicating. Muhammad Ali (b. 1942), three-time world heavyweight boxing champion and Olympic gold medalist, developed parkinsonism, which may have resulted from his years in the ring. A person with parkinsonism usually has muscle rigidity, tremors, and twitches that may make it difficult to walk or even to talk. In severe cases, parkinsonism also may affect a person's mental abilities.

* **clots** are jellylike masses of congealed blood that stop blood flow.

are done as an emergency procedure to prevent further brain damage from increased pressure in the skull caused by the bleeding. Epidural hematomas may require repeated operations to remove blood clots*. Damage to brain tissue cannot be repaired by surgery or medicine. The harmful effects of brain injuries respond best to aggressive treatment by rehabilitation teams typically made up of specially trained physicians, psychologists, physical therapists, speech-language pathologists*, physical and occupational therapists*, and other professionals. Patients must be monitored constantly and their condition reevaluated as their behavior and symptoms change.

What Are the Long-Term Effects of Brain Injury?

Recovery from a minor brain injury, such as a concussion, usually takes a short period of time (three to six months), and the recovery often is complete. For more serious injuries, degrees of recovery vary. Factors that predict good recovery are the patient's age (younger is better), duration of coma (longer is worse), presence of bleeding in the brain, and the site and amount of trauma to the head and brain. Patients who survive severe brain injury often face a long recovery process (years) and are left with permanent disabilities.

Rehabilitation programs help patients regain their cognitive and emotional faculties. During the rehabilitation process, patients commonly have lapses of memory, behavioral changes, emotional problems such as anxiety or depression, changes in sleep patterns, declines in intellectual ability, and seizures. Psychological counseling and brain injury support groups are available to help patients and families deal with the long-term rehabilitation process.

Patients who end up in a coma or a persistent vegetative state (PVS) usually have the most severe types of brain injury. In these types of injury, the cognitive centers of the brain are badly damaged while the brain stem that controls bodily functions may remain intact. The PVS can last for many years. During the PVS, patients are not mentally aware of their surroundings, but they may still have basic reflexes and sleep cycles. Patients in a PVS that lasts longer than three months have a slight chance of some amount of recovery, whereas patients in a PVS for more than six months rarely recover.

How Can Brain Injury Be Prevented?

Most brain injuries are the result of accidents or falls. Wearing safety belts in cars and helmets when using wheeled vehicles, such as bicycles and skateboards, can help prevent many of these injuries. Observing safety practices is important. Wearing a safety belt in the front seat of a car prevents the wearer from hitting the dashboard, steering wheel, or windshield. Wearing seatbelts in the front seat or backseat keeps the wearer from being thrown around inside the vehicle or thrown out of the vehicle. Wearing a helmet while riding a bicycle or motorcycle or using a skateboard or skates helps protect the rider from injuries during falls. The

helmets should be tight fitting and padded and have a chin strap. It is also important to wear helmets while playing contact sports such as football. Even in sports such as baseball, helmets should be worn whenever there is a possibility that the ball could strike the head.

▶ See also **Concussion • Consciousness • Dementia • Memory and Amnesia**

Resources

Books and Articles

Chudler, Eric H. *Inside Your Brain*. New York: Chelsea House, 2007.

Organization

Brain Injury Resource Center. P.O. Box 84151, Seattle, WA, 98104-5451. Telephone: 206-621-8558. Web site: <http://www.headinjury.com>.

Brain Tumor

A brain tumor is a mass of abnormal cells growing in the brain. Despite its frightening name, not all brain tumors are cancerous or fatal.

What Is a Brain Tumor?

A brain tumor is a clump of abnormal tissue that can be found anywhere in the brain. The brain and spinal cord form the central nervous system, which controls bodily functions. Some of these, such as walking and talking, are voluntary or intentional actions. Others, such as food digestion and heart rate, are involuntary or automatic functions. The central nervous system manages the latter in conjunction with hormones secreted through numerous glands that are part of the endocrine system*. Besides these tasks, the central nervous system also controls people's senses, emotions, thoughts, memory, and personality.

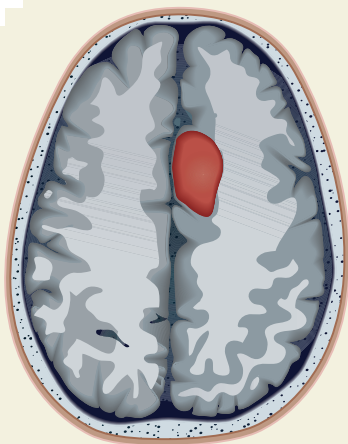
Brain tumors are categorized in two ways: first, by how they look during imaging tests that create pictures of the brain and by how the tissue appears under a microscope; and second, according to whether they formed in the brain or spread there from another part of the body.

Benign brain tumors have clearly defined edges and contain cells that look healthy, just like normal cells. They tend to grow slowly, are not likely to spread, and rarely grow back once they are removed. The word "benign" means harmless or not cancerous. Benign tumors may cause impairment if they start to interfere with normal brain function.

* **speech-language pathologists** (pa-THAH-lo-jists) are professionals who are specially trained to test and treat people with speech, language, and voice disorders.

* **physical and occupational therapists** are professionals who are trained to treat injured people by means of activities designed to help them recover or relearn specific functions or movements and restore their abilities to perform the tasks of daily living.

* **endocrine system** is a system of ductless glands, including the thyroid and pituitary among others, that secrete hormones and control many bodily functions.



Brain scan, from the top of the head, showing a tumor (the red mass) in the right hemisphere. *Illustration by Argosy. Reproduced by permission of Gale, a part of Cengage Learning.*

Malignant brain tumors are also called brain cancer. They are made up of abnormally shaped cells and can have irregular borders. They tend to spread quickly by sprouting new “roots” into surrounding brain tissue, almost like a plant in the soil. While the tumors may also spread to the spinal cord, they generally do not spread to other parts of the body. In some cases, one tumor may contain a combination of nearly normal and extremely abnormal cells.

Primary brain tumors originate in the tissues of the brain and may be either benign or malignant. According to the American Brain Tumor Association, about 45,000 people in the United States receive a diagnosis of a primary brain tumor each year, and about 60 percent of these will be benign. Of the 45,000 total, approximately 3,400 occur in individuals less than 20 years of age.

Secondary brain tumors are actually formed from cancer cells that have traveled to the brain from another part of the body. For example, cells from tumors in the lung or breast can spread to the brain and cause new tumors to grow. Secondary brain tumors are always malignant.

In addition, brain tumors are classified by the type of brain cell that became a tumor, with medical names such as astrocytoma (as-tro-sy-TO-ma), glioma (glee-O-ma), ependymoma (e-pen-di-MO-ma), germinoma (jer-mi-NO-ma), medulloblastoma (med-yoo-lo-blas-TO-ma), meningioma (men-in-jee-O-ma), and neuroblastoma (noor-o-blas-TO-ma). Their common ending “-oma” means “tumor,” and the remainder of the word indicates the part of the brain where the tumor forms. For example, gliomas, the most common type of brain tumor, forms in the supportive tissue of the brain, called the glia. The second most common type, meningioma, forms in the meninges, which are the membranes that cover the brain and spinal cord.

Why Do People Develop Brain Tumors?

Doctors cannot explain why some individuals develop brain tumors. Even though a tumor can spread within the brain, it cannot spread from one person to another; in other words, brain tumors are not contagious.

Researchers have found that some brain tumors are more common in people who are frequently exposed to certain industrial chemicals used to manufacture rubber, pharmaceuticals, crude oil and petroleum, and nuclear fuel and weapons, as well as agricultural chemicals used on farms. They also have investigated whether certain viruses may contribute to brain tumor development.

Heredity is another possible cause. Because brain tumors sometimes occur in several members of the same family, researchers have investigated whether the tendency to develop them may be inherited.

In addition, some studies have linked cellular phone usage to increased risk, but many others have shown no such connection.

THE STORY OF JOHNNY GUNTHER

Brain tumors affect people of all ages. Among children and young adults who have tumors, the brain tumor is one of the more common types diagnosed. Still, childhood brain tumors are relatively rare. The American Brain Tumor Association estimates that only about four of every 100,000 children under age 20 develop a brain tumor.

In 1946 one such child was Johnny Gunther, whose father wrote the widely read book *Death Be Not Proud* about Johnny's experiences. At the age of 16, Johnny started experiencing some vision problems and a stiff neck. After a series of tests, he was diagnosed with glioblastoma, a fast-growing tumor that tends to spread quickly within the brain.

The book describes the diagnostic tests that Johnny underwent and his treatments, including surgery and radiation therapy, which was called x-ray therapy at that time. Johnny's father also recounts how the family coped with the disease and the eventual knowledge that Johnny would not get better. The boy died in 1947 at the age of 17.

Johnny's tumor is not typical of all brain tumors. Some grow much more slowly and do not invade the surrounding tissue. Gunther notes that while his son's tumor looked like a spider stretching out its legs, another type might look more like "a marble stuck in jelly."

Treatment methods for all types of brain tumors have advanced since 1946, making it easier for doctors to remove these tumors and control their growth. Johnny's doctors had to rely on x-rays, vision tests, and a brain wave test called an electroencephalogram to locate his tumor. In the early 2000s doctors use CTs, MRIs, and other computer technologies to create visual "maps" of the brain and pinpoint a tumor's exact location before and during surgery.

Neurosurgery and Brain Tumors

Neurosurgery has a principal role in the treatment of brain tumors and other tumors within the central nervous system, which includes the brain and spinal cord. It has come a long way since the work of Harvey Cushing (1869–1939), who pioneered the specialty of neurosurgery and post-operative care in the United States in the early 20th century.

Later neurosurgeons used a variety of tools to assist them in precisely locating and removing CNS tumor tissue in order to avoid or significantly decrease trauma to healthy cells that are vital to normal bodily functions. These tools, a number of which are at least partially computer-controlled, allowed the surgeons to maneuver carefully within the tight confines of the skull or backbone.

Through these techniques and the skill of the surgeons, an increasing number of people who have had brain and other CNS tumors removed, were alive and well years after surgery.

What Are the Symptoms of a Brain Tumor?

As the tumor grows, it exerts pressure on the brain that often causes headaches, drowsiness, blurred or double vision, or nausea and vomiting. Of course, most of the time these symptoms are *not* caused by brain tumors. Because different parts of the brain control specific functions in the body, a tumor's symptoms often depend on its location in the brain. Symptoms may include the following:

- Seizures, or sudden movements or changes in consciousness over which the person has no control
- Weakness or loss of feeling in the arms or legs
- Stumbling or lack of coordination in walking
- Abnormal eye movements or changes in vision
- Changes in personality or memory
- Speech problems

Stereotactic Surgery

Stereotactic surgery uses a frame attached externally to the skull. The frame allows the surgeon to attach surgical instruments and to position them precisely.

Before surgery, tumor locations are identified using computerized tomography (CT) or magnetic resonance imaging (MRI). The surgeon then drills a small hole in the skull and, using the CT or MRI data, inserts the instruments and navigates to an exact point in the brain. The surgeon can then remove a tumor or perform other procedures.

Doctors often use stereotactic surgery to steer biopsy needles and forceps, to direct electrodes for recording or marking lesions, to guide lasers, to insert endoscopes for looking inside the body, and to conduct gamma knife procedures, which use radiation to do surgery.

* **chemotherapy** (KEE-mo-THER- α -pee) is the treatment of cancer with powerful drugs that kill cancer cells.

How Do Doctors Diagnose Brain Tumors?

In addition to asking about symptoms, the doctor performs a neurological exam, which involves different tests of vision and eye movement, hearing, reflexes, balance and coordination, memory, thinking ability, and other functions controlled by the brain.

The doctor is also likely to order imaging tests such as a computerized tomography (CT) scan (a special x-ray that uses a computer to create pictures of the brain), or a magnetic resonance imaging (MRI) scan, which creates a picture of the brain by using a very strong magnetic field instead of x-rays. Another possible type of test, called angiogram imaging, involves injecting dye into a blood vessel and creating a series of images as the dye moves through the brain. This procedure helps doctors to visualize the tumor and the blood vessels leading to it.

Once a tumor is found, doctors often need to gather more information to figure out what type it is. In some cases, the doctor takes a sample of the cerebrospinal fluid that surrounds the brain and spinal cord, and then sends the fluid to be examined under a microscope. More commonly, surgeons remove part or all of the tumor in a process called a biopsy and then send the tissue to the laboratory for analysis. To get at the tumor, they open part of the skull (a procedure called craniotomy), or they may drill a small hole in the skull and use a needle to take a tissue sample. Both before and sometimes during the operation, surgeons use computerized images of the brain to help them locate the tumor and avoid the nearby healthy tissues that are essential for normal function.

How Do Doctors Treat Brain Tumors?

Surgery, radiation therapy, and chemotherapy* are the three most common treatments for a brain tumor, but the type of tumor, its location, and the person's age often determine how these treatments are used. Before the process starts, most patients receive medications to relieve any swelling in the brain and control the seizures that often occur with brain tumors.

Surgery During surgery, surgeons attempt to remove the entire tumor. However, if the tumor cannot be removed completely without damaging vital brain tissue, then they remove as much as they can. Surgery is usually the only treatment needed for a benign tumor.

Radiation therapy Radiation therapy (also called radiotherapy) is the use of high-powered radiation to destroy cancer cells or stop them from growing. It is often used to destroy tumor tissue that cannot be removed with surgery, or to kill cancer cells that may remain after surgery. Radiation therapy can be used when surgery is not possible. External radiation comes from a large machine, while internal radiation involves implanting radioactive material directly into the tumor. Even though the radiation is focused on the tumor, some of the surrounding healthy tissue is often damaged as well. Therefore, doctors avoid giving radiation to very young children, especially those under age three because their brains are

still developing. These children are often treated with chemotherapy until they are old enough to have the radiation therapy.

Chemotherapy During chemotherapy, doctors give anticancer drugs by mouth or by injection into a blood vessel or muscle. Because the body automatically tends to prevent chemicals and other foreign substances from entering the brain and spinal cord (a kind of “self-defense” mechanism), doctors may need to inject them right into the spinal fluid.

Research Efforts Research studies called clinical trials evaluate numerous other treatments for brain tumors. For example, researchers can test biological therapies that try to “supercharge” the body’s disease-fighting immune system against the tumor. They also test drugs that would prevent tumors from creating the new blood vessels they need to keep growing. In the United States, the National Cancer Institute formed groups of doctors nationwide who work together to find new treatments for brain tumors in children and adults.

Life after a Brain Tumor

Sometimes, the tumor or the treatment damages some of the nearby healthy brain tissue that controls physical and mental function. Patients need to work with a special therapist if they are having trouble using their arms or legs, maintaining balance, speaking, swallowing, or expressing their thoughts. They may feel tired or depressed, and they may experience personality changes. Children may find that they have problems with learning or remembering what they learn when they return to school.

▶ See also **Brain Chemistry (Neurochemistry)** • **Cancer: Overview** • **Seizures** • **Tumor**

Resources

Books and Articles

Black, Peter. *Living with a Brain Tumor: Dr. Peter Black’s Guide to Taking Control of Your Treatment*. New York: Owl Books, 2006.

Gunther, John. *Death Be Not Proud: A Memoir*. New York: HarperPerennial Library, 1998.

Organizations

American Brain Tumor Association. 2720 River Road, Des Plaines, IL, 60018. Toll free: 800-886-2282. Web site: <http://www.abta.org>.

National Brain Tumor Foundation. 22 Battery Street, Suite 612, San Francisco, CA, 94111-5520. Toll free: 800-934-2873. Web site: <http://www.braintumor.org>.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov/cancertopics/wyntk/brain>.

Breast Cancer

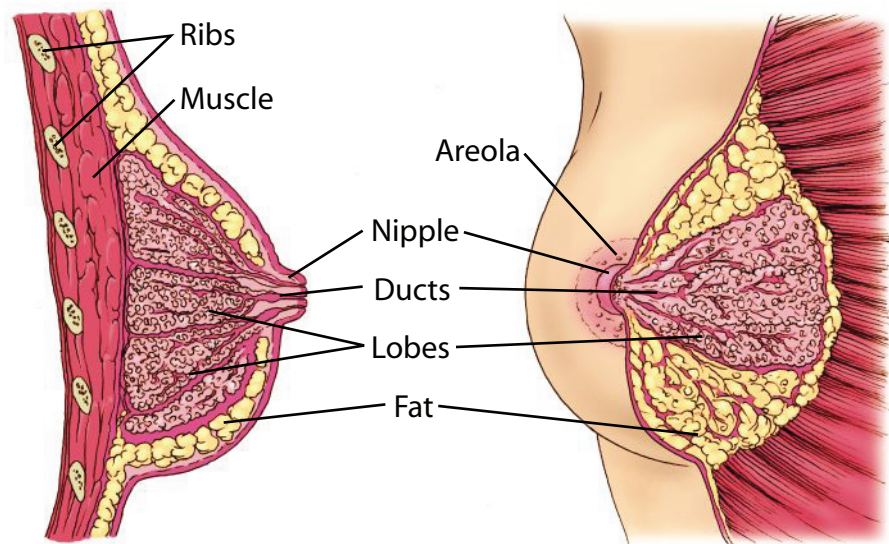
Breast cancer is a potentially dangerous tumor that develops in the cells of the breast. Cancer cells sometimes spread from the breast to other parts of the body.

How Common Is Breast Cancer?

In the United States, breast cancer is a very common cancer among women. Only skin cancer is more common. Breast cancer may occur in men, too, but is much rarer. Breast cancer is also the second leading cause of cancer death in women behind lung cancer, but deaths from breast cancer were reduced substantially in the late 1990s and the early 2000s because more effective treatments became available and because skilled health professionals using state-of-the-art equipment were able to find these cancers earlier when they are easier to treat.

How Does Breast Cancer Start?

A woman's breast contains millions of milk-producing glands called lobules (LOB-yools) that look like tiny bunches of grapes. When a woman is lactating after giving birth, milk from the lobules flows out through channels, or ducts, and to the nipple. Breast cancer begins when a single cell in a duct or lobule undergoes changes (mutations) that cause it to



Anatomy of the breast. Ducts carry milk from the lobules to the nipple. The lobules and ducts are surrounded by fatty tissue and ligaments called stroma. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

start growing out of control. At first, despite the prolific growth, the cells remain within the duct or lobule. At this stage the cancer is called “cancer *in situ*.” Later, the cells may break out of the duct or lobule into the fat and surrounding tissue, where they continue to divide and multiply. The cells form a mass called a tumor that sends out signals in the form of proteins to prompt new blood vessels to form. These vessels provide the nourishment a tumor requires to continue growing.

Metastasis Cancer cells may enter the bloodstream, where the body’s immune system (the body’s defense against disease) may kill them. If the immune system is not successful, the cancer cells may travel to distant organs of the body, settle there, grow, and divide. This spreading process is called metastasis (me-TAS-ta-sis). Breast cancer cells are most likely to spread to the lungs, liver, and bones.

Who Gets Breast Cancer?

Breast cancer is not contagious, and in the early 2000s no one yet knew exactly what causes breast cancer to start. It was known, however, that certain risk factors, such as smoking and obesity*, placed a person at higher risk of getting the disease.

Can Teenagers Get Breast Cancer? Breast cancer in teenagers is very rare. A girl whose breasts are developing may feel some discomfort from time to time, but these pains are a normal part of the body’s functioning and are not a sign of cancer.

Family history A woman whose mother, sister, or daughter has had breast cancer has twice the risk of getting the disease compared to a woman without the family history of breast cancer. Most women diagnosed with breast cancer, however, do not have such a family history.

BRCA1, BRCA2, and Estrogen Women who inherit certain mutated genes* are at higher risk of getting breast cancer. Two of the genes commonly implicated in this higher risk are BRCA1 and BRCA2 (BRCA is short for BReast CAncer). Each person inherits two copies of any given gene from their parents, one from the mother and one from the father. When only one copy of a gene is required to have an effect, it is known as an autosomal dominant gene. BRCA1 or BRCA2, as well as some genes associated with other cancers, are autosomal dominant genes. According to the National Cancer Institute, the presence of BRCA1 or BRCA2 genes can increase breast cancer risk by three to seven times. Although these two mutations account for no more than 10 percent of the overall number of breast cancer cases, women should learn their family history for the disease and report it to their health professionals.

Researchers suspect that natural substances in the body called hormones, especially the female hormone estrogen, play a role in promoting some types of breast cancer. Numerous research studies have linked high lifetime exposure to estrogen to an increased risk of breast cancer.

Women, Breast Cancer, and Mammograms

- All women are at risk for breast cancer. Most women diagnosed with breast cancer do not have a family history of the disease. In fact, according to a very large study compiled in 2001, eight of nine affected women did not have a mother, daughter, or sister with breast cancer.
- As of 2009, invasive (spreading) breast cancer occurs in one out of every eight U.S. women.
- The early detection of breast cancer by mammograms increases the chance of successful treatment.
- Some doctors believe that a woman should have her first mammogram by age 35. This first mammogram provides a baseline for comparison with future mammograms.
- The American Cancer Society recommends that women 40 years old and older have a mammogram every year. The National Cancer Institute recommends a mammogram screening for this age group every one to two years.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person’s body structure and physical characteristics. Inherited from a person’s parents, genes are contained in the chromosomes found in the body’s cells.

Men and Breast Cancer

- About 1 percent of all cases of breast cancer occur in men.
- A family history of breast cancer is one of several risk factors for men as well as for women.
- Breast cancer in men usually shows up as a lump beneath the breast area, fixation of skin to the lump, and discharge from the nipple.
- While breasts are smaller in men, which makes any unusual lumps easier to feel, breast cancers in men typically spread much faster than they do in women. For this reason, breast cancer in men is often detected when the cancer is advanced and more difficult to treat.
- Treatment usually involves surgical removal of the lump and surrounding tissue in to which the cancer may have spread, followed by chemotherapy or radiation therapy to kill any remaining cancer cells in the body.
- The survival rates for men who are treated for breast cancer are similar to those for women at the same stage of the disease.

* **mammography** (mam-MOG-ra-fee) is x-ray examination of the breasts. A mammogram is used in the diagnosis of breast cancer. It may show changes that indicate a possibility of cancer, and medical professionals will then run other tests to check for other signs of the disease.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **benign** (be-NINE) refers to a condition that is not cancerous or serious and will probably improve, go away, or not get worse.

Estrogen levels may become elevated due to obesity, use of birth control pills or other estrogen-containing medications, possibly exposure to environmental chemicals, and other causes.

Age Older women have a higher risk of developing breast cancer. Another risk factor is early age for first menstrual period as well as late age for menopause. Women who have their first child after the age of 30, or who do not have any children, also have a slightly higher risk. In addition, a woman who has already had breast cancer in one breast is at higher risk of getting it in the other breast.

Diet and lifestyle Rates of breast cancer vary around the world, and these general differences appear to be related to diet or lifestyle. For example, women in Southeast Asia in the 1990s showed that they had only one-fifth to one-fourth the risk of getting breast cancer as women in the United States. Numerous studies have explored possible connections between diet and lifestyle and the threat of breast cancer.

Signs and Symptoms of Breast Cancer

The first sign of breast cancer is often a painless lump in the breast. In some cases, the shape, color, or texture of the breast or nipple may be different, or the nipple may be tender or have a discharge. Sometimes, medical professionals may find the cancer before symptoms occur. One method for doing so is the routine or “screening” mammography* (mam-MOG-ra-fee) (x-ray examination of the breasts). A mammogram may show changes that indicate a possibility of cancer, and medical professionals will then run other tests to check further for the disease.

Diagnosis If screening tests or a woman’s symptoms suggest cancer, the doctor may request a biopsy* (BI-op-see). In this procedure, a small amount of tissue is removed from the abnormal area of the breast and examined under a microscope. Most biopsies show that the tissue is benign*, which means that the tissue is cancer-free, and the woman may need no further treatment. A woman who receives a diagnosis of cancer, by contrast, should proceed to learn about the disease and discuss her options for treatment with her health professionals, as well as her friends and family.

Treatment Breast cancers that do not appear to have spread may be treated through lumpectomy (lump-EK-to-mee), which removes only the tumor. Sometimes, however, a mastectomy* (mas-TEK-to-mee) may be required, which is the surgical removal of the breast. The size and sometimes the kind of tumor will determine which is best.

Follow-up treatment may include radiation therapy and anti-cancer medication, called chemotherapy* (kee-mo-THER-a-pee), to kill any remaining cancer cells and to prevent them from returning. The choice of follow-up treatment depends on the kind of tumor and whether it appears to have spread to the lymph nodes* or other parts of the body.

3,000 YEARS OF BREAST CANCER RESEARCH AND TREATMENT

The history of breast cancer and its treatment goes back thousands of years.

- A description of “bulging tumors” being burned or cut out of the breast can be found in the Edwin Smith papyrus from Thebes, dated 1600 B.C.E.
- Ancient Greek women sought help from Aesculapius (es-ku-LA-pe-us), their mythical god of healing. Aesculapian temples were filled with offerings, including carvings of excised tumorous breasts. The women hoped their gifts would prompt an explanation of their disease or convey thanks to the god for his healing power.
- The Greek physician Hippocrates (c. 460–c. 375 B.C.E.) emphasized the importance of diet and the environment for the management of breast cancer. During the second century, the Roman physician Galen (130–200 C.E.) focused his research on a hypothesis that excess black bile caused cancer and that treatment required that the bile be removed by means of bloodletting.
- Bloodletting as a medical technique prevailed until the 1500s, when medieval doctors began returning to surgical treatment of breast cancer.

Support groups

For women with breast cancer, talking to other women who are living with the disease can be a very comforting experience. For women whose breast cancer has come back or spread, support can be even more beneficial. One study showed that women with metastatic breast cancer who participated in support groups lived an average of almost two years longer than women who did not.

Women who have just been diagnosed with breast cancer also may find it helpful to meet and to talk to women who had breast cancer 10 or 15 years earlier and who are now living happy, healthy lives.

Listings of support groups are available through many organizations, including the American Cancer Society.

Can Breast Cancer Be Prevented?

No guaranteed method of breast cancer prevention was available as of the early 2000s, but risk for the disease might be reduced by restricting alcohol consumption, by eating a healthy diet, by getting regular exercise, or by taking other measures. In addition, the early detection of breast cancer greatly improved recovery rates, so women aged 40 years and older were advised by many physicians to have regular screening mammograms and physical exams to check their breasts.

Will a Way to Prevent Breast Cancer Ever Be Found?

Besides focusing on ongoing studies to improve chemotherapy options for treating breast cancer, many researchers were working in the early 2000s on genetic tests that might help to determine who is more susceptible to the disease in the first place. These tests, which begin with a simple blood sample, search for mutated genes that may make a woman more likely to develop breast cancer. While the tests did not identify whether a woman definitely would or would not get breast cancer, they could show the presence of mutated genes, such as BRCA1 or BRCA2, that are related to breast cancer. Numerous studies were underway as of 2009 to investigate

* **mastectomy** (mas-TEK-to-mee) is the surgical removal of the breast.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

how best to use the information from such genetic tests to help a woman lower her risk of getting breast cancer.

Tamoxifen research An effective treatment for many women with breast cancer is a drug called tamoxifen (tam-OX-ih-fen). This drug works against the hormones that stimulate the cells in the breast to grow which are likely factors in many breast cancers. In particular, tamoxifen fills the docking ports (known as receptors) on cancer cells where the hormone estrogen would otherwise fit. In other words, tamoxifen mimics the lock-and-key fit of estrogen into the cancer cell's receptors, and this blocking action stops the hormone from causing cancer growth. Tamoxifen was approved in the late 1990s for use by women who do not have breast cancer but who are at high risk of getting it. Because tamoxifen carries a risk for serious side effects, researchers investigated safer alternatives, including synthetic drugs that work as well as or better than tamoxifen. Scientists also studied other hormones, including progesterone, and their potential implications in either stimulating breast cancer or protecting against it.

What Is It like to Live with Breast Cancer?

Treatment for breast cancer can be very taxing emotionally and physically. Women who undergo mastectomy face emotional difficulties and may also experience serious post-operative swelling in their arms. Chemotherapy carries a set of side effects. If the cancer has spread, individuals face the challenges of recognizing, planning for, and coping with the prospect of dying. Even if the breast cancer was successfully treated, patients must learn to live with the fear that the cancer might someday return.

On the brighter side, treatment options and post-operative care continue to improve. Many women who have had mastectomies are able to have reconstructive surgery that can restore a more normal appearance following breast removal. In addition, support groups for women and men assist those dealing with the stresses of the illness, and love and understanding from family and friends may help to make even the most difficult situation bearable.

▶ See also **Cancer: Overview • Fibrocystic Breast Disorder • Tumor**

Resources

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Love, Susan M. *Dr. Susan Love's Breast Book*, 4th ed. Cambridge, MA: Da Capo Lifelong Books, 2005.

Organizations

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-227-2345. Web site: http://www.cancer.org/docroot/LRN/LRN_0.asp?dt=5.

Breast Cancer and the Environment Research Centers. Web site: <http://www.bcerc.org/pubs.htm>.

Breast Cancer Network of Strength. 212 W. Van Buren, Suite 1000, Chicago, IL, 60607-3903. Telephone: 312-986-8338. Web site: <http://www.networkofstrength.org>.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov/cancertopics/wyntk/breast>.

Breast Lumps See *Breast Cancer; Fibrocystic Breast Disorder*.

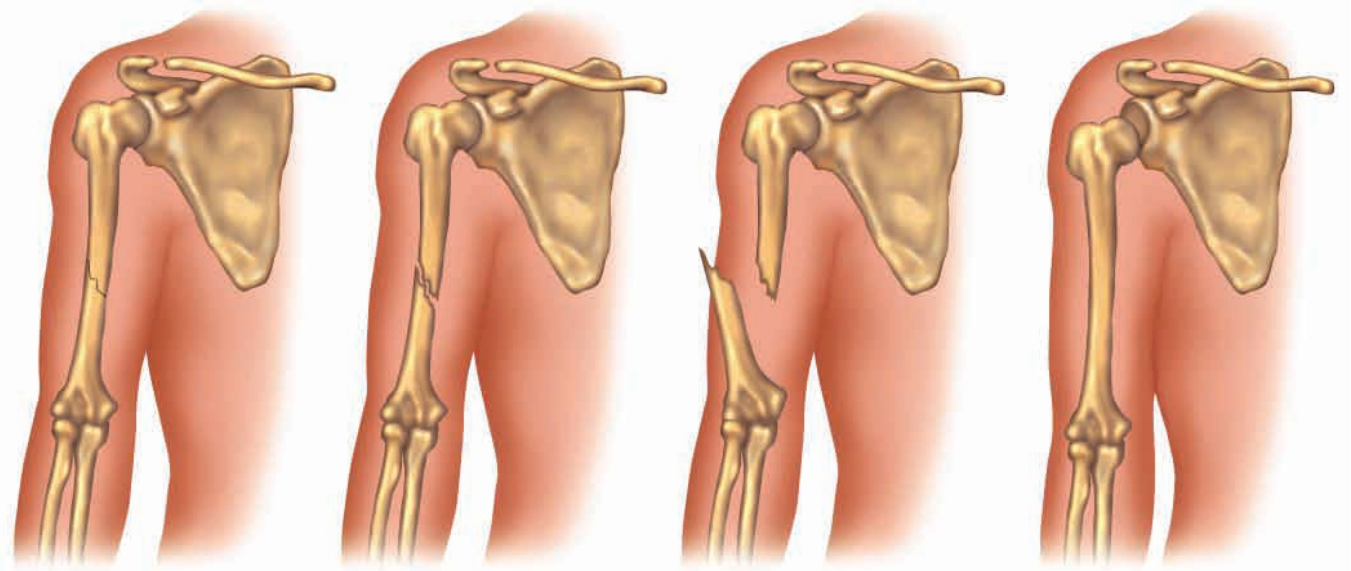
Broken Bones (Fractures)

The bones in the human body are very strong, but they can be broken (fractured) as a result of trauma. Breaks can range in severity from hairline fractures that require minimal treatment to shattered bones that require surgery and may result in permanent damage.

Ken's Elbow

Ken knew the steps to the attic were steep, but when his little sister ran off with his toy airplane, he took the stairs two at a time. Halfway down he slipped. Ken landed in a heap at the bottom and immediately howled in pain. When he got up, his arm was twisted in a funny way, and his elbow would not bend.

Ken's mother rushed him to the emergency room where doctors took x-rays of his arm. He had broken the bone in the upper part of his arm as well as his elbow. The breaks were so bad that Ken had to have surgery that afternoon. The doctor put a metal pin in his elbow to hold the bones together while they healed. After surgery, Ken's arm had to be in traction for two weeks, which means that he had to lie on his back in bed while his elbow was held in place by a special device hanging from the ceiling. This device put tension on his arm and elbow in just the right places to allow them to heal properly. After getting out of the hospital, Ken had a plaster cast on his whole arm for another eight weeks. Ken's arm and elbow healed completely, but every so often his elbow aches when he plays baseball.



Closed fracture:
crack

Closed fracture:
complete break

Open fracture

Dislocation

▲ Bone is the hardest tissue in the human body, but when bones are subjected to forces that exceed their strength, they may break in several different ways.

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

What Are Bone Fractures?

Bone is the hardest tissue in the human body, but when bones are subjected to forces that exceed their strength, they may break. The terms “break” and “fracture” mean the same thing.

- A simple fracture is the most common type of break. The bone breaks but does not break through the skin.
- A compound (open) fracture occurs when the broken bone breaks through the skin. This type of break is serious because in addition to the damaged bone bacteria can infect the body through the break in the skin. Sometimes the jagged edges of bone break blood vessels and cause bleeding.
- A greenstick fracture is a type of incomplete fracture. Greenstick fractures often affect children, whose bones are springy and resilient. The best way to visualize a greenstick fracture is to think of trying to break a small branch off a growing tree. It will not snap off; rather it requires twisting. Twisting of the branch produces splinters. This effect is similar to what happens in a greenstick bone fracture: The bone cracks and splinters but does not break. If the bone does break into separate pieces, it is called a complete fracture.
- Stress fractures are tiny hairline cracks that can occur when a bone is repeatedly stressed.
- An impacted fracture occurs when a bone breaks and the two pieces ram into each other.
- A comminuted fracture is one in which a bone shatters into pieces.

- Fractures also can occur through joints.
- Sometimes, people tear ligaments (tough bands of connective tissue that hold joints and bones together) even when a bone is not broken. Torn ligaments frequently affect the ankles and knees.
- Dislocations are injuries in which the bones in a joint are pulled apart or displaced in relation to each other. Ligament injuries and fractures often occur with dislocations.

What Causes Breaks and Fractures?

Bones break when they are subjected to extreme force or stress. The likelihood that a bone will break depends on the location of the bone in the body, the thickness of the bone, and the circumstances under which the force is applied. The most commonly broken bones are those in the wrist, hip, and ankle.

Bone is living tissue, and like other living tissue in the body, bone is affected by genetics, hormones, diet, physical activity, disease, and drugs. All of these factors determine which bones are more or less prone to injury. In addition, the strength of bone and the forces acting on bone vary with age, so the types of fractures and the number of people affected by them vary with age as well.

Other factors that weaken bone and predispose individuals for bone fracture include those associated with low bone mineral density such as osteoporosis*, age (over 50 years of age), menopausal and post-menopausal women (due to low estrogen levels), previous fractures, ethnicity (Caucasian and Asian groups have a higher incidence of osteoporosis), long-term corticosteroid* therapy, rheumatoid arthritis*, elevated levels of parathyroid hormone (associated with hyperparathyroidism), and androgen deficiency* in men. In addition, some cancer treatments, immunosuppressants*, steroids, antipsychotics*, and anticonvulsants* may predispose individuals who use them to bone fracture. Some diseases associated with nutritional deficiencies and/or immobility may predispose to poor bone health such as Crohn's disease, rheumatoid arthritis, blood disorders, and endocrine disorders. Healing time also varies with a patient's general state of health and nutrition.

Many types of trauma (for example, skiing or car accidents) can cause a bone to break. However, some people are more prone to breaks because they have genetic conditions or bone diseases that weaken their bones, such as the following:

- Osteogenesis imperfecta, which means imperfect bone formation, is also called brittle bone disease. People with this condition have inherited genes that cause a defect in the production of bone. The result is weakened bones that break easily.
- Osteoporosis causes a thinning and weakening of the bones, making bones prone to fracture. It affects older adults, particularly women after they reach menopause.

Anatomy of Bone

The human skeleton consists of 206 bones that support the body and allow it to move. There are 29 bones in the skull, 27 in each hand, and 26 in each foot.

Bone is living tissue. It consists of cells, blood vessels, connective tissue, proteins, and fibers, as well as minerals such as calcium and phosphorus. Every bone contains both trabecular (tra-BEK-yoo-lar) and cortical (KOR-ti-kal) bone. Trabecular, or cancellous (KAN-sell-us) bone, looks like honeycomb. Despite being porous, it is very strong. Cortical bone is solid and dense. In cross-section, it reveals circular patterns like those seen in slice of a tree trunk. It forms the outer layer of bones. Many bones also contain bone marrow, where blood cells are made.

The ratio of trabecular to cortical bone varies depending on the type of bone. Trabecular bone surrounded by a thin layer of cortical bone makes up the spine, skull, ribs, and sternum (breast bone), whereas the bones of the arms and legs consist mostly of cortical bone, with only a small amount of trabecular bone at both ends.

* **osteoporosis** (os-te-o-por-O-sis) is the loss of material from the bone. This makes the bones weak and brittle.

* **corticosteroid** (KOR-ti-ko-STER-oid) is one of several medications that are prescribed to reduce inflammation and sometimes to suppress the body's immune response.

* **rheumatoid arthritis** (ROO-mah-toyd ar-THRY-tis) is a chronic disease characterized by painful swelling, stiffness, and deformity of the joints.



X-ray image showing a fracture of the fibula, a leg bone. Doctors use x-rays to confirm fracture diagnoses. *Scott Camazine/Photo Researchers, Inc.*

* **androgen deficiency** (AN-dro-gen de-fish-ens-see) is reduced male hormones in men, also called male menopause.

* **immunosuppressants** (im-yoo-no-su-PRES-ants) are substances that weaken the body's immune system.

* **antipsychotics** describes a type of medication that counteracts or reduces the symptoms of a severe mental disorder such as schizophrenia.

* **anticonvulsants** (an-tie-kon-VUL-sents) are medications that affect the electrical activity in the brain and are given to prevent or stop seizures.

* **bone marrow** is the soft tissue inside bones where blood cells are made.

RÖNTGEN AND THE DISCOVERY OF X-RAYS

X-rays are the result of the collision between electrons and protons. German physicist Wilhelm Conrad Röntgen (or Roentgen) (1845–1923) discovered what he called X-radiation in 1895. This form of radiation was noted to have properties allowing transparency and fluorescence that absorbed visible light and contrasting shadows. Experiments with this new form of radiation revealed the distinction between bone and soft tissues in the body, such as in the hand.

Röntgen's first x-ray was of his wife's hand, which showed bones, soft tissue, and metal from the ring she was wearing. His discovery of x-rays heralded a significant and valuable diagnostic tool used in the field of medicine.

Röntgen was awarded the Nobel Prize for Physics in 1901 for his discovery. He was the first recipient to be honored in this category. This Nobel Laureate was honored "in recognition of the extraordinary services he has rendered by the discovery of the remarkable rays subsequently named after him". They were called Röntgen Rays in many countries, but the scientist himself preferred to call them x-rays, as the letter *X* in mathematics stands for an unknown.

- Osteopetrosis is a rare hereditary disease that causes the bones to thicken. Osteopetrosis comes in several forms, some of which cause joint problems. Osteopetrosis congenita is discovered in infancy or childhood and it affects the bone marrow*; without a bone marrow transplant, this condition usually is fatal. Marble bone disease also is discovered in infancy. It causes short stature and mental retardation.
- Other diseases, such as bone cancer, osteomalacia (adult rickets), Paget's disease (in which the bones become enlarged, weak, and deformed), and exposure to radiation can weaken bones and make them susceptible to breaks.

How are Fractures Diagnosed and Treated?

Diagnosis A doctor may suspect a broken bone based on the appearance of the injured area. A fractured bone may cause swelling or bruising in the affected area. As in Ken's case, the affected limb might look deformed and it may hurt to move it. Sometimes a break is obvious because the bone has poked through the skin. By touching and pressing on the injured area, the doctor may be able to tell if a bone is broken. X-rays of the injured area usually confirm the diagnosis of a broken bone, although stress fractures or hairline fractures (these are fractures due to continued overuse associated with small amounts of repeated trauma causing the area to become weakened) can be difficult to detect on x-rays. Sometimes two or three x-rays may need to be taken from different viewpoints because

a fracture may be difficult to see from one angle, but easily seen from another x-ray view.

Treatment Broken bones may be treated by realigning the bones in their proper position, if necessary (a process called “reduction”), and then holding them in place while they heal.

How a broken bone is treated depends on where in the body it is located and how severe the break is. In the case of a stress fracture, a device called a splint may be used to immobilize the injured area while it heals. An arm sling may also be used to keep a person from using an injured arm. When a person has a simple fracture, the doctor guides the bones back into their proper place, if necessary, and then immobilizes the injured area with a cast made of plaster or fiberglass.

Other more serious types of fractures can require surgery. For example, in Ken’s case, realigning the bones was not a straightforward task. An orthopedic surgeon (bone specialist) needed to open the site of the fracture surgically and use metal pins and plates to hold the bones together while they healed. Ken’s injury required his arm to be in traction for several weeks before having a cast for an additional two months.

Healing The healing process for fractures takes place in three stages known as inflammation, repair, and remodeling. The first phase (inflammation phase) occurs as damaged soft tissue in the surrounding area becomes swollen and painful. This swelling and pain may last from a few days to a few weeks. The second phase (repair phase) may last from a few weeks to a few months, as bone regeneration occurs and the new soft bone without calcium (callus) moves from being soft to being hard and strong. The third stage (remodeling phase) may last for many months, as the bone builds itself back to its normal, hardened state.

Splints, casts, and slings are used to keep bones in place while they heal. Healing occurs when the bone tissues produce a substance called callus, which binds the broken pieces together. Healing time varies with age. A fracture that may take three weeks to heal in a four-year-old may take three months to heal in an adult. Casts for simple breaks usually stay on for six to eight weeks, but more severe breaks may require a cast for much longer time periods.

Bones, like other living tissue, maintain continuous states of renewal. Osteoblasts and osteoclasts are special types of cells that are responsible for the formation (osteoblasts) of new bone and the breakdown (osteoclasts) of bone material. Callus formation (created by the union of bone, blood, and cartilage material) allows for a bridge-like connection during repair of a bone fracture. During this time, bone-forming cells grow and surround the fracture to gradually renew and strengthen the bone and fracture site.

Many people recover completely from breaks and fractures. However, one possible complication that may increase recovery time is osteomyelitis*, an infection of the bone. Osteomyelitis may be acute or chronic, and it is

Is It Broken?

People can break bones anytime and anywhere. To assess the situation, doctors often look for signs of fractures and ask about symptoms. Among the signs doctors look for are the following:

- Swelling and bruising
- A limb hanging at an unusual angle
- A limb that appears out of place
- A bone sticking out through the skin

Doctors also ask about the following:

- Did the person feel or hear anything breaking?
- Can the person move the injured area?
- Does the area hurt when touched?

* **osteomyelitis** (ah-stee-o-my-uh-LYE-tis) is a bone infection that is usually caused by bacteria. It can involve any bone in the body, but it most commonly affects the long bones in the arms and legs.

* **trachea** (TRAY-kee-uh) is the windpipe—the firm, tubular structure that carries air from the throat to the lungs.

usually caused by bacteria entering the bone. The infection may occur at the fracture site or in another part of the body; in the latter case, the infection then travels to the bone via the bloodstream. Osteomyelitis may be a concomitant result when a person sustains a compound fracture (often from physical trauma) in which a break in the skin occurs. The open skin allows bacteria to enter, and osteomyelitis may result. Antibiotics are often prescribed for compound fractures in order to prevent or eliminate the infection and thus minimize the possibility of osteomyelitis. Compound fractures may take a long time to heal, necessitating prompt and aggressive antibiotic therapy.

▶ See also **Arthritis • Osteomyelitis • Osteoporosis • Rickets • Strains and Sprains • Trauma**

Resources

Books and Articles

Dutton, Mark. *Orthopaedic Examination, Evaluation, and Intervention*. New York: McGraw-Hill Medical, 2008.

Royston, Angela. *Broken Bones*. Chicago: Heinemann Library, 2004.

Skinner, Harry. *Current Diagnosis and Treatment in Orthopedics*. New York: McGraw-Hill, 2006.

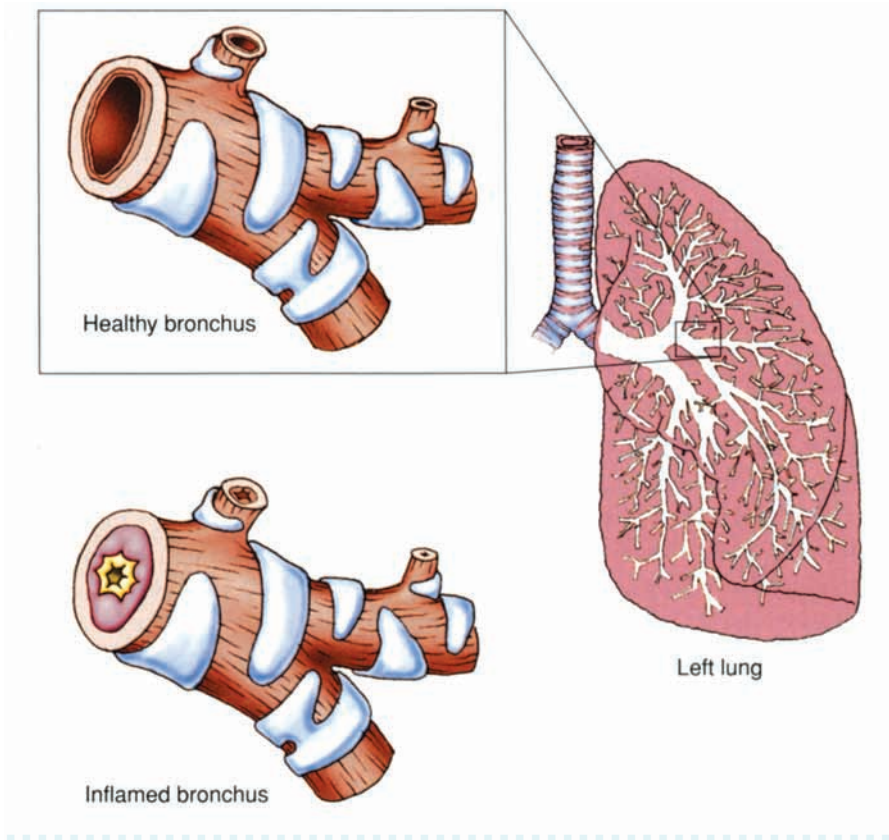
Organizations

American Association of Orthopedic Surgeons. 6330 North River Road, Rosemount, IL, 60018. Telephone: 708-823-7186. Web site: <http://www.aaos.org>.

Osteogenesis Imperfecta Foundation. 804 W. Diamond Ave, Suite 210, Gaithersburg, MD, 20878. Toll free: 800-981-2663. Web site: <http://www.oif.org>.

Bronchiolitis and Infectious Bronchitis

Bronchiolitis (brong-kee-o-LYE-tis) is an infection that causes inflammation of the lung's smaller airways, also called the bronchioles (BRONG-kee-oles). It is common among very young children, particularly during the winter months. Bronchitis (brong-KYE-tis) is a disease that involves inflammation (irritation and swelling) of the larger airways in the respiratory tract. These airways, called the bronchial (BRONG-kee-ul) tubes or bronchi (BRONG-kye), extend from the windpipe to the lungs. Another name for the windpipe is the trachea to the lungs. Bronchitis and bronchiolitis can result from infection or other causes.*



Close-up view of the anatomy of the left lung and of one of its bronchial tubes, which is called a bronchus. Healthy bronchi bring air in and out of the lungs, but people with irritated and inflamed bronchi have mucus clogging up the inside of the tubes. The inflammation interferes with breathing and causes coughing that often brings up the mucus. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



What Are Bronchitis and Bronchiolitis?

In both bronchitis and bronchiolitis, the tissue lining the airways swells, narrowing the air passages and making breathing difficult. The inflamed airways produce larger amounts of a thick, slippery substance called mucus*, which can clog the air passages and complicate breathing even more. People who have bronchitis and bronchiolitis cough frequently to drive out this excess mucus.

Bronchitis and bronchiolitis can also affect the cilia, which are fine, hair-like structures on the surface of the cells lining the airways. Normally, the cilia help cleanse the airways of inhaled particles, but in individuals who have these conditions, the cilia become less able to clear impurities and bacteria from the airways, making it harder for the person to fight off lung infection.

What Causes Bronchitis?

Infection with viruses and sometimes with bacteria can cause bronchitis, but many people get it as the result of smoking or from living or working in areas that have heavy air pollution and/or dust. Bronchitis comes in three types: acute bronchitis, a persistent or recurring form called chronic (KRAH-nik) bronchitis, and asthmatic bronchitis.

Acute bronchitis Acute bronchitis comes on quickly and often results from an infection with a virus. Viruses that can cause acute bronchitis are

* **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

* **respiratory syncytial virus** (RES-puh-ruh-to-re sin-SIH-she-ul), or RSV, is a virus that infects the respiratory tract and typically causes minor symptoms in adults but can lead to more serious respiratory illnesses in children.

* **parainfluenza** (pair-uh-in-floo-EN-zuh) is a family of viruses that cause respiratory infections.

* **influenza A** (in-floo-EN-zuh A) is one member of a family of viruses that attack the respiratory tract.

* **adenovirus** (ah-deh-no-VY-rus) is a type of virus that can produce a variety of symptoms, including upper respiratory disease, when it infects humans.

contagious. People can get a viral infection from someone who is infected if they come into contact with that person's respiratory fluids. The virus also can spread from person to person through the air by way of the droplets from a sneeze or cough. Acute bronchitis can also result from an allergy or from inhaling irritating substances in the air, such as smoke from a fire. In all, more than 12 million people have bouts of acute bronchitis every year, and most of them are children under five years of age, who typically get it in winter and early spring. Usually, acute bronchitis lasts about 10 days, but in severe cases, an individual may have a bad cough that lasts up to a month as the bronchi heal.

Chronic bronchitis No matter who they are, what their job is, or where they live, people who smoke cigarettes are more likely to experience chronic bronchitis. The American Lung Association reports that the disease develops in more than nine million people in the United States every year. People with chronic lung disease are also likely to experience chronic bronchitis. Generally, chronic bronchitis is not contagious. Rather, it results from persistent or repeated inflammation of the lungs over at least two to three months, which can continue or come and go over years. Individuals with chronic bronchitis typically have a bad cough and restricted airflow because of the excess mucus in their airways.

Asthmatic bronchitis Asthmatic bronchitis is seen in people with persistent asthma.

What Causes Bronchiolitis?

In the vast majority of bronchiolitis cases, a virus infects the bronchioles, the smallest airways that carry air through the lungs. The virus that most often causes bronchiolitis is called respiratory syncytial virus* (RSV). Other viruses, such as rhinovirus, parainfluenza* virus, influenza A*, and adenovirus*, also can cause bronchiolitis. These viruses are contagious.

Viral bronchiolitis occurs commonly in late fall, winter, and early spring. It typically affects younger children, with most cases occurring in children two years old or younger. Many may only get bad cold symptoms and nothing more, but others may need hospital care. In fact, bronchiolitis is a leading cause of hospitalizations for children under age five; more than 100,000 per year occur annually in the United States.

While most bronchiolitis results from viral infection, it sometimes has other causes. These types of non-infectious bronchiolitis may stem from the following:

- constrictive bronchiolitis (also called bronchiolitis obliterans), which sometimes occurs when the body of a lung-transplant patient rejects the new organ
- diffuse panbronchiolitis, a poorly understood condition that mainly affects Asian men
- respiratory bronchiolitis, which occurs mainly among smokers

What Are the Signs and Symptoms of Bronchitis and Bronchiolitis?

Chronic bronchitis usually is marked by a cough that lasts three months or longer, tightness in the chest, and trouble breathing. Acute bronchitis and bronchiolitis symptoms often mimic those of a cold. Common symptoms include coughing that brings up mucus, wheezing, tiredness, chest pain, a low fever, and difficulty breathing. Individuals who have difficulty breathing should see a doctor immediately to make sure they are getting enough oxygen. Signs of breathing difficulties may be blue skin or lips, very rapid breaths, or a noticeable inward movement, which is called a retraction, of the muscles between the ribs while breathing. Individuals who cannot drink and hold down fluid should also see a doctor right away. In that case, the doctor may check for signs of dehydration*.

In diagnosing these conditions, a doctor may start by listening to the person's breathing or ordering a chest x-ray to check for pneumonia or a lung function test to check for asthma. The doctor may also take a sample of the individual's nasal fluid and ask laboratory technicians to check it for the presence of RSV. They do this with an antigen* detection test.

How Are Bronchitis and Bronchiolitis Treated?

Most otherwise-healthy people who have bronchitis and bronchiolitis can recover at home. Doctors usually recommend that individuals drink lots of fluids, eat a well-balanced diet, and get plenty of sleep, preferably in a room that has a cool-mist vaporizer or humidifier running to ease breathing. For pain and fever, doctors typically suggest over-the-counter medications, such as acetaminophen*. For patients with acute bronchiolitis, a doctor may also prescribe bronchodilator* drugs to help open the airways. Bronchodilator drugs come either in pill form or in a spray inhaler.

The vast majority of bronchitis and bronchiolitis cases result from viruses, so doctors generally do not prescribe or recommend antibiotics. Although decongestants may seem like a good choice as a way of decreasing the amount of mucus, they often produce unwanted side effects in very young children and should not be given to them. Instead, a parent can clear the mucus from a child's nose with suction from a rubber bulb and saltwater nose drops. Occasionally children with bronchiolitis, especially those who were born prematurely or with heart or lung problems, may have to be hospitalized so that they can get extra oxygen and fluids, and if necessary, breathing treatments.

For people who have chronic bronchitis, the best treatments are preventative measures: stop smoking and avoid dust, fumes, and cold or dry air. Besides these preventative steps, individuals with chronic bronchitis may get some relief from their symptoms through cough medicine and vaporizers.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **antigen** (AN-tih-jen) is a substance that is recognized as a threat by the body's immune system, which triggers the formation of specific antibodies against the substance.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **bronchodilator** (brong-ko-DYE-lay-tor) is a medication that helps improve air flow through the lungs by widening narrowed airways.

Kicking Butts

When a smoker quits smoking, it takes only 20 minutes to feel better. Statistics from the American Lung Association show the following:

- **20 minutes after quitting** blood pressure decreases and pulse rate lowers
- **Eight hours after quitting** the oxygen level in the blood rises to normal and the carbon monoxide level in the blood returns to normal
- **One day after quitting** the chance of a heart attack drops
- **Two days after quitting** nerve endings begin to regrow, allowing the senses of taste and smell to improve
- **Two weeks to three months after quitting** circulation of the blood improves and both walking and breathing become easier
- **One to nine months after quitting** coughing, congestion, tiredness, and shortness of breath diminish
- **One year after quitting** the risk of heart disease becomes half that of a smoker

The long-term benefits are encouraging, too. After 5 to 15 years, the risk of stroke drops to that of someone who has never smoked. At 10 years after quitting, the risk of lung cancer can become just half of that of a continuing smoker and the risk of several other smoking-related cancers becomes lower, and at 15 years, the likelihood of having a heart attack drops to that of someone who has never smoked at all.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

What to Expect

Most symptoms of acute bronchitis and bronchiolitis clear up after a few days to a week, but the cough may last several weeks longer while the airways in the lungs heal. Chronic bronchitis symptoms last longer and may never resolve, because the damage to the lungs may be permanent. Because of the production of excess mucus, the body's natural reflex will be to cough it up, and this cough may come and go for a long time, flaring up, subsiding, and flaring up again.

Occasionally, people with bronchitis and bronchiolitis develop other conditions, which include pneumonia*, apnea*, and respiratory failure*. These are more common among individuals who have heart, lung, or other health problems, and among children who were born prematurely. Children who have had bronchiolitis are more prone to asthma* later in childhood. Chronic bronchitis, by contrast, can lead to heart failure, because it makes the heart work harder to compensate for the lack of oxygen. Severe respiratory problems can develop, and in some cases the disease can result in death.

How Can Bronchitis and Bronchiolitis Be Prevented?

Because the viruses that cause bronchitis and acute bronchiolitis—especially RSV—spread very easily from one person to another, people can reduce their chances of getting the diseases by washing their hands frequently. Parents should also instruct their children not to share drinks or eating utensils with other children. In addition, parents should keep their children home from school if they have either disease, so the children do not infect their classmates. As an added precaution, doctors may suggest infection-preventing immunizations against RSV for certain children who are at high risk of becoming seriously ill from bronchiolitis. These children include premature infants and those with chronic heart or lung disease.

For chronic bronchitis, the best preventative measure is to stop breathing cigarette smoke. In fact, if people did not smoke, most cases of chronic bronchitis would not develop. Doctors usually advise people with chronic bronchitis or other chronic lung diseases to get a yearly influenza* vaccination* (flu shot) to prevent symptoms from flaring up in response to infection with flu viruses.

▶ See also **Chronic Obstructive Pulmonary Disease (COPD) • Common Cold • Influenza • Pneumonia**

Resources

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.familydoctor.org>.

American Lung Association. 1301 Pennsylvania Ave. NW,
Suite 800, Washington, DC, 20004. Toll free: 800-LUNG-USA.
Web site: <http://www.lungusa.org>

Bruxism (Jaw Grinding) *See Temporomandibular Joint (TMJ) Syndrome.*

Bubonic Plague *See Plague.*

Bulimia Nervosa

Bulimia Nervosa (bull-EE-me-a ner-VO-sa—often called simply “bulimia”), sometimes referred to as the “binge-purge” disorder, involves repeated episodes of excessive eating (bingeing) followed by attempting to rid the body of the food by vomiting, using laxatives or enemas (purging), or exercising excessively.*

Marlene’s Perfect Figure

To her friends and family, Marlene had a perfectly fine figure, and she seemed confident and self-assured. But privately, Marlene suffered from bulimia and could not seem to stop bingeing and purging. Several times per week, she would eat whole batches of cookies, packages of candies, and as much bread and muffins as she could find. Her guilt and fear of becoming overweight always led her to make herself vomit. Marlene stayed at a healthy weight for her size, but she was obsessed with her weight and body shape.

What Is Bulimia?

Eating disorders are habits or patterns of eating that are out of balance and may involve major health and emotional problems. Bulimia is a type of eating disorder in which a person binges, or consumes large quantities of food, and then purges, or attempts to rid the body of the food. When bingeing, people with bulimia often feel like they have little control over their behavior. After a binge, they feel guilty and fearful of becoming fat, so they try to rid the body of the food by vomiting or using laxatives or enemas. They may use diet pills or take diuretics, drugs to reduce the volume of fluids in the body. Some people with bulimia also exercise excessively in order to burn up some of the calories eaten during binges. People

* **apnea** (AP-nee-uh) is a temporary stopping of breathing.

* **respiratory failure** is a condition in which breathing and oxygen delivery to the body are dangerously altered. This may result from infection, nerve or muscle damage, poisoning, or other causes.

* **asthma** (AZ-mah) is a condition in which the airways of the lungs repeatedly become narrowed and inflamed, causing breathing difficulty.

* **influenza** (in-floo-EN-zuh), also known as the flu, is a contagious viral infection that attacks the respiratory tract, including the nose, throat, and lungs.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

* **enemas** (EH-nuh-muhz) are procedures in which liquid is injected through the anus into the intestine, usually to flush out the intestines.

* **body image** is a person's impressions, thoughts, feelings, and opinions about his or her body.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

with bulimia have a distorted body image*; even though many people with bulimia stay at a fairly healthy weight, they are fixated on body shape and weight and feel like they are fat.

Most people who develop bulimia are girls and young women of European ancestry, although males and people of all ethnic groups can have it. Bulimia affects at least 1 to 3 percent of middle and high school girls and up to 5 percent of college-age women in the United States.

What Causes Bulimia?

Bulimia often starts with dieting after a binge, but once the purging begins, the situation worsens. A person eats too much, feels guilty about it, and purges. The purging provides some immediate relief but is followed by shame and guilt. People with bulimia begin to believe that the only way to control their weight is to purge. They often feel intense social and cultural pressure to be thin. Family problems and conflict are often present in the lives of people with bulimia. Poor self-esteem can also play a role. People with bulimia overemphasize the importance of body shape and size in their overall self-image.

What Are the Signs and Symptoms of Bulimia?

A person with bulimia can often hide it very well. A girl with bulimia is usually near a healthy weight but is preoccupied with eating and dieting. Bulimia and other eating disorders share many symptoms, such as fatigue, low blood pressure, dehydration*, preoccupation with food, and secretiveness about eating. However, because of the purging, bulimia can be associated with additional, serious symptoms that include:

- tooth and other dental problems caused by stomach acids damaging tooth enamel
- rips or tears in the esophagus (the tube that runs from the throat to the stomach) from frequent vomiting
- other gastrointestinal problems
- imbalances in electrolytes (essential body chemicals and minerals) that can lead to heart and other health problems
- feelings of loss of control, shame, depression, irritability, withdrawal, and secretiveness

How Is Bulimia Diagnosed?

Like Marlene, people often keep their bulimia hidden from family, friends, and healthcare professionals. The shame and embarrassment about purging can be profound. Sometimes a dentist will notice damage to the tooth enamel. A healthcare professional might ask about a person's weight, diet, nutrition, and body image, and the responses may reveal an eating disorder. If concerned, a physician might order lab tests to study nutritional and medical status. A mental health professional may uncover bulimia when a person is treated for a different symptom, such as anxiety* or depression*.

How Is Bulimia Treated?

Bulimia, like other eating disorders, is treated most effectively with a combination of therapies. The main treatment for bulimia is psychotherapy*. The focus of treatment is on changing eating behaviors and thinking patterns. To help a person overcome bulimia, a therapist also addresses the person's distorted body image and fear of being fat. Sometimes a physician prescribes an antidepressant medication* to relieve anxiety or depressive symptoms. Nutritional counseling, support groups, and family counseling can also be helpful.

▶ See also **Binge Eating Disorder** • **Body Image** • **Eating Disorders: Overview**

Resources

Books and Articles

Stavrou, Maria, ed. *Bulimics on Bulimia*. London: Jessica Kingsley, 2009.

Watson, Stephanie. *Bulimia*. New York: Rosen, 2007.

Organizations

National Association of Anorexia Nervosa and Associated Disorders.

P.O. Box 7, Highland Park, IL, 60035. Telephone: 847-831-3438.

Web site: <http://www.anad.org>.

National Eating Disorders Association.

603 Stewart Street, Suite 803,

Seattle, WA, 98101. Toll free: 800-931-2237. Web site: <http://www.nationaleatingdisorders.org>.

National Women's Health Information Center.

8270 Willow Oaks

Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web

site: <http://www.4woman.gov/faq/easyread/bulnervosa-etr.htm>.

Bunions

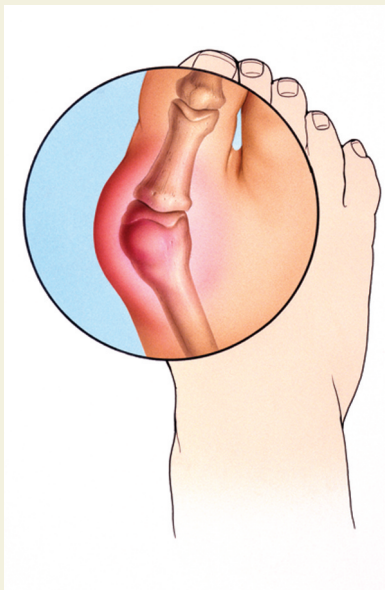
Bunions (BUN-yunz) are foot deformities caused by displacement of certain bones. A bunion is visible as a bump on the side of the foot at the joint at the base of the big toe.

The Price of Style

When Natalie began her job at the bank, she finally could afford to indulge her love of stylish shoes, the higher the heel and the more pointed the toe, the better. However, after several months, the inner side of Natalie's right

* **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.

* **antidepressant medications** are used for the treatment and prevention of depression.



▲ A bunion is formed when the first metatarsal bone (along the inner side of the foot) pushes out at the base of the big toe, and the big toe is displaced toward the smaller toes. The bump that characterizes a bunion is caused by joint inflammation and swelling. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **orthotic** is a support or brace for weak or ineffective joints or muscles.

foot, especially around the base of the big toe, began to swell and turn red. As it rubbed against her shoe, the bump on her foot grew bigger. After a few weeks, even sneakers hurt her foot. Natalie knew she had a bunion; she must have inherited the tendency for them since her foot looked just like her mother's and grandmother's feet. She counted the days until her appointment with a podiatrist (po-DY-a-trist), or foot specialist.

What Causes Bunions?

Hallux valgus The medical term for bunion is hallux valgus: Hallux means big toe, and valgus means a deformity pointing away from the middle of the body. A bunion is formed when the first metatarsal (MET-a-tar-sal), which is the long bone along the inner side of the foot, pushes out at the base of the big toe, and the big toe is displaced toward the smaller toes. The first metatarsal and one of the big toe bones meet at the first joint of the big toe; the bump characteristic of a bunion is caused by inflammation and swelling of this joint.

Anyone can develop a bunion Bunions are a very common and often painful foot deformity. Anyone, including children, can develop a bunion. However, bunions are most common in women over 30, possibly because of shoe choice. Narrow, pointy, high-heeled shoes can speed the formation of a bunion in people who are susceptible to developing them. People who have flat feet or low arches are more prone to develop bunions than people with higher arches.

Pronation and other foot abnormalities Foot abnormalities are a common cause of bunions. For example, people whose feet are rotated so that the inside edge of the foot hits the ground first when they walk (pronated feet) are prone to bunions. Many people have a genetic susceptibility to developing bunions, and bunions also may develop in association with arthritis.

How Are Bunions Treated?

Natalie had the classic symptoms of a bunion: The inner side of her foot was deformed by a red, swollen, painful lump the size of a large marble; she also had a big callus (an area of hard thick skin) along the inner side of her foot; her other toes overlapped one another; and sometimes the skin over the bunion became infected.

Before treating the bunion, Natalie's podiatrist took x-rays of her foot to examine the foot bones. She had a large and well-developed bunion, and he decided to inject medication into her big toe joint to reduce the swelling. He also prescribed a device called an orthotic* that fit into her shoes and helped reduce pressure and weight on her big toe. To help reduce swelling, the podiatrist told Natalie to take an over-the-counter pain reliever, put ice packs on her foot, and soak her foot in mineral salts. She also would have to give up the high heels.

Osteotomy These treatments did not work for Natalie, and ultimately she had bunion surgery. The podiatrist performed an osteotomy (os-tee-OT-o-mee), which means “cutting of bone.” After giving Natalie local anesthesia* to block pain in her foot, the podiatrist removed areas of the metatarsal that had thickened, and he used a small titanium (ty-TANE-ee-um) screw to hold the bones in their correct position. Like almost all bunion repairs, Natalie’s was successful. She was walking again the day of the surgery and was back to work in four days.

▶ See also **Arthritis • Flat Feet**

Resources

Books and Articles

Copeland, Glenn, with Stan Solomon. *The Good Foot Book: A Guide for Men, Women, Children, Athletes, Seniors—Everyone*. Alameda, CA: Hunter House, 2005.

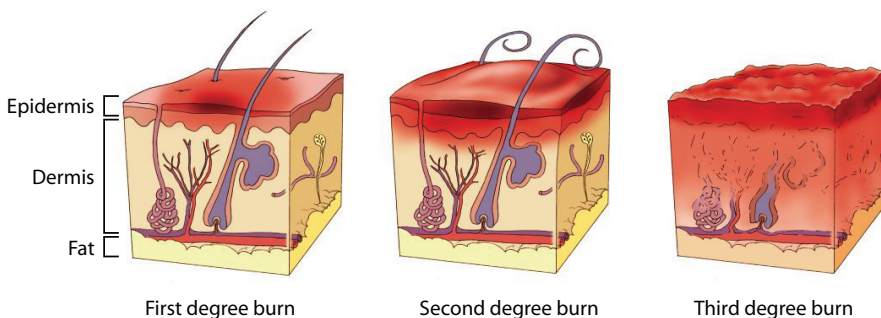
Organizations

American College of Foot and Ankle Surgeons. 8725 West Higgins Road, Suite 555, Chicago, IL, 60631-2724. Toll free: 800-421-2237. Web site: <http://www.acfas.org>.

American Podiatric Medical Association. 9312 Old Georgetown Road, Bethesda, MD, 20814-1621. Web site: <http://www.apma.org>.

Burns

Burns are tissue injuries caused by direct contact with heat, such as fire, sunlight, steam, boiling fluids, heated objects, electricity, lightning, and radiation. Burns may cause a variety of problems ranging from minor discomfort to serious, life-threatening conditions.



* **local anesthesia** (an-es-THEE-zha) means using medicine to block or numb pain in one part of the body while patients remain awake. General anesthesia blocks pain over the entire body while patients sleep.

A first degree burn affects only the top layer of skin (the epidermis). A second degree burn affects the epidermis and the dermis. A third degree burn is the most serious as it affects deeper layers of tissue, including nerves, sweat glands, fat, and hair follicles. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Did You Know?

The National Institute of General Medical Sciences and the American Burn Association report that in the United States, more than a million burn injuries require medical attention each year. Among those with burn injuries, the following applies:

- 45,000 require hospitalization, and about half of them require treatment in special burn units
- as many as 10,000 people die of burn-related infections
- burn research and burn treatments are greatly improving survival rates even among people with burns covering more than 90 percent of their bodies.

Sunburns

The discomfort of sunburns can be eased with the following:

- cool baths or cool compresses (ice should not be placed directly on a burn)
- soothing lotions
- over-the-counter pain medications such as acetaminophen.

Some products can make sunburns worse. These include the following:

- petroleum jelly
- butter
- harsh soaps
- over-the-counter sprays or lotions containing benzocaine or lidocaine.

Severe sunburn should be treated by a doctor.

What Is a Burn?

The skin is the protective external surface of the body. Its outer layer, the epidermis, comprises several layers of epithelial cells arranged like shingles on a roof. Its inner layer is the dermis, which contains many types of nerves that sense touch, pain, heat, and cold. Healthy skin renews itself and helps keep body fluids in and unwanted bacteria out. When burns injure the skin, they upset these processes. All burns result in skin cell injury, and the most serious burns can result in death.

Three Classes of Burns

Burns are categorized by the degree of severity.

First-degree burns These burns are the least severe. They affect only the top layer of skin, the epidermis, which turns red at the burn site and causes pain when it is touched. Small blisters and mild swelling sometimes accompany first-degree burns, but usually the blisters heal rapidly and the swelling recedes on its own.

Second-degree burns These burns affect both the dermis and the epidermis. They often cause pain, fever, swelling, chills, and blisters, which may be reddish or whitish in color. Severe sunburns often are second-degree burns, and a person with such a burn should consult a doctor about it.

Third-degree burns These are the most serious burns and require immediate medical treatment. They affect all layers of skin and cause damage and cell death to numerous kinds of tissues, including nerves, sweat glands, fat, and hair follicles. The burn area itself may be free from pain if its nerve endings have been damaged, but the area around the burn will often be extremely painful. The whitish or reddish blisters of second-degree burns usually will not be present, but the skin may be blackened or charred. Other complications of third degree burns may include the following:

- loss of body fluids (dehydration)
- respiratory (breathing) problems
- bacterial infections and pneumonia
- shock

How Do Doctors Treat Burns?

Treatment depends on how deeply the burn has injured skin tissue and underlying organs, the overall size of the burn, and the burn's location. For instance, a person with a sizeable burn to the hands, feet, face, joints, groin, or buttocks should consult a doctor.

Mild burns usually heal on their own when the injured area is kept clean and dry. More serious burns often require treatment in a hospital, and the most severe of these cases may necessitate care in a hospital's specialized burn unit or in an intensive care unit.

Doctors often treat second- and third-degree burns with an antimicrobial agent, such as a silver sulfadiazine cream. Externally applied, this agent kills a range of bacteria. These burns often demand skin graft surgery to replace the damaged tissue followed by a long healing period and physical therapy for the injured area. Often a patient may receive a “skin bandage” prior to a skin graft. These skin bandages, which usually come from pigs although they may also come from human cadavers, serve as temporary coverings for the burned area.

The best defenses against burns are following fire safety rules, being aware, and preventing accidents. Being informed about the sun’s harmful rays is also helpful.

▶ *See also* **Shock • Skin Conditions • Trauma**

Resources

Books and Articles

Royston, Angela. *Burns and Blisters*. Chicago: Heinemann Library, 2004.

Organizations

American Burn Association. 625 N. Michigan Avenue, Suite 2550, Chicago, IL, 60611. Telephone: 312-642-9260. Web site: <http://www.ameriburn.org>.

National Institute of General Medical Sciences. 45 Center Drive, MSC 6200, Bethesda, MD, 20892-6200. Telephone: 301-496-7301. Web site: <http://www.nih.gov/nigms>.

Bursitis *See Arthritis.*

C

Caffeine-related Disorders

Caffeine-related disorders are a group of psychiatric disorders defined by DSM-IV that are caused by taking in large amounts of caffeine in foods, drinks, or over-the-counter medications. Caffeine is a stimulant* that also affects the muscles and the digestive tract. Some doctors include digestive problems caused by caffeine in the category of caffeine-related disorders.*

Keith's Story

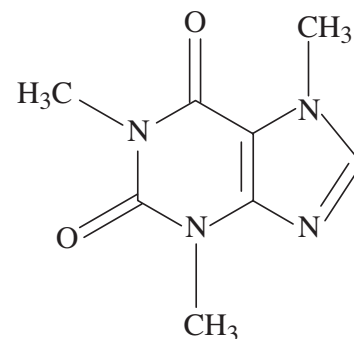
Keith, a high-school student in Chicago, got into the habit of drinking Redline, a caffeinated energy drink that his friends recommended as a way of boosting his energy and endurance before basketball practice. Keith thought of Redline as much like a soft drink: a drink to quench thirst as well as improve sports performance. Before long he was drinking two or three cans per day.

One afternoon Keith felt sick after his basketball game. He could feel his heart beating, he was sweating heavily, and he could not stop vomiting. He was also very anxious. The coach took him to the emergency room of a nearby hospital, where the doctor diagnosed Keith with caffeine intoxication. Keith was surprised to learn how much caffeine he had been taking on a daily basis and how quickly it could affect his health.

What Is Caffeine?

Caffeine is a naturally occurring chemical compound that is classified as a xanthine (ZAN-then). Xanthines are nitrogen-based compounds that are found in both plant and animal tissue and have a stimulating effect on the nervous system. Caffeine itself is found in various amounts in the stems, leaves, and berries or beans of some plants, particularly the coffee plant and the leaves of tea bushes. Other natural sources of caffeine used by humans to make beverages include yerba maté, a shrub in the holly family that grows in South America; guarana, a climbing plant found in the Amazon rain forest; kola nuts, used to flavor cola beverages; and cacao pods, the source of cocoa and chocolate. The caffeine in all these plants acts as a natural pesticide that paralyzes and kills insects that would otherwise feed on their leaves and berries.

Caffeine was given its name in 1819 by Friedrich Ferdinand Runge, the first chemist to isolate it from plants. Runge named the white powder caffeine because he derived it from coffee beans. In its chemically pure state,



Chemical structure of caffeine

▲
Illustration by Studio:EIG. Reproduced by permission of Gale, a part of Cengage Learning.

* **DSM-IV** is *The Diagnostic and Statistical Manual of Mental Disorders*, 4th revision, published by the American Psychiatric Association. This is the system of classification and diagnosis of mental conditions used in the United States.

* **stimulant** (STIM-yoo-lunt) a drug that produces a temporary feeling of alertness, energy, and euphoria.

Caffeine

Product	Amount of caffeine (mg)
Cocaine energy drink, 8.5 oz.	280
Caffeine tablet, 1	200
Coffee, brewed 8 oz.	135
Red Bull energy drink, 8.5 oz.	80
SoBe No Fear energy drink, 8 oz.	80
Excedrin headache tablet, 1	65
Mountain Dew, 1 can, 12 oz.	55
Black tea, brewed, 8 oz.	50
Diet Coke, 1 can, 12 oz.	45
Sunkist Orange, regular or diet, 1 can, 12 oz.	41
Coffee, espresso, 1 oz.	40
Pepsi Cola, 1 can, 12 oz.	37
Coca-Cola Classic, 1 can, 12 oz.	34
Hershey's Special Dark chocolate, 1 bar, 1.5 oz.	31
Barq's Root Beer, 1 can, 12 oz.	22
Green tea, brewed, 8 oz.	15
Hershey's Milk Chocolate, 1 bar, 1.5 oz.	10
Coffee, decaffeinated, 8 oz.	5
Tea, decaffeinated, 8 oz.	4
Diet Barq's Root Beer, 1 can, 12 oz.	0
Sprite, diet or regular, 1 can, 12 oz.	0
7-Up, 1 can, 12 oz.	0

▲
 Illustration by GGS Information Services.
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 of Cengage Learning.

* **psychoactive** (sy-ko-AK-tiv) affecting a person's mood, behavior, perceptions, or consciousness.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **diuretics** (dye-yoor-EH-tiks) are medications that increase the body's output of urine.

caffeine is an odorless powder consisting of white crystals with a slightly bitter taste. It can be dissolved in alcohol and some other liquids as well as in water.

Caffeine is the most widely consumed psychoactive* substance in the world, although most people do not think of it as a drug. Unlike most other psychoactive substances, caffeine is legal and unregulated in almost all countries. The Food and Drug Administration (FDA) defined caffeine in 2003 as a "Multiple Purpose Generally Recognized as Safe Food Substance." An FDA publication from 2007, however, described caffeine as "both a drug and a food additive." This change in wording reflects a growing awareness around the world that caffeine can be addictive when it is overused and that it can have toxic side effects on people who take very high doses of it or who are unusually sensitive to its effects.

How Does Caffeine Affect Humans?

Human use of caffeine Humans have known for centuries about the effects of caffeine in improving alertness, fighting off drowsiness, and increasing physical endurance and muscular coordination. There is evidence from Stone Age burial sites that early humans (possibly as early as 10,000 B.C.E.) knew that chewing the leaves of plants containing caffeine relieved fatigue, enabled people to do hard physical work for longer periods of time, and helped to lift depressed moods. It was not until about 3000 B.C.E., however, that the Chinese discovered that soaking tea leaves in hot water produced a beverage containing more caffeine than the fresh tea leaves themselves. Brewed coffee appeared in the Arab world around the 9th century C.E. but did not reach Europe until the 17th century.

Cacao beans were used for their caffeine content by the Maya in southern Mexico as early as 600 B.C.E. The cacao beans were ground and flavored with vanilla and chili peppers to make a spicy drink to relieve tiredness. When the Spanish conquistadors came to Mexico in the 16th century C.E., they adopted the chocolate-flavored drink (minus the chili peppers), and brought it back to Europe. They planted cacao trees in the West Indies and the Philippines to supply the new European craving for chocolate.

In the 20th century, kola nuts were used by the Coca-Cola Company to flavor its well-known soft drink. Although most cola-flavored soft drinks use artificial flavoring as of 2009, some energy drinks use kola nuts as well as guarana berries to increase their caffeine content. These drinks became increasingly popular in the two decades following their introduction in the 1980s.

Caffeine in the body Caffeine is classified as a central nervous system* stimulant because it reduces drowsiness, increases alertness and the ability to focus, and speeds up the flow of thought. It is also a diuretic*, which means that it increases the loss of body water in the urine.

Caffeine usually enters the body through the mouth and is absorbed by the stomach and small intestine within 45 minutes. The half-life of

caffeine—the time it takes for the body to eliminate half the caffeine taken at one time—varies according to age, sex, the healthiness of a person's liver, and other medications the person may be taking, but in general the half-life of caffeine in a healthy adult is three to four hours. In pregnant women, however, the half-life of caffeine is 9 to 11 hours; in young children, it is as long as 30 hours; and in elderly adults with liver disease, it can be as long as 96 hours.

After being absorbed from the digestive tract, caffeine passes rapidly into other body tissues. It can affect the brain because it is able to cross the blood-brain barrier*. Once in the brain, caffeine acts primarily as an antagonist* of a brain chemical called adenosine (ah-DEN-oh-seen), a chemical that occurs naturally in the body and among its other functions promotes sleep and suppresses arousal. It is also involved in the sleep-wake cycle. Although the chemical reactions involved are complicated, caffeine's ability to increase alertness and physical endurance is largely due to its role as an adenosine antagonist.

In the digestive tract, caffeine stimulates the stomach to produce more gastric acid and reduces muscle tone in the (lower esophageal) esophago-gastric sphincter (the muscle ring that closes off the esophagus from the stomach during digestion), which is the reason why some people experience heartburn after drinking tea or coffee. Caffeine is metabolized (broken down) in the liver into three simpler compounds. One of these compounds is a diuretic; it increases the person's urine output. This pattern of caffeine metabolism* explains why drinks containing high levels of caffeine do not quench thirst as effectively as noncaffeinated beverages. The three compounds formed from the metabolism of caffeine in the liver are broken down still further and leave the body in the urine.

Other effects of caffeine on the digestive tract include stimulation of the gall bladder* and the colon*. In addition, caffeine relaxes the muscles of the anal* sphincter (SFINK-ter), the ring of muscles surrounding the anus that holds fecal matter inside the body. The effects of caffeine on the colon and anal sphincter help to explain why people with fecal incontinence* should not drink coffee or tea.

Tolerance and withdrawal People who drink large quantities of coffee, tea, or energy drinks develop tolerance* to the psychological and physical effects of caffeine. That means that people get used to the stimulant effects of caffeine and are not kept awake at night even after consuming several cups of tea or coffee. Tolerance to caffeine builds up quite rapidly; one study found that test subjects who took 400 mg of caffeine three times per day for seven days did not have any problems with sleep. Another study found that subjects who took in 300 mg of caffeine three times per day for 18 days developed complete tolerance to the psychological effects of caffeine.

The other side of caffeine tolerance is caffeine withdrawal*. Withdrawal refers to the symptoms experienced by heavy caffeine users when they suddenly stop taking large amounts of caffeine. The most common

* **blood-brain barrier** is a biological shield in the body that helps prevent germs or other potentially harmful materials in the blood from entering the brain and spinal cord.

* **antagonist** (an-TAG-oh-nist) a chemical that acts within the body to reduce or oppose the effects of another chemical.

* **metabolism** (meh-TAB-o-liz-um) is the process in the body that converts foods into the energy necessary for body functions.

* **gall bladder** is a small pear-shaped organ on the right side of the abdomen that stores bile, a liquid that helps the body digest fat.

* **colon** (KO-lin), also called the large intestine, is a muscular tube through which food passes as it is digested, just before it moves into the rectum and out of the body through the anus.

* **anal** refers to the anus, the opening at the end of the digestive system through which waste leaves the body.

* **incontinence** (in-KON-ti-nens) is loss of control of urination or bowel movement.

* **tolerance** (TALL-uh-runce) a condition in which a person needs more of a drug to feel the original effects of the drug.

* **withdrawal** a group of symptoms that occurs when a drug that causes physical or psychological dependence is regularly used for a long time and then suddenly discontinued or decreased in dosage.

* **antihistamines** (an-tie-HIS-tuh-meens) are drugs used to combat allergic reactions and relieve itching.

* **insomnia** abnormal inability to get adequate sleep.

symptoms of caffeine withdrawal are headache, nausea, drowsiness or difficulty sleeping, irritability, difficulty concentrating, and pain in the stomach, upper body, or joints. Some people also experience a psychological depression. Caffeine withdrawal begins within 12 to 24 hours after the last dose of caffeine and lasts anywhere from 1 to 5 days.

Medical uses of caffeine Although most people think of caffeine simply as an ingredient of certain beverages and a few solid foods such as chocolate, it is also used in some medications to improve the effectiveness of aspirin and other pain relievers, to treat migraine headaches, or to counteract the drowsiness caused by antihistamines*. A number of over-the-counter medications taken to relieve menstrual cramps or to help dieters control their appetite contain caffeine.

What Are Caffeine-related Disorders?

Caffeine-related disorders are a group of four mental disorders defined by DSM-IV. Some doctors also use the term loosely to refer to physical problems caused or made worse by consuming large amounts of caffeine.

Psychiatric disorders DSM-IV defines four caffeine-related psychiatric disorders:

- Caffeine intoxication. A diagnosis of caffeine intoxication is based on the patient's recent intake of 250 mg or more of caffeine and five or more of the following symptoms during or shortly after consuming the caffeine: restlessness, nervousness, insomnia*, excitement, flushed face, increased urine output, digestive disturbance, muscle twitching, rambling thought or speech, fast or irregular heartbeat, pacing the room, or working for hours without needing rest. In addition, the patient's symptoms are severe enough to interfere with study, work, or relationships.
- Caffeine-induced anxiety disorder. This diagnosis depends on anxiety being the primary symptom together with evidence that the anxiety is directly related to caffeine intoxication or withdrawal within the past month. Again, the patient's symptoms must be severe enough to interfere with functioning to make the diagnosis.
- Caffeine-induced sleep disorder. In this disorder, difficulty sleeping is the central symptom, is directly related to the patient's caffeine intake and is severe enough to interfere with daily functioning.
- Caffeine-related disorder not otherwise specified (NOS). This is a catchall category for symptoms of caffeine withdrawal or other problems related to caffeine intake that are not quite severe enough to meet the definitions of the first three disorders.

Other caffeine-related health problems The long-term use of high doses of caffeine has been linked to several digestive problems caused by increased secretion of stomach acid:

- Peptic ulcers
- Gastroesophageal (GAS-tro-ess-off-uh-JEE-ul) reflux disease (GERD). GERD is a disorder in which the acid contents of the stomach move back up into the esophagus* because the sphincter at the lower end of the esophagus has been weakened. GERD is also known as acid reflux disease.
- Chronic inflammation of the esophagus

There is less agreement among doctors about the effects of high doses of caffeine on miscarriage*. Some studies maintain that high caffeine intake doubles a woman's risk of miscarriage whereas several other studies found no connection. In addition, whereas children can experience the same symptoms of anxiety, speeded-up heart rate, and digestive disturbances as adults, there is no evidence that caffeine stunts children's growth.

How Common Are Caffeine-related Disorders?

It is difficult to find exact figures on the frequency of caffeine disorders, either in the United States or worldwide. One reason is that people vary considerably in their sensitivity to caffeine; age, sex, and body size make a difference too. Most adults do not experience significant side effects from caffeine until they are taking 300 mg or higher each day. Another is the widespread use of tea, coffee, and soft drinks on social occasions or during coffee breaks in the workplace. Because caffeine is such a common part of everyday social customs, most people do not think of it as a habit-forming substance. It is estimated that Americans consume on average 291 mg of caffeine per day, adults in the form of coffee or tea and children in the form of soft drinks or energy drinks. The worldwide average daily dose of caffeine is 76 mg.

In addition, the caffeine content of coffee or tea can vary from cup to cup, depending on the growing conditions at the time the coffee or tea was produced, the processing techniques that were used before the coffee or tea was marketed, and the method of preparation used. Even beans from the same coffee bush in the same growing season can show variations in caffeine content. One 5-ounce serving of coffee can range from 40 to 100 mg of caffeine per cup.

Another reason why it is difficult to gather accurate statistics about the frequency of caffeine-related disorders is that many people who are dependent on caffeine are also taking other psychoactive drugs. Using caffeine along with alcohol or other drugs makes it hard to tell how much the caffeine by itself contributes to the patient's symptoms. In addition, about 50 percent of people diagnosed with depression and other mood disorders* are dependent on caffeine. Moreover, many people with schizophrenia* also consume large amounts of caffeine. This overlap with other mental disorders also makes it hard to tell how many people in the general population have caffeine-related disorders. DSM-IV states simply that the frequency of caffeine-related disorders is unknown as of the early 2000s.

* **esophagus** (eh-SAH-fuh-gus) is the soft tube that, with swallowing, carries food from the throat to the stomach.

* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

* **mood disorders** are mental disorders that involve a disturbance in the person's internal emotional state. They include depressive disorders, bipolar disorders, and mood disorders associated with the use of drugs or medical illnesses.

* **schizophrenia** (skit-so-FREE-nee-ah) is a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors, which distort their view of reality.

ENERGY DRINKS: A PROBLEM FOR SOME PEOPLE

Energy drinks are soft drinks containing high levels of caffeine that have been advertised since the 1980s as improving athletic performance and mental concentration. Some contain guarana or yerba maté as well as caffeine derived from tea or coffee. The average energy drink contains about 80 mg of caffeine in an 8-ounce serving, with some containing higher levels. In addition, some energy drinks contain such other stimulants as ginseng, which increase the stimulant effect of caffeine.

An average-sized adult is not likely to have symptoms from a single energy drink; however, those who drink two or more in a short period of time can develop caffeine jitters and other symptoms of caffeine intoxication. According to a May 2008 article in the *New York Times*, hospitals across the United States have seen high school students come to the emergency room with heart palpitations, nausea, and severe sweating after drinking Redline, a popular energy drink. Several school districts in Oregon and Colorado have banned energy drinks from school properties. France and Denmark banned Red Bull, another popular energy drink, following the death of an 18-year-old Irish athlete, who consumed four cans of the drink and then played a basketball game.

Many doctors are concerned about the advertising campaigns for these drinks, which target high school- and college-age males by appealing to their need to appear masculine and adventurous.

How Are Caffeine-related Disorders Diagnosed?

People commonly experience one or more symptoms of a caffeine-related disorder if they take in large quantities of caffeine on a daily basis. They may not always draw a connection, however, between their symptoms and caffeine. One reason is that people vary in their sensitivity to caffeine. Another reason is that people do not always add up all the caffeine they take in from different sources in a short period of time. Individuals who drink a cup of coffee with each meal, take a caffeinated headache remedy, and drink a lot of cola consume much more caffeine than they realize. Common symptoms of high caffeine intake include:

- Nervousness and anxiety
- Muscle twitching or trembling, sometimes called “caffeine jitters”
- Flushing of the face
- Insomnia
- Increased urination
- Stomach or digestive disturbances
- Headache

- Faster breathing rate
- Rapid heart rate or heart palpitation*
- Irritability

Some people do not recognize that they may have a caffeine-related disorder until they try to stop drinking caffeinated beverages or using caffeinated over-the-counter medications. Some researchers at Johns Hopkins University found that some people can experience the symptoms of caffeine withdrawal when they are used to doses of caffeine as low as 100 mg per day, which is the caffeine equivalent of one 6-ounce cup of brewed coffee or two to three 12-ounce servings of caffeinated soft drink.

How Serious Are Caffeine-related Disorders?

Most people who experience the symptoms of caffeine withdrawal or caffeine jitters do not suffer any long-term consequences. The most serious consequences of caffeine-related disorders are found in individuals who combine caffeine with alcohol or other drugs and then drive under the influence or engage in other risky behaviors. One study of college students who were heavy drinkers of alcohol combined with energy drinks reported that these students had much higher than average rates of car accidents, being injured while riding with an intoxicated driver, date rape, and falls or other accidents that needed a doctor's attention.

Some rare cases have been reported of people who have died from extremely high doses of caffeine, usually from taking caffeine pills to stay awake. The lethal dose of caffeine in humans is estimated to be about 150 to 200 mg per kilogram of body mass; an average-sized adult would have to drink between 80 to 100 cups of coffee within 4 to 6 hours to take in that much caffeine. However, people can overdose on No Doz or similar pills to stay awake. Some have needed hospitalization after consuming only 2 grams of caffeine (about 0.07 ounces). When death does occur from a caffeine overdose, it is usually due to an abnormal heart rhythm brought on by the effects of caffeine on the heart and blood vessels.

How Are Caffeine-related Disorders Diagnosed and Treated?

Diagnosis The diagnosis of caffeine-related disorders begins with taking a careful patient history, including any other substances the patient may be using and other mental disorders being treated as well as the patient's use of caffeine. The reason for asking about other substance use (or abuse) and treatment for other psychiatric conditions is that the symptoms of caffeine-related disorders can be disguised by the symptoms of other substance abuse and mental disorders. In addition, caffeine interacts with some medications used to treat schizophrenia by increasing their side effects. Caffeine can also worsen the symptoms of depression and panic attacks*.

To narrow the diagnostic possibilities, the doctor may perform a mental status examination (MSE) in the office. This is a brief test in which the

* **palpitation** is the sensation of a rapid or irregular heartbeat.

* **panic attacks** are periods of intense fear or discomfort with a feeling of doom and a desire to escape. During a panic attack, a person may shake, sweat, be short of breath, and experience chest pain.

* **electrocardiogram** (e-lek-tro-KAR-dee-o-gram), also known as an EKG, is a test that records and displays the electrical activity of the heart.

patient is asked to answer a set of questions, follow simple instructions, and walk across the room while the doctor evaluates the patient's appearance, mood, speech patterns, coordination, thought processes, insight, judgment, and perceptions. A person with a caffeine-related disorder will often appear jittery, tense, having trouble making eye contact, and generally fidgety. The person would not, however, have hallucinations or memory problems, be disoriented, or talk about suicide or murder simply from the effects of caffeine. Any person with these symptoms has another mental or substance abuse disorder.

Caffeine can be detected in the blood, but blood tests are not useful in diagnosing caffeine-related disorders. The doctor might order a urine test to rule out other drug-related disorders or an electrocardiogram* to evaluate an irregular heartbeat if one is present.

Treatment Treatment of caffeine-related disorders consists of lowering daily caffeine consumption or stopping it altogether. Withdrawal symptoms can be treated by taking pain relievers containing small amounts of caffeine until the withdrawal is over.

Can Caffeine-related Disorders Be Prevented?

Caffeine-related disorders can be prevented by becoming knowledgeable about the caffeine content of favorite foods or over-the-counter medications and monitoring one's daily intake of caffeine. One can also prevent caffeine-related disorders by simply avoiding all products with significant amounts of caffeine. Some religious groups, such as the Mormons, Seventh-day Adventists, and some sects of Hinduism discourage their members from drinking caffeinated beverages.

Resources

Books and Articles

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Klosterman, Lorrie. *The Facts about Caffeine*. New York: Marshall Cavendish Benchmark, 2006.

Marcovitz, Hal. *Caffeine*. San Diego, CA: Lucent Books, 2006.

Organizations

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.psych.org>.

Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857-0001. Toll free: 888-INFO-FDA (888-INFO-FDA). Web site: <http://www.fda.gov>.

National Toxicology Program. P.O. Box 12233, MD K2-03, 111
T. W. Alexander Drive, Durham, NC, 27713. Telephone: 919-541-
0530. Web site: <http://ntp.niehs.nih.gov>.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

Campylobacteriosis

Campylobacteriosis (kamp-pi-lo-BAK-ter-ee-ob-sis) is an infection of the intestinal tract that is caused by the *Campylobacter* bacterium. The infection may cause diarrhea*, nausea and vomiting, and abdominal cramps.

What Is Campylobacter?

Campylobacter (kamp-pi-lo-BAK-ter) is a type of curved bacteria that is a normal inhabitant of the digestive tract of wild and domesticated animals. The bacteria are passed in feces*, which can lead to infection in humans. People, however, do not normally carry *Campylobacter*, and exposure to it usually causes an intestinal infection called campylobacteriosis (kamp-pi-lo-bak-ter-ee-O-sis).

The most common source of *Campylobacter* in the United States is chicken. When chickens (and other animals) are killed for food, the bacteria from their digestive tract can contaminate the meat. People get infected when they eat raw or uncooked meats and eggs (thorough cooking kills the bacteria), drink raw (unpasteurized) milk, or drink contaminated water. Oftentimes, juices from raw meats drip on and contaminate other foods. In rare cases, contact with people or animals who are infected spreads the illness.

Campylobacter is the most common bacterial cause of diarrhea in the United States, where more than 2 million cases occur each year. The illness most frequently affects infants and children younger than age 10, although anyone can get it. Most cases occur in the summer and fall.

What Are the Symptoms of Campylobacteriosis?

Within two to five days after exposure to *Campylobacter*, a person may develop diarrhea, fever, abdominal cramps, and blood in the stool. Most people with campylobacteriosis recover within about ten days without any treatment other than drinking lots of fluids to prevent dehydration (a dangerous loss of fluids and salts). Symptoms of dehydration that should be monitored closely may include: being thirsty, irritable or feeling restless and tired; having sunken eyes, dry mouth and tongue, dry skin; and urinating less frequently; and (in infants) a dry diaper for several hours.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

More severe manifestations of campylobacteriosis included colitis (severe inflammation of the colon), bacteremia (bacterial infection of the blood), and meningitis (inflammation and infection of the layers of tissue that cover the brain). A form of arthritis and Guillain-Barré (gee-YAN-ba-RAY) syndrome, a disorder that causes temporary paralysis*, may also occur in individuals who have recently recovered from a campylobacter infection. This is thought to be due to an overreaction of the immune system*, in response to the presence of the campylobacter bacteria. As a result, the immune system overproduces cells that then attack and damage the individual's own tissues.

Treatment Most people who suffer from campylobacter infection do not require any medication to recover. Those with mild to moderate diarrhea without dehydration may be treated at home. They are given a normal diet and fluids are increased except for fruit juices and sodas. However, in serious cases, people with campylobacteriosis, especially very young children, may require intravenous* (IV) rehydration (fluid replacement).

Prevention The best way to prevent infection is to treat all meat and eggs as if they were contaminated: avoid letting meat drip on other food; always cooking meat thoroughly; always wash cooking utensils and cooking areas thoroughly; and always wash hands after using the bathroom, touching pets, and before handling food. The following are other ways of preventing campylobacteriosis:

- Always drink water that has been tested and approved for purity and drink milk that has been pasteurized. While hiking and camping, people need to avoid drinking water from streams and from sources that pass through land where animals graze.
- Eat foods while they are still warm.
- In caring for a family member who has diarrhea, individuals need to wash their hands before touching other people in the household. Clean and disinfect toilets after they are used by the person with diarrhea.
- In caring for a pet dog or cat that has diarrhea, individuals need to wash hands frequently and check with a veterinarian about treatment.

▶ See also **Arthritis • Bacterial Infections • Colitis • Diarrhea • Food Poisoning • Gastroenteritis • Meningitis • Shock**

Resources

Books and Articles

Bell, Chris, and Alec Kyriakides. *Campylobacter: A Practical Approach to the Organism and its Control in Foods*. Oxford, UK: Blackwell, 2010.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/dbmd/diseaseinfo/campylobacter_g.htm.

Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 888-INFO-FDA. Web site: <http://vm.cfsan.fda.gov/~mow/chap4.html>.

- * **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.
- * **benign** (be-NINE) refers to a condition that is not cancerous or serious and will probably improve, go away, or not get worse.
- * **connective tissue** helps hold the body together. It is found in skin, joints and bones.

Cancer: Overview

Cancer is a group of diseases all caused by the out-of-control growth of abnormal cells.

An Ancient Affliction

The disease called cancer has been around as long as human beings have existed. Evidence of cancerous growths, or tumors, has been found among fossilized bones and in human mummies dating from Ancient Egypt. The ancient Greek physician Hippocrates (hi-POK-ra-tees) was the first to use the word “carcinoma” (kar-si-NO-ma) to describe various kinds of tumors. Hippocrates noted that parts sticking out from some tumors looked like the limbs of a crab. The word “cancer” comes from the Latin word for crab. In 1913, only one in nine people had a chance of being alive five years after a diagnosis of cancer. In the early 2000s, depending on the site of the cancer, more than 50 percent of people survive the disease for five or more years. For many types of cancer, early detection and treatment result in a normal lifespan. Despite this progress, however, cancer is the second leading cause of death in the United States.

What Is Cancer?

Cancer can arise almost anywhere in the body, but no matter where it occurs, it is characterized by three features: first, the appearance of abnormal cells, meaning cells that do not function as they should; second, their uncontrolled growth into a nonstructured mass (tumor); and third, their spread (metastasis) (meh-TAS-ta-sis) to surrounding tissues and distant parts of the body. Because cancer cells can spread (metastasize), cancer is also called a malignancy or a malignant* tumor, as opposed to a benign* tumor, which remains in the part of the body in which it starts and does not endanger life.

The main types of cancers are as follows:

- Carcinomas, the most common types of cancer, arise from the cells that cover external and internal body surfaces. Lung, breast, and colon are the most frequent carcinomas diagnosed in the United States.
- Sarcomas arise from cells found in the supporting tissues of the body, as for example in bone, cartilage, fat, connective tissue* is

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Common childhood cancers

Percentage of total childhood cancers	Type of cancer
39%	Leukemia (white blood cell cancer) and lymphoma (lymph system cancer)
20.7%	Brain cancers (brain and spinal cord tumors)
7.3%	Neuroblastoma (nerve cell cancer, most commonly in the adrenal gland)
6.1%	Wilms' tumor (kidney cancer that can metastasize to lung)
4.7%	Osteosarcoma (bone cancer) and Ewing's sarcoma (cancer in the bone shaft)
3.4%	Rhabdomyosarcoma (muscle tissue cancer, most often in head and neck)
2.9%	Retinoblastoma (malignant eye tumor)
16.4%	Germ cell cancer (ovarian or testicular cancers) and others

SOURCE: Margo Hoover-Regan. <http://www.csupomona.edu/~cancerbio/pediatric%20cancer%20-%20Dr.%20Hoover-Regan.htm>. Updated May 15, 2000.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **bone marrow** is the soft tissue inside bones where blood cells are made.

the material that holds various body structures together, such as cartilage, tendons, ligaments, and blood vessels, and muscle.

- *Lymphomas* (lim-FO-mas) arise in the lymph nodes* and tissues of the immune system*.
- *Leukemias* (loo-KEE-mee-yas) are cancers of immature blood cells that grow in the bone marrow* and accumulate in large numbers in the blood stream.

A cancer is generally named for the site of the body where it starts and no matter where it spreads to later, it retains the name of the initial site.

Almost everyone knows someone who has had cancer, and it is natural for children to worry that they might get it. However, cancer in children is very rare. Some cancers are more common than others. The cancers that adults get most frequently are cancers of the skin, lungs, and colon and rectum. Breast cancer is common among women and prostate cancer among men. Childhood cancers include leukemias, lymphomas, brain cancer, and osteosarcomas (os-tee-o-sar-KOME-as) (bone cancer).

How Does Cancer Begin?

A healthy body is home to more than 10 trillion cells (at least 100 times as many stars as there are in the entire Milky Way galaxy). Just as neighbors cooperate to maintain an orderly community, cells usually grow, divide, and die in a controlled fashion. In infants and young people, normal cells divide more rapidly than in adults. In adults, most body cells divide only to replace worn-out, dying cells and to repair injuries. The operating instructions for everything that cells do are contained in the genes*, the

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

CANCER IN THE UNITED STATES AND THE WORLD

- The National Cancer Institute (NCI) estimated that 1,444,920 Americans (766,860 men and 678,060 women) might be diagnosed with cancer and 559,650 might die of cancer of all types in 2007. The American Cancer Association also estimated that one out of every two American men and one out of every three American women would develop a cancer at some point during their lifetime.
- In the United States, the death rates for most major cancers steadily declined after the 1970s due to improved screening, earlier detection, and more effective treatment. They decreased by 2.1 percent per year from 2002 through 2004, nearly twice the annual decrease of 1.1 percent per year recorded from 1993 through 2002.
- Still cancer killed 550,270 Americans in 2004, or 187 people per 100,000, making it the second leading cause of death after heart disease. From 2000 to 2004, the average age at death for cancer of all types was 73.
- The overall five-year relative survival rate reported by the NCI for the 1996–2003 period was 64.9 percent. The breakdown of these rates by race and sex were: 65.5 percent for white men, 66.2 percent for white women, 58.6 percent for black men, and 53.8 percent for black women.
- The 2005 NCI Cancer Trends progress report stated that the death rates for the four most common cancers (prostate, breast, lung, and colorectal), as well as for all cancers combined, continued to decline and that the rate of cancer incidence had been relatively stable since the mid-1990s. However, the incidence of non-Hodgkin's lymphoma and cancers of lung and bladder and brain in women, prostate and testis in men, as well as leukemia, myeloma, melanoma of skin, and cancers of the thyroid, kidney, pancreas, liver, and esophagus were rising. Childhood cancer increased slightly. Cancer-related health differences were observed in population subgroups. For example, Blacks and people with low socioeconomic status had the highest rates of both new cancers and cancer deaths.
- The World Health Organization (WHO) reported that, worldwide, 7.6 million people died of cancer out of 58 million deaths in 2005. More than 70 percent of cancer deaths occurred in low- and middle-income countries, due to a lack of resources for prevention, diagnosis, and treatment.
- Population studies showed that cancers arise with different frequencies in different parts of the world. For example, stomach cancer was especially frequent in Japan, lung and colon cancer in the United States, skin cancer in Australia, leukemia in Canada, and lung cancer in the United Kingdom.
- According to the WHO, worldwide cancer deaths were expected to rise in with an estimated 9 million people dying from cancer in 2015, and 11.4 million dying in 2030. Reasons included increased smoking and pollution in developing nations, unhealthy diets, and more people living into old age, when cancer risk is higher. A link was also established with uncontrolled infection rates. For example, more than 400,000 cases of liver cancer were tied to infection with hepatitis in the mid-1990s. Parasites in food also can lead to stomach cancers.

* **carcinogens** (kar-SIH-no-jenz) are substances or agents that can cause cancer.

* **lymphatic system** (lim-FAH-tik) is a system that contains lymph nodes and a network of channels that carry fluid and cells of the immune system through the body.

packets of information inherited by offspring from their parents. Genes are made of DNA, a large molecule that stores the information needed for growth and development. Genes make proteins, the molecules required for the structure, function, and regulation of the body's cells, tissues, and organs. When a gene inside a cell is switched on, the cell starts producing the required protein. Sometimes genes undergo changes called mutations. Mutations in a gene can affect how it works; for example, a mutated gene might produce too much of a protein or perhaps none at all or protein that will not be able to function.

Life proceeds by cell growth and division, and this process is directed by a collection of genes whose proteins work like traffic police to encourage growth or to halt it. When these genes are mutated, the proteins they make may erroneously tell cells to continue growing, like a traffic light stuck on green. Such mutated genes are called oncogenes because they are capable of transforming normal cells into cancer cells. Normal genes that regulate cell growth and proliferation but which can cause cancer when mutated are called proto-oncogenes. In the late 20th century, dozens of proto-oncogenes were identified in human cancer. Normal cells with damaged DNA die if the body cannot repair the DNA, but cancer cells produced by oncogenes do not die. They keep growing.

Many tumors need 30 to 40 years to develop, which explains why children rarely get cancer. However, it is possible for a person to inherit a mutant cancer-causing gene, in which case the onset of cancer will be at an earlier age.

Genes can undergo mutations as a result of cancer-causing substances called carcinogens* (kar-SIN-o-jens) that are found in the environment and in chemicals in human cells. Another source of mutations is mistakes in the information copying that occur when DNA is replicated during cell division. Cells normally have repair systems to correct such errors. When the repair system slips up, however, the damage becomes a permanent part of that cell and its descendants. If a person has a faulty repair system, mutations in the genes build up rapidly, making the cells more likely to become cancerous. Faulty repair plays a role in certain kinds of colon, skin, and breast cancers.

How Does Cancer Spread?

The process by which cancer cells spread to other parts of the body where they again begin to grow and replace normal tissue is called metastasis. During this process, cancer cells break away from the primary tumor and enter the blood stream or lymphatic system*, which can carry them to almost any part of the body. Carcinomas metastasize primarily through lymphatic channels, whereas sarcomas metastasize primarily through the blood stream. Cancer cells frequently first spread to the regional lymph nodes, meaning those near the primary tumor, which is called regional disease (or involvement). Cancer that spreads to other organs or to lymph nodes distant from the primary tumor is called metastatic disease. New tumors

resulting from metastasis are called metastatic tumors and their cells are the same as that of the primary tumor. The most common sites of metastasis from solid tumors are the lungs, bones, liver, and brain.

New techniques show that abnormal cells from a tumor often are circulating even when doctors can find no evidence of spread, which is referred to as undetectable spread micrometastasis (MY-kro-meh-TAS-ta-sis). Once a cancer cell has found a new site, it must reverse all the steps it took in liberating itself from the primary site. It has to attach to the inner lining of a blood or lymph vessel, cross through it, invade the tissue beyond, and multiply. Probably fewer than 1 in 1 million of these cancer cells are able to survive to take up residence elsewhere. Much of how cancer spreads remained a mystery in the early 2000s. Some tissues—for example, cartilage and brain tissue—seemed more resistant to cancer. And some animals almost never have cancer.

What Causes Cancer?

A risk factor is anything that increases a person's chance of getting a disease. However, having a risk factor does not mean that a person will get the disease for sure. People usually get cancer as a result of a complex set of interactions between many risk factors, and this is why it is often called a multifactorial disease. While science could not as of 2009 provide all the answers, many of the causes of cancer had been identified. Besides factors such as heredity, diet, and hormones, studies point to key external factors that promote cancer such as carcinogens, pollution, radiation, and viruses or bacteria.

Exposure to chemical carcinogens Carcinogens are substances that directly cause or can help cause cancer. Thousands of chemicals used in farming and industry can cause cancer in humans or animals after prolonged or excessive exposure. Notorious chemical carcinogens include asbestos (az-BES-tos), and several insecticides* (e.g., DDT, ethylene dibromide (EDB), and kepone) that have a long history of having caused cancer. Other examples include industrial workplace chemicals such as the fumes of the metals cadmium, nickel, and chromium, known to cause lung cancer. Leukemia can result from chemically induced changes in bone marrow from exposure to benzene (BEN-zeen) and cyclophosphamide. Government regulations control the use of these chemicals, but not the use of other chemicals considered by many research scientists to be probably carcinogenic in humans because they are powerful carcinogens in animals.

Tobacco, food, and alcohol Tobacco contains chemicals that are lethal carcinogens, and its use is responsible for 30 percent of all cancer deaths every year in the United States, which affect the lungs and other organs of the body. In Western countries, diet has also been associated with certain cancers, particularly diets containing high amounts of animal (saturated) fat and red meat. Eating insufficient quantities of fruits and vegetables appears to contribute to cancer, for reasons no one understood as of 2009. It may be that fruits and vegetables help to block cancer-causing

* **insecticides** are chemicals used to kill insects and prevent infestation.

Cancer-fighting foods

Foods	Effects on cancer
Avocados	May attack free radicals in the body by blocking intestinal absorption of certain fats; may be useful in treating viral hepatitis (a cause of liver cancer)
Beans	May prevent or slow genetic damage to cells, prevent prostate cancer, and lower the risk of digestive cancers
Berries	May help prevent skin, bladder, lung, and breast cancers and slow the reproduction of cancer cells
Cabbage and cauliflower	May slow cancer growth and development and help to reduce the risk of lung, prostate, and bladder cancers
Broccoli	May prevent some types of cancer, including stomach, colon and rectal
Carrots	May reduce a wide range of cancers including lung, mouth, throat, stomach, intestine, bladder, prostate and breast
Chili peppers and jalapeños	May prevent cancers such as stomach cancer
Cruciferous vegetables (broccoli, cauliflower, kale, Brussels sprouts, and cabbage)	May help decrease prostate and other cancers
Dark green leafy vegetables	May reduce the risk of lung and breast cancer
Figs	May shrink tumors
Flax	May reduce the risk of breast, skin, and lung cancer
Garlic	May increase the activity of immune cells that fight cancer and indirectly help break down cancer causing substances. May help block carcinogens from entering cells and slow tumor development. May render carcinogens in the liver inactive. May lower risk of a variety of cancers including stomach, colon, lung and skin
Grapefruits	May prevent cancer by sweeping carcinogens out of the body and inhibit the proliferation of breast-cancer cells in vitro
Grapes	May inhibit the enzymes that can stimulate cancer-cell growth and suppress immune response
Kale	May help stop the conversion of certain lesions to cancerous cells in estrogen-sensitive tissues, suppress tumor growth, and block cancer-causing substances from reaching their targets
Licorice root	May prevent the growth of prostate cancer
Mushrooms	May help the body fight cancer and build the immune system
Nuts	May suppress the growth of cancers
Oranges and lemons	May stimulate cancer-killing immune cells like lymphocytes that may function in breaking down cancer-causing substances
Papayas	May reduce absorption of cancer-causing nitrosamines from the soil or processed foods. May minimize cervical dysplasia and certain cancers
Red wine	May inhibit cell proliferation and help prevent cancer
Rosemary	May inhibit the development of breast and skin tumors
Seaweed and other sea vegetables	May help in the fight against breast cancer
Soy products like tofu	May help to prevent breast and prostate cancer by blocking and suppressing cancerous changes
Sweet potatoes	May prevent cancer cells from dividing, reduce the risk of cancer of the stomach, lung, colon, rectum, liver and pancreas, and protect against various types of cancer
Tomatoes	May combat prostate cancer and protect against breast, lung, mouth, stomach, and pancreatic cancer. May reduce risk of breast, prostate, pancreas and colorectal cancer. May prevent cellular damage that leads to cancer.
Turmeric	May inhibit the production of the inflammation-related enzyme cyclo-oxygenase 2 (COX-2), which reaches abnormally high levels in certain inflammatory diseases and cancers, especially bowel and colon cancer
Whole grains	May help decrease the risk of developing most types of cancer

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effects. Drinking large amounts of alcohol increases the risk of cancer of the upper respiratory and digestive tracts, and alcoholic liver disease can lead to liver cancer. Even moderate drinking may contribute to breast and colon and rectal cancer. Meats cooked at high temperatures are known to form small quantities of many potent carcinogens, comparable to those found in cigarette smoke.

Some research focused on trying to answer more questions about diet and cancer. One European study, called EPIC, involved 500,000 people

in 10 countries and aimed to produce detailed, reliable information about diet and cancer. The first results, published in 2001, confirmed that a high-fiber diet reduces colorectal cancer and that eating red or processed meat increases colorectal cancer risk whereas intake of fish decreases it.

Pollution In the early 2000s there was mounting evidence that toxic pollution causes cancer, especially in children. Polluters dumped more than 175 million pounds of cancer-causing chemicals into U.S. air and water systems in 1996, and this amount increased sharply during the early 2000s when many environmental regulations were relaxed. Many believe that carcinogenic industrial pollution was severely under-reported because the Environmental Protection Agency (EPA) did not report on carcinogenic chemicals from cars, trucks, buses, mines, power plants, airports, incinerators, and other small polluters.

The EPIC study also focused on the relation between air pollution or environmental tobacco smoke (ETS) and incident cancers of the bladder, lung, oral cavity, pharynx, larynx or leukemia.

Natural and human-made radiation Some forms of radiation have been shown to cause cancer, especially ionizing radiation which has been proven to cause genetic damage leading to cancer. X-rays, gamma rays, cosmic rays, and particles released by radioactive materials such as alpha particles and beta rays are examples of ionizing radiation. Leukemia was at one time thought to be the major cancer to arise from high-dose radiation exposure, based on the experience of people exposed to the atomic blasts in Japan in 1945. It was later determined that other cancers can result from radiation exposure, although they may take 10 to 15 years to develop.

Most cancer deaths are caused by non-ionizing radiation from natural sources such as the sun's ultraviolet* rays. For example, sunburns during childhood are a key factor in causing a kind of skin cancer called melanoma (mel-a-NO-ma) and most skin cancers are a direct result of sunlight exposure. But electric power lines, household appliances, and cellular telephones had as of 2009 not been proven to cause cancer. In the late 1990s and early 2000s, questions were raised about possible cancer risk associated with the use of video display terminals, but research did not provide definite evaluations as of 2009.

Viruses Viruses have also been shown to help trigger some cancers. These findings do not mean, however, that these cancers can be caught like a flu infection. What happens is that the virus can cause genetic changes in cells that make them more likely to become cancerous. For instance, links have been established between the following pairs:

- Cervical cancer and the genital wart virus (HPV)
- Primary liver cancer and the Hepatitis B virus
- T-cell leukemia in adults and the Human T-cell leukemia

* **ultraviolet** light is a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

Eating for Health

The American Cancer Society recommended the following general nutritional guidelines that may help people prevent cancer:

- Choosing most foods from plant sources such as vegetables, fruits, and grains
- Limiting intake of high-fat foods, especially from animal sources
- Staying physically active
- Maintaining a healthy weight
- Limiting consumption of alcoholic beverages

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

How Do People Know They Have Cancer?

Many symptoms of cancer such as weight loss, fever, fatigue, and various kinds of lumps could also be caused by other diseases. Some cancers may cause no symptoms until they have spread. Based on the most commonly occurring cancers, the American Cancer Society published a list of seven warning signs of cancer:

- Change in bowel or bladder habits (for instance diarrhea that does not go away or pain during urination)
- A sore anywhere on the skin that does not heal
- Unusual bleeding or discharge from the nose, mouth, skin, nipple, or vagina
- A thickening or lump in the breast or elsewhere
- Indigestion or difficulty in swallowing
- Obvious changes in a wart or mole
- Nagging cough, particularly if these symptoms occur in a cigarette smoker.

How Is Cancer Diagnosed and Treated?

Diagnosis Diagnosing cancer involves removing some tissue for evaluation. This procedure is called a biopsy* (BY-op-see). Once the diagnosis is made, a treatment plan is put together. To do that, the doctor must determine how widespread and how serious the disease is. Staging the disease means assigning letters and numbers to it as a way of indicating whether it has spread and if so how far. There are several systems for staging, depending on the type of cancer. Generally speaking, the smaller the tumor, the more curable it is, although some cancer can be unpredictable. The outlook for some cancers, for example, leukemia and lymphoma, is judged according to other criteria. Cancer is classified according to the part of the body in which it begins and by how it looks under a microscope.

Treatment Various treatment for cancer are surgery, radiation therapy, and chemotherapy* (kee-mo-THER-a-pee), either prescribed alone or together. Other treatment methods such as immunotherapy and anti-angiogenesis treatment are also used. Because cancers vary in how fast they grow, where they spread, and how they respond to treatment, treatment is specifically tailored to the specific cancer a person has.

- Surgery performed to remove tumors is the oldest form of treatment for cancer, and it offers the greatest chance of cure for many kinds of cancer. About 60 percent of patients with cancer have some type of surgery.
- Radiation therapy uses high-energy radiation to kill cancer cells that surgery cannot remove because they are too small.

- Chemotherapy uses anticancer drugs to treat cancer. Chemotherapy drugs are given through a vein (also called an intravenous or IV line) or by mouth as pills. These drugs enter the blood stream and reach places in the body that surgery and radiation cannot reach. Chemotherapy is often given for cancer that has spread.
- Immunotherapy uses the body's own immune system to fight cancer. This therapy can be applied either by stimulating the immune system or by prescribing human-made immune system proteins.
- Anti-angiogenesis therapy prevents the creation of new blood vessels, as its name implies (from the Greek *anti*, meaning “against” *angio* meaning “blood vessel” and *genesis* meaning “beginning”). As the human body grows, it requires new blood vessels to distribute blood to all of its cells. Adults also need new blood vessels to heal wounds and repair damaged tissues. In people with cancer, however, this same process also creates new blood vessels that provide a tumor with its own blood supply to grow and spread. Anti-angiogenesis uses drugs to stop tumors from making new blood vessels.

Can Cancer Be Prevented?

Many cancers could be prevented by changes in a person's lifestyle. For example, cancers caused by cigarette smoking and drinking a lot of alcohol could be prevented completely. Limiting certain kinds of foods, such as red meats and animal fats, and eating lots of fruits and legumes (such as peas and lentils) may also help reduce the risk of getting many cancers. Physical activity helps to avoid obesity* and is believed to have other protective effects against cancer. Most of the 1 million skin cancers that are diagnosed each year could be avoided by staying out of the sun.

Regular cancer checks, called screenings, for cancer of the breast, colon, rectum, cervix, prostate, testes, mouth, and skin are an effective way of detecting cancer early enough so that it can be treated successfully. In addition, self-examination for breast and skin cancers may also help to detect tumors at earlier stages. The American Cancer Society estimates that if all Americans participated in regular cancer screenings, survival would be dramatically improved.

However, cancer prevention efforts would be more successful with improved federal regulation of pollution and carcinogenic substances. Such regulation would require industry to stop dumping cancer-causing chemicals and chemicals of unknown risk in the environment, where they can lead to carcinogenic exposure or leach into the food chain. The federal government should require polluting industries to conduct community cancer studies to determine danger near major pollution sites, such as power plants, highways, and airports. It should also strictly enforce the Superfund law to clean up toxic waste sites, and the Clean Water Act to keep pollution out of drinking water while enforcing

Clinical Trials and New Cancer Treatments

Studies of new or experimental treatments in patients are known as clinical trials. Research in cancer could not move forward without them because drugs may work very differently in people than in the animals in which the drugs first proved successful.

Clinical trials seek to answer such questions as the following:

- Does this new drug or treatment work?
- Does it work better than other treatments already available?
- Do the benefits outweigh the risks, including side effects?

Although there are risks to new treatments, clinical trials are done only when there is some reason to believe that the treatment will be of value to the patient.

Participating in a clinical trial is completely up to the patient. The doctor may suggest it, or patients can request information about clinical trials from the National Cancer Institute.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

urban air pollution standards to protect people from cancer-causing pollution.

Through much of the 20th century commercial cigarette manufacturers increased concentrations of nicotine in cigarettes while company executives pursued aggressive marketing that denied tobacco's addictive nature and its connection to cancer. Similarly industrial chemicals such as U238 (so-called depleted uranium) munitions, and other profitable cancer-causing chemicals went unregulated in the second half of the 20th century and contributed to cancer rates. There is a recognized need for education on what carcinogens are and how to avoid them. Government oversight and increased regulation are key for the protection of both the environment and the public; they are also essential in the fight to control and even reduce the incidence of cancer in the 21st century.

Living with Cancer

A cancer diagnosis is usually shocking and frightening. A person's life is suddenly disrupted by visits to the doctors, surgery, treatment, and changing personal relationships. Children with cancer may have to miss school for a time or to give up sports or other activities. Children especially may feel incorrectly that something they did caused the cancer, especially if it is a brother or sister who is sick. Family, physician, friends and organizations, religious clergy, and self-help groups may be important sources of support. Each person's way of dealing with cancer is unique. Even with life-threatening cancers, a person may live for many years. And more than 70 percent of children and adolescents with cancer are successfully treated.

Alternative and complementary therapies Many patients seek alternative therapies during their treatment. These therapies generally are of two kinds:

- Alternative therapies are often advertised as cancer cures. Patients should be aware that these therapies have either not been tested for safety and effectiveness or have been tested and found to be ineffective.
- Complementary therapies, by contrast, are used in addition to standard medical therapy. They may help to relieve symptoms of the disease or side effects of treatment, or they just may make patients feel better. Examples of complementary therapies are meditation to relieve stress and peppermint or ginger tea to combat nausea (stomach upset) from chemotherapy.

▶ *See also* **Bladder Cancer • Brain Tumor • Breast Cancer • Cervical Cancer • Cirrhosis of the Liver • Colorectal Cancer • Fibrocystic Breast Disorder • Hepatitis • Kidney Cancer • Leukemia • Liver and Biliary Tract Cancers • Lung Cancer • Lymphoma • Malignant Melanoma • Oral Cancer • Ovarian Cancer • Pancreatic Cancer • Polyps • Skin Cancer • Stomach Cancer • Testicular Cancer • Thyroid Cancer • Tumor • Uterine Cancer • Viral Infections**

Resources

Books and Articles

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- Silver, Julie K. *After Cancer Treatment: Heal Faster, Better, Stronger*. Baltimore, MD: Johns Hopkins University Press, 2006.
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- State of Connecticut. *Connecticut's Lawsuit against the Tobacco Companies*. Text available at <http://www.ct.gov/ag/cwp/view.asp?A=1771&Q=291124>
- Van der Keur, Henk. "PSR Minimizes Depleted Uranium Health Hazards." *Nuclear Monitor*, December 23, 2005.

Organizations

- American Cancer Society.** 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-ACS-2345. Web site: <http://www.cancer.org>.
- Canadian Cancer Society.** Suite 200, 10 Alcorn Avenue, Toronto, ON, M4V 3B1, Canada. Telephone: 416-961-7223. Web site: <http://www.cancer.ca>.
- National Cancer Institute.** Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov>.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

* **viral infections** cause mouth sores that are called fever blisters or cold sores. These are often caused by the herpesvirus, and they usually appear on the gums or around the mouth and lips. Unlike canker sores, fever blisters and cold sores are contagious.

World Health Organization. Avenue Appia 20, CH-1211 Geneva 27, Switzerland. Telephone: 41-22-791-2111. Web site: <http://www.who.int/topics/cancer/en>.

Canker Sores (Aphthous Ulcers)

Canker sores, or aphthous (AF-thus) ulcers, are small, round sores in the mouth that quickly turn white and usually are painful.

Ashley's Story

Ashley first noticed a slight tingle in her mouth one morning as she was brushing her teeth before school. It was inside her lower lip, on the soft, fleshy part in front of her bottom teeth. By the next morning, she felt a bump that hurt when her tongue touched it and when she tried to drink orange juice with her breakfast. By dinner time, when Ashley pulled down her lip (gently) to look at the small, round blister in her mouth, she saw that it was white and rimmed with a red ring that looked like a halo. It was Ashley's first canker sore, but it probably would not be her last.

What Is a Canker Sore?

Canker sores are small, round sores that are found where Ashley discovered hers: inside the mouth. They may occur on the inside of the lips, on the tongue, on the roof or floor of the mouth, or inside the cheeks. They may appear as one small sore or in groups, and they can be quite irritating and painful to even the slightest touch. Contact with acidic, salty, or spicy foods and fluids, such as chips or orange juice, can be particularly painful for people with canker sores.

Canker sores are not contagious*. They cannot be passed along from one person to another by kissing or by sharing food. It is important, however, to distinguish canker sores from other kinds of mouth sores, which may be caused by viral infections*, trauma, vitamin deficiencies, and sometimes, but not often, cancer. If a mouth sore has not healed within a week or two, it is important to see a doctor.

What Causes Canker Sores?

No one is sure what causes canker sores, although they occur more frequently when people are experiencing stress. Often, the first sores appear as children near middle-school age. Canker sores are more common among women.

How Are Canker Sores Treated?

Ashley's canker sore disappeared on its own two weeks after she first noticed that sore feeling inside her mouth. Most canker sores clear up the same way, without treatment, although some people use over-the-counter

medications to numb canker sores during the first four or five days when they are most painful. It also helps to avoid the sore while brushing teeth and to eliminate foods that aggravate the pain, such as salty chips, citrus fruits, or spicy foods.

If canker sores recur or return or if they do not heal on their own within two weeks, they may need to be seen by a doctor or dentist. Usually, canker sores go away on their own.

People with AIDS and other severe immunodeficiency states can develop severe and prolonged episodes of canker sores that may require medical attention and treatment.

▶ See also **Herpes Simplex Virus Infections**

Resources

Organization

National Institute of Dental and Craniofacial Research. 45 Center Drive, MSC 6400, Bethesda, MD, 20892. Telephone: 301-496-4261. Web site: <http://www.nidcr.nih.gov/OralHealth/Topics/HIV/Aphthous.htm>, <http://www.nidcr.nih.gov/OralHealth/Topics/HIV/MouthProblemsHIV>.

Candidiasis See *Yeast Infection, Vaginal*.

Carbon Monoxide Poisoning

Carbon monoxide is a colorless, tasteless, odorless gas that results from incomplete burning of solid, liquid, and gaseous fuels. This gas can cause dizziness, nausea, coma, or death if breathed in sufficient amounts.*

A Close Call

The neighbors could set a clock by Dr. Smith's morning routine. He turned off the porch light at 6:00 a.m., picked up the newspaper from the driveway at 6:15, and took the dog for a walk at 6:30. One winter morning, Dr. Smith's next-door neighbor noticed that none of these activities had occurred. He knew the Smiths were home, but they did not answer the doorbell or the telephone.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.



Carbon monoxide detectors for the home look like smoke detectors and can be installed to monitor for CO fumes.

AP Images.

* **hemoglobin** (HE-muh-glo-bin) is the oxygen-carrying pigment of the red blood cells.

* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

The neighbor called the police, who broke into the house and found four unconscious people. The gas heater had shut off during the night and had been giving off carbon monoxide gas for many hours. The Smiths were rushed to the hospital and treated for carbon monoxide poisoning. Dr. Smith and his wife and children were lucky; they were found in time and recovered completely after several weeks.

What is Carbon Monoxide (CO) Poisoning?

Carbon monoxide (CO) is a chemical created when some fuels, such as coal and gas, are burned. CO is toxic because it reduces the amount of oxygen received by the body's cells. Red blood cells contain a protein called hemoglobin* that carries oxygen to the body's cells. Because CO binds much more easily and tightly to hemoglobin than oxygen does, CO will replace oxygen in the bloodstream when inhaled. When that happens, the cells that need lots of oxygen, such as those of the heart, skeletal muscles, and central nervous system, cannot operate properly.

Acute CO poisoning Dr. Smith and his family suffered acute* CO poisoning, in which a large amount of CO was breathed at one time. This kind of poisoning can lead to death: It kills 25 to 40 percent of those exposed. Survivors may feel symptoms for days, months, or years.

Chronic CO poisoning CO poisoning also can be chronic*. A small amount of CO inhaled continuously or frequently over a long period of time does not kill, but it does impair oxygen flow to the brain and may cause long-term nervous system problems, such as headaches, dizziness, weakness, sleepiness, nausea, and vomiting. Low-level chronic exposure to CO is especially serious for people with heart, lung, or circulatory problems, and for infants and older adults. Developing fetuses also can be affected by CO poisoning.

Carbon Monoxide and the Environment

CO is one of the most prevalent poisons in the environment. It can get into buildings, homes, and vehicles in many ways. Sources of CO include car exhaust, gas or oil furnaces, kerosene lamps, space heaters, improperly installed appliances, wood stoves, wood-burning fireplaces, and tobacco smoke. CO poisoning most often occurs during winter months, when people use heaters and fireplaces.

How Is CO Poisoning Treated?

A person with acute CO poisoning requires extra oxygen as soon as possible. The individual may be given pure oxygen to breathe. A hyperbaric (hy-per-BARE-ik) oxygen chamber also may be used to treat CO poisoning. This is a large chamber that holds the patient and sometimes the

medical team. The chamber is filled with 100 percent oxygen, and the pressure is increased to three atmospheres (three times the pressure of the air near the Earth's surface, or the pressure the body feels about 90 feet under water). Pressure and pure oxygen help the oxygen molecules displace the CO attached to hemoglobin. Diagnosis and treatment of chronic CO poisoning may be more difficult because its symptoms are similar to flu and many other conditions.

Can CO Poisoning Be Prevented?

CO poisoning is usually preventable. Basic safety guidelines include the following:

- Never burning charcoal in a tent or camper to keep warm.
- Installing water heaters and gas appliances properly and checking them often to make sure they are operating correctly.
- Keeping chimneys and wood-burning fireplaces clean.
- Never letting a car idle inside a garage, especially if the garage is attached to the house.
- Installing commercial CO detectors (similar in design to smoke detectors) for the home.

▶ See also **Environmental Diseases**

Resources

Books and Articles

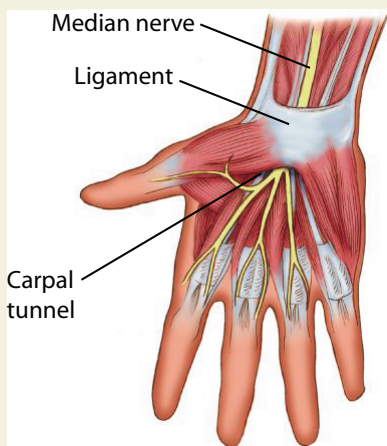
Penney, David G. (ed.). *Carbon Monoxide Poisoning*. Boca Raton, FL: CRC Press, 2008.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/co>.

Environmental Protection Agency/Office of Radiation and Indoor Air, Indoor Environments Division. 1200 Pennsylvania Avenue, NW, Mail Code 6609J, Washington, DC, 20460. Telephone: 202-343-9370. Web site: <http://www.epa.gov/iedweb00/pubs/coftsht.html>.

Cardiovascular Disease See *Heart Disease*.



▲
Anatomy of the wrist and palm.
Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

- * **ligaments** (LIG-a-ments) are bands of fibrous tissue that connect bones or cartilage, supporting and strengthening the joints. Ligaments in the mouth hold the roots of teeth in the tooth sockets.
- * **ergonomics** (er-go-NOM-iks) is a science that helps people to know the best postures and movements to use while working, in order to avoid injury and discomfort.
- * **synovitis** (sin-o-VY-tis) is inflammation of the membrane surrounding a joint.
- * **arthritis** (ar-THRY-tis) refers to any of several disorders characterized by inflammation of the joints.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

Carpal Tunnel Syndrome

Carpal tunnel syndrome is a repetitive stress disorder caused by the compression of the median nerve in carpal tunnel in the wrist that causes pain and numbness in the hand and fingers.

Rodney's story

Rodney loved coaching his son John's Little League team. Shortly before the season began, though, Rodney took a new job on a small appliance assembly line. After a few weeks, his fingers began to tingle and hurt. When he was at baseball practice, he experienced pain while gripping the bat properly. When the pain did not get better, Rodney went to the doctor and complained that it hurt to cross his thumb over the palm of his hand and that the pain and tingling came and went but was worse at night.

What Is Carpal Tunnel Syndrome and Who Gets It?

The median nerve extends through the forearm into the palm of the hand where it divides and sends branches to the thumb and first three fingers. To reach the hand, the nerve passes through a narrow space, or tunnel, in the wrist formed by ligaments* and the carpal bones of the wrist. Carpal tunnel syndrome (CTS) occurs when this space becomes narrowed and the median nerve is compressed or irritated. Pressure on the median nerve causes numbness, weakness, and pain. If not corrected, CTS can result in permanent damage and loss of feeling in some fingers.

It is hard to estimate how many people develop CTS because many people with mild CTS do not see a doctor. One study found that as many as half the people in high-risk occupations develop CTS. Another study estimated that 10 percent of people in the United States would have CTS at some point during their lifetime. Most people do not develop CTS until after age 35. Women are at least three times more likely to develop the condition than men. Researchers hypothesize that is because the space in the wrist that the median nerve must pass through is smaller in women to begin with, so it takes less narrowing to put pressure on the nerve.

Carpal Tunnel Syndrome is common, especially among people who perform repeated motions with their hands and wrists or who use them in ways that are not ergonomically* correct. There are other causes of CTS, and often the cause is not clear. CTS affects some people who have synovitis*, arthritis*, diabetes*, thyroid disease, and acromegaly*. Injury to the wrist is another cause of CTS. Pregnant women sometimes retain fluid, making the ligaments in the carpal tunnel swell and causing CTS.

What Happens When People Have Carpal Tunnel Syndrome?

The doctor can usually diagnose CTS by having the patient do certain manipulations with his or her hands and noting whether these are painful. Another clue to CTS is that the little finger is not painful, because the median nerve does not send a branch to this finger. More extensive testing can be done to rule out other conditions, for example x-rays may be done to rule out a fractured wrist bone. Sophisticated tests can measure the speed at which the median nerve transmits impulses if a diagnosis of CTS is uncertain.

Mild CTS is usually treated by resting the wrists and then splinting them. However, the best way to treat CTS caused by repetitive motion is to eliminate the cause, which could mean allowing assembly line workers to switch jobs frequently during their shift or purchasing ergonomically correct office equipment and computer keyboards.

Advanced CTS may be treated by the injection of cortisone* or a related medication into the wrists. In severe cases of CTS, the doctor may recommend a surgical procedure called carpal tunnel release. This surgery cuts a band of tissue in the wrist so that the space for the median nerve is widened. The procedure is usually done as day surgery and does not require hospitalization. If left untreated, CTS can cause permanent nerve damage. With early treatment and lifestyle modifications most people achieve pain relief.

▶ See also **Repetitive Stress Syndrome • Strains and Sprains**

Resources

Books and Articles

Pascarelli, Emil. *Dr. Pascarelli's Complete Guide to Repetitive Strain Injury: What you Need to Know about RSI and Carpal Tunnel Syndrome*. Hoboken, NJ: Wiley, 2004.

Organizations

American Academy of Orthopaedic Surgeons. 6300 North River Road, Rosemont, IL, 60018-4262. Telephone: 847-823-7186. Web site: <http://orthoinfo.aaos.org/topic.cfm?topic=a00005>.

Association for Repetitive Motion Syndromes. P.O. Box 471973, Aurora, CO, 80047-1973. Telephone: 303-369-0803. Web site: <http://www.certifiedpst.com/arms>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20828. Toll free: 800-352-9424. Web site: http://www.ninds.nih.gov/disorders/carpal_tunnel/detail_carpal_tunnel.htm.

High-Risk Jobs for CTS

As many as half of all people in high-risk jobs develop carpal tunnel syndrome.

High-risk workers include the following:

- Assembly line workers, especially those who manipulate small objects
- Butchers
- Carpenters
- Computer users, especially word processors and data entry clerks
- Hair stylists
- Dental hygienists
- Jackhammer operators and others who use heavy, vibrating tools
- Musicians, especially string and woodwind players

* **acromegaly** (akro-MEG-al-ee) is a disease in which the pituitary gland secretes too much growth hormone with the effect of gradual and permanent enlargement of flat bones, the hands and feet, abdominal organs, and some facial features.

* **cortisone** (KOR-ti-zone) is a medication used to relieve inflammation.



▲
The organism *Bartonella henselae* is spread by a scratch to the skin. After an incubation period a red papule arises on the site of the scratch. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/carpaltunnelsyndrome.html>.

Cat Scratch Disease

Cat scratch disease is an infectious illness that can cause flu-like symptoms and swelling of lymph nodes. It is caused by bacteria carried in cat saliva. The bacteria usually enter the body from a cat scratch or a bite that breaks the skin.*

What Is Cat Scratch Disease?

Cat scratch disease (also called cat scratch fever) is caused by the bacterium *Bartonella henselae* (bar-tuh-NEH-luh HEN-suh-lay), which is found in the saliva of cats and kittens all over the world. About 3 to 10 days after a person is bitten or scratched by a cat, a blister or small bump may develop. This is called an inoculation (ih-nah-kyoo-LAY-shun) lesion, which means that it appears at the site where germs entered the body. Usually about two weeks later, there is inflammation of nearby lymph nodes. If the scratch or bite is on the arm, the lymph nodes on the arm or in the armpit will become swollen. Swelling also can develop in the lymph nodes in the neck or groin, depending on the site of the scratch or bite.

Who Gets Cat Scratch Disease?

People of any age can get the disease, but most cases occur in children and teens. It is estimated that there are about 24,000 cases of cat scratch disease each year in the United States. Members of the same household can become ill if they are scratched or bitten by the same infected cat. Cat scratch disease affects 9 of every 100,000 persons each year worldwide. People can get the disease only from infected cats and kittens. It cannot be transmitted from person to person, but it can spread among cats. It is thought that cats and kittens can become infected with *Bartonella henselae* from fleas.

What Are the Signs and Symptoms of the Disease?

The most common symptoms of cat scratch disease are a bite or scratch that does not heal normally; painful or swollen glands (lymph nodes), especially in the armpit or near the inside of the elbow; fever; headache; fatigue; joint pain; and sometimes a rash. Less common symptoms are weight loss, sore throat, and draining lymph nodes. If a person is suspected of having cat scratch disease, the doctor will ask about any recent

contact with a cat and will look for signs of a cat scratch or bite, swollen lymph nodes, or an inoculation lesion. Sometimes a person with cat scratch disease does not recall having had contact with a cat. Blood tests can rule out other causes of swollen nodes and check for the presence of antibodies* to the bacteria that cause the disease. In some cases, a doctor will use a needle to take a sample (a piece of tissue) from a swollen lymph node for examination under a microscope.

How Do Doctors Treat Cat Scratch Disease?

Antibiotics may be prescribed for cat scratch disease, but some doctors advise taking these medications only in severe cases. Most people eventually get well without treatment. If the patient is otherwise healthy, rest and over-the-counter medicines, such as acetaminophen* to relieve pain and fever, are all that are needed while waiting for the disease to run its course. If a lymph node becomes very swollen and painful, the doctor may decide to drain it. Treatment with antibiotics often is recommended for patients who have weakened immune systems as the result of other illnesses. The symptoms in most patients usually resolve after several weeks of treatment with antibiotics and within three months without antibiotic treatment. Swollen lymph nodes may take several months to return to normal size. Most people recover completely from the illness. After an episode of cat scratch disease, people are usually immune to it, meaning that they cannot get the disease again.

Complications

Generally, cat scratch disease is not serious in people who are healthy. However people with weak immune systems, such as those with human immunodeficiency virus* (HIV) infection or poorly controlled diabetes* and those receiving chemotherapy* for cancer, have a greater risk of complications and need to be watched closely by their healthcare providers. These complications include hepatitis*, osteomyelitis*, encephalitis*, and retinitis*. Sometimes cat scratch disease can appear in the form of Parinaud oculoglandular syndrome (PAH-rih-nod ok-yoo-lo-GLAN-dyoo-ler-SIN-drome). In this condition, a small sore and inflammation develop in the membrane lining the inner eyelid, called the conjunctiva (kon-jung-TIE-vuh), accompanied by swollen lymph nodes around the ear. Rubbing one's eyes after handling an infected cat can transmit the infection to the conjunctiva because the bacteria can be present on the cat's coat wherever it licks itself.

Prevention

About 30 percent of American households have pet cats. Keeping cats indoors and free of fleas may help prevent them from contracting the infection. It is a good idea to avoid stray or unfamiliar cats and not to provoke any cat or kitten to the point that it scratches or bites. Thoroughly cleaning any wounds inflicted by a cat may help prevent infection.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **human immunodeficiency virus** (HYOO-mun ih-myoo-no-dih-FIH-shen-see), or HIV, is the virus that causes AIDS (acquired immunodeficiency syndrome), an infection that severely weakens the immune system.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **hepatitis** (heh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.

* **osteomyelitis** (ah-stee-o-my-uh-LYE-tis) is a bone infection that is usually caused by bacteria. It can involve any bone in the body, but it most commonly affects the long bones in the arms and legs.

* **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.

* **retinitis** (reh-tin-EYE-tis) is an inflammation of the retina, the nerve-rich membrane at the back of the eye on which visual images form.

▶ See also **Bacterial Infections • Encephalitis • Infection • Toxoplasmosis**

Resources

Organizations

American Academy of Family Physicians. P.O. Box 11210
Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237.
Web site: <http://familydoctor.org/online/famdocen/home/healthy/firstaid/bites/024.html>.

Directors of Health Promotion and Education. 1015 18th Street NW,
3rd Floor Washington, DC, 20036. Telephone: 202-659-2230.
Web site: <http://www.dhpe.org>.

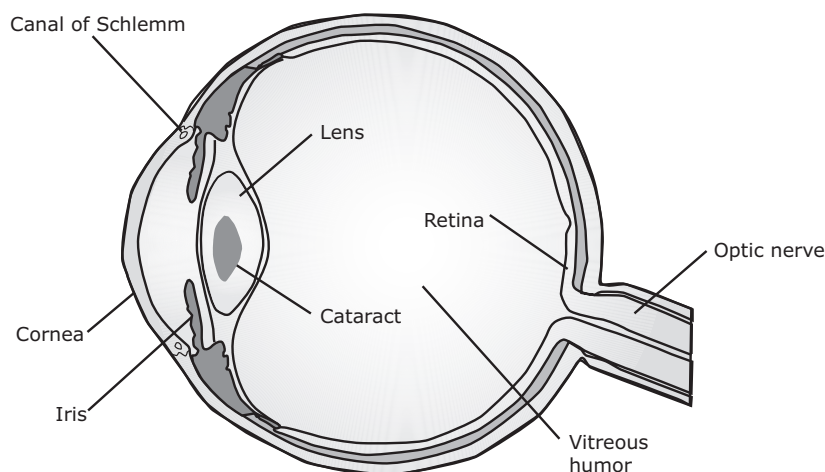
Cataracts

Cataracts develop when the lens of the eye becomes cloudy. They usually impair vision and sometimes occur as people get older.

What Are Cataracts?

Many people who live to an old age develop cataracts, often without noticing the effects until they are past age 70. For some, it might mean only a slight change in vision. Others, however, find they need surgery to remove the cloudy lens.

A cataract results when the clear lens in the eye becomes cloudy. Like frost on a window, the cataract makes it more difficult to see clearly. The reason is that the light passing through the cloudy lens is distorted



▶ Cataracts develop slowly, causing the eye's clear lens to become cloudy. Cataracts can be removed surgically. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

before it reaches the visual receptors in the retina* at the inside rear of the eyeball.

What Happens When People Get Cataracts?

Researchers believe that cataracts develop because the proteins in the eye change as people age. The changes cause the lens to become cloudy. Other factors, such as smoking, poor nutrition, eye injury, exposure to excessive sunlight, and certain medical conditions such as diabetes*, also may be factors that put people at higher risk of developing cataracts.

Cataracts develop slowly. At first, people notice difficulty reading the newspaper, or they experience blurry vision. The eyes become more sensitive to light, and seeing at night becomes especially difficult. People with cataracts often say they feel they have a film over their eyes, as if they are looking through a piece of gauze.

For a short time, the condition actually may benefit some people who always had trouble seeing objects that are near them, such as the words on a page. The cloudiness of a cataract changes how light is focused and temporarily results in better vision for such people. They may find themselves able to read for the first time without eyeglasses, a condition sometimes called “second sight.” As the cataracts worsen, however, eventually these people experience increasing visual difficulties.

How Do Doctors Diagnose and Treat Cataracts?

An ophthalmologist* examines the eye to detect a cataract and follow its progress. When cataracts are detected, the doctor can evaluate the symptoms and decide on the best course of treatment.

Many people can live with the condition untreated. For others, surgery may be recommended to remove the cloudy lens and to replace it with a clear artificial lens that is smaller in size than a dime. Cataract surgery improves vision in 90 to 95 percent of cases. It is one of the most common operations, with more than 1 million performed each year. Surgery generally is done when the lens has become so opaque or cloudy that reading, driving, or watching television are major problems.

Can Cataracts Be Prevented?

Some studies suggest that vitamins C and E may lower the likelihood of developing cataracts. That is because these vitamins appear to reduce damage to the proteins that are linked to the development of cataracts. Also, using sunglasses that block ultraviolet* light may lower a person’s risk of developing cataracts because studies strongly suggest that sunlight plays a role in their development. Avoiding cataracts is another important reason to avoid smoking, as smokers appear to have an increased risk of developing cataracts.

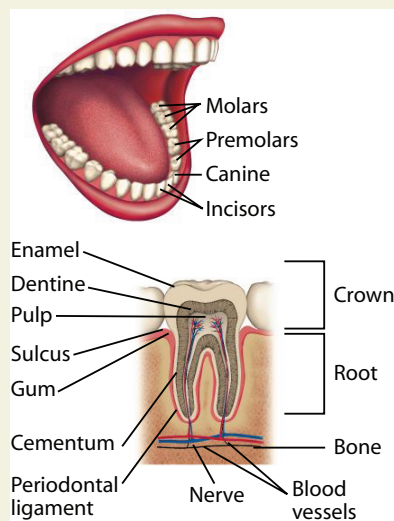
* **retina** (RET-i-na) is the tissue that forms the inner surface of the back of the eyeballs; it receives the light that enters the eye and transmits it through the optic nerves to the brain to produce visual images.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body’s pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **ophthalmologist** (off-thal-MOLL-o-jist) is a medical doctor who specializes in treating diseases of the eye.

* **ultraviolet** light is a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

▶ See also **Aging • Presbyopia**



▲ Cavities are most likely to form in the areas where plaque sticks to the teeth. The acid in plaque can eat a hole in a tooth's enamel, allowing bacteria to reach the tooth's pulp. Left untreated, infection of the pulp can cause the blood vessels and nerves in the tooth to die. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

Resources

Books and Articles

Fekrat, Sharon, and Jennifer S. Weizer, eds. *All about Your Eyes*. Durham, NC: Duke University Press, 2006.

Organization

National Eye Institute. 2020 Vision Place, Bethesda, MD, 20892-3655. Telephone: 301-496-5248. Web site: http://www.nei.nih.gov/health/cataract/cataract_facts.asp.

Cavities

Cavities are areas of tooth decay caused by bacteria.

Grin, Don't Bear It

Michael's friend Ashley always said that she loved his smile, and Michael wanted to keep it that way. However, Michael was unaware that he had a small cavity starting in one of his front teeth. Even though Michael had felt a little twinge now and then when he ate ice cream and candy, his favorite foods, he had not paid much attention. Michael never would have known that he had a cavity if he had not gone to the dentist for a regular checkup. Luckily, the dentist was able to drill out the decay and fill the cavity before it got worse. Michael vowed to do a better job in the future of brushing, flossing, and cutting back on sugary snacks.

What Are Cavities?

Cavities, also known as caries (KARE-eez), are areas of decay on the teeth that are caused by bacteria*. They are one of the most common of all human diseases. Almost half of American children have had a cavity by age four. Not only children have cavities, however. Teenagers and adults also are prone to tooth decay. Fortunately, most cavities can be prevented by taking good care of the teeth, eating a healthy diet, and getting regular dental care.

What Causes Cavities?

The human mouth is home to a host of bacteria. The type of bacteria that causes cavities most often is *Streptococcus mutans* (strep-to-KOK-us MU-tanz), but other types play a role, too. Such bacteria in the mouth change the sugars and starches in food to acid. The bacteria and acid combine with mucus* and food particles, forming a sticky mass called plaque on the teeth. Plaque is the rough substance that people feel when running their tongue over their teeth several hours after brushing.

The acid in plaque can eat a hole in a tooth's enamel, the hard substance that covers and protects the outside surfaces of the tooth. People hardly notice the cavity at this stage, or they might feel a slight twinge when eating foods that are sweet or very cold or hot. However, bacteria that enter the hole in the enamel can make their way through the softer inside parts of the tooth. Eventually, the bacteria may reach the tooth's pulp, the soft tissue in the center of the tooth that contains nerves and blood vessels. When this happens, the blood vessels can swell and press on the nerves, causing a painful toothache. Left untreated, infection of the pulp by bacteria can cause the blood vessels and nerves in the tooth to die.

Plaque sticks best in the pits and grooves of the back teeth, just above the gums, between the teeth, and around the edges of earlier fillings. Cavities are most likely to form in these areas.

Who Gets Cavities?

Anyone can get cavities. They are most common in children, young adults, and the elderly. People who eat a diet filled with sugary foods also have a high risk of developing cavities, because the more sugar people eat, the more cavity-causing acid they make. People who already have a lot of fillings have an increased risk as well, since the area around fillings is an ideal spot for decay to start.

How Are Cavities Treated?

Cavities are usually painless during the early stages. Most are found during regular dental checkups. A dental x-ray can find cavities that are hard to see. Treating cavities early can prevent later pain and tooth loss.

If a cavity is found, the decay process can be stopped by removing the decayed part of the tooth with a special drill. If there is a lot of decay, or if a tooth is very sensitive, the dentist may give the person a shot of anesthetic* or have the person breathe an anesthetic gas before drilling. The decayed material is then replaced with a filling. Such fillings can be made from a number of materials. The most common is silver amalgam (a-MAL-gam), an alloy of silver and other metals, which is used mainly in back teeth. Fillings in the front usually are made of other materials that match the color of the teeth.

Sometimes, there is so much decay that removing it all leaves a tooth weak and easily broken. In that case, the dentist may fit the person with a crown, an artificial replacement for the part of the tooth above the gum. The crown is made in a laboratory, and then it is cemented to what is left of the tooth.

If the tooth is very seriously decayed or infected, the dentist may perform a root canal. In this procedure the pulp is removed from the root, which is the part of the tooth that anchors it to the gums. The empty space is then cleaned and filled with a special material. The root and the tooth stay in place, but the tooth structure is not as strong as before. To strengthen it, the person may need a crown.

* **anesthetic** (an-es-THET-ik) is a medicine that decreases the sensation of pain.

A Flurry of Fluoridation

Fluoride is a mineral that occurs naturally in all water sources. Many areas, especially in the southern states, have a water supply that is well fluoridated naturally.

Scientists as far back as the early 1900s noted fluoride's role in preventing tooth decay. Fluoride can even reverse the early decay process. Since the 1940s, some communities in areas where natural fluoride is low have been adding extra fluoride to their water. This is a very effective and inexpensive way to help prevent cavities on a large scale.

In the early 2000s, about 60 percent of the U.S. water supply is fluoridated. In places where the water is not fluoridated, or in families who drink unfluoridated bottled water instead of tap water, dentists may prescribe fluoride supplements for children.

How Can Cavities Be Prevented?

People can take several steps to stop most cavities. They can brush twice per day and floss every day. Brushing and flossing help remove plaque. They can use a soft-bristled toothbrush. People should pick a brush that feels comfortable and will reach all the teeth, even those in back. They should replace the toothbrush when the bristles show signs of wear. People should use toothpaste that contains fluoride (FLOOR-eyed), a mineral that helps protect against tooth decay. To clean the teeth, they should brush with a short, gentle, back-and-forth motion. People should not forget the inside surfaces, the back teeth, and the tongue. They should floss to reach plaque between the teeth and under the gum line, where a brush cannot go. Finally, people should cut down on sweets and between-meal snacks. Damaging acid forms in the mouth each time a person eats a sugary or starchy food. The acid continues to affect the teeth for at least 20 minutes afterward. The more often people eat these kinds of food, the more times they feed the bacteria that cause cavities. In addition, some sugary foods do more harm than others. Sticky or chewy sweets may cling to the teeth, staying in the mouth and causing problems longer than other foods.

People should see their dentist regularly for checkups and cleanings. Dentists may apply extra fluoride in the form of a gel, foam, or rinse. In addition, dentists may apply dental sealants, thin plastic coatings that are put on the chewing surface of back teeth. Such sealants are painted on as a liquid, but they quickly harden to form a shield over the teeth that keeps out the food and bacteria that cause decay. Dentists say that children should get sealants on their permanent back teeth as soon as they come in. In some cases, sealants are also put on baby teeth or on the teeth of teenagers or adults.

▶ See also **Abscesses • Bacterial Infections • Gum Disease • Halitosis**

Resources

Books and Articles

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Royston, Angela. *Tooth Decay*. Mankato, MN: Black Rabbit Books, 2009.

Organizations

American Dental Association. 211 East Chicago Avenue, Chicago, IL, 60611-2678. Telephone: 312-440-2500. Web site: <http://www.ada.org>.

National Institute of Dental and Craniofacial Research. 45 Center Drive, MSC 6400, Bethesda, MD, 20892. Telephone: 301-496-4261. Web site: <http://www.nidcr.nih.gov>.

Celiac Disease

Celiac disease is a digestive disease that adversely affects people when they eat foods that contain the protein gluten.

What Is Celiac Disease?

Celiac disease (CD)—also spelled “coeliac” and also called by such names as gluten sensitive enteropathy, celiac sprue, and gluten intolerance—is a digestive disease that adversely affects both children and adults when they eat foods that contain the protein gluten. The inability of some people to digest gluten completely is the reason behind celiac disease. Although it resembles a food allergy*, celiac disease is not one. Instead, it is an autoimmune disease* (an adverse reaction of antibodies* within the body) of the small intestine. The primary difference between the two conditions is that people sometimes resolve their food allergies, but people with celiac disease will not outgrow it. They will always be intolerant to gluten.

The Celiac Disease Foundation states that about one person in 133 in the United States is affected with CD. Moreover, a person is at an increased risk (about 5–10%) when an immediate family member has celiac disease. Without proper diagnosis and treatment of the disease, people with celiac disease may develop medical complications such as cancer or osteoporosis*.

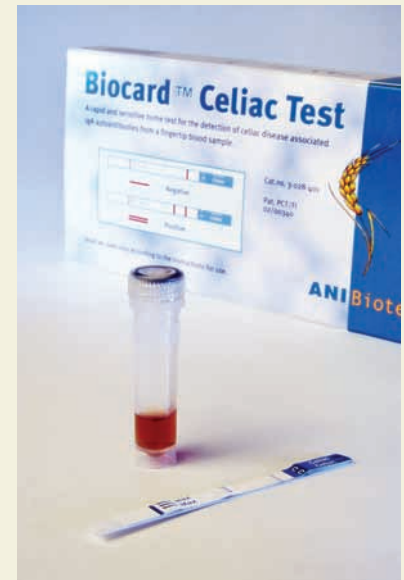
What Are the Symptoms of Celiac Disease?

The symptoms experienced by people with celiac disease vary widely. Moreover, they may appear for the first time at any point during a person’s life. In fact, some people with the disease do not have symptoms. Other people mistake their symptoms for an intestinal problem, such as irritable bowel syndrome or lactose intolerance. Medically, the disease is thought to be brought on by a stressful physiological event such as pregnancy, childbirth, major surgery, or a viral infection*, or by some psychologically stressful event. Severity of the symptoms, along with when they first appear, may be caused by the severity of the particular stressful event. For instance, a minor viral infection may initiate less severe symptoms of CD than a major infection.

The range of symptoms may in part be determined by the length of time that individuals were breastfed as a baby, the age in childhood at which they were first fed gluten-containing food, or the amount of gluten-containing foods that they eat as an adult. Another factor that can influence the severity of the symptoms is the length of time before a person is diagnosed, with the longer period without diagnosis increasing the risk of more severe symptoms.

Symptoms of celiac disease usually, but not necessarily, involve the digestive tract. The more common digestive-based symptoms include the following:

- Abdominal pain, cramping, and bloating
- Frequent or long-lasting diarrhea (frequent, watery bowel movements)



▲ Celiac disease is an intolerance to gluten that usually occurs in young children. Symptoms include abdominal distention, diarrhea, and fatigue. Home testing kits require a small blood sample to be taken. *Cordelia Molloy/Photo Researchers, Inc.*

* **allergy** (AL-uhr-jee) is an immune system-related sensitivity to certain substances, for example, cat dander or the pollen of certain plants, that cause various reactions, such as sneezing, runny nose, wheezing, or swollen, itchy patches on the skin, called hives.

* **autoimmune disease** (aw-toh-ih-MYOON) is a disease in which the body’s immune system attacks some of the body’s own normal tissues and cells.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body’s immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **osteoporosis** (os-te-o-por-O-sis) is the loss of material from the bone. This makes the bones weak and brittle.

* **viral infections** cause mouth sores that are called fever blisters or cold sores. These are often caused by the herpesvirus, and they usually appear on the gums or around the mouth and lips. Unlike canker sores, fever blisters and cold sores are contagious.

* **failure to thrive** is a condition in which an infant fails to gain weight and grow at the expected rate.

* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

* **epilepsy** (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **small intestine** is the part of the intestines—the system of muscular tubes that food passes through during digestion—that directly receives the food when it passes through the stomach.

- Constipation (hard, dry stools that are difficult to pass)
- Weight loss
- Vomiting
- Pale colored, foul smelling, or fatty stools
- In infants, failure to thrive*
- In children, lack of growth, especially in height; lateness of puberty; problems with dental enamel and discoloration of teeth; and behavioral issues

Non-digestive symptoms in adults include the following:

- Anxiety, leading often times to depression
- Unexplained anemia
- Skin rash
- Fatigue, weakness, lack of energy
- Depression, irritability
- Arthritis (swollen, painful joints)
- Joint and/or bone pain
- Osteoporosis (brittle bones)
- Canker sores (ulcers) within the mouth
- Numbness of the extremities, especially the feet and hands
- Seizures (convulsions)
- In women, missed or irregular menstrual periods
- In women, spontaneous miscarriages*
- Infertility

Because people with celiac disease are malnourished, the disease can lead to neurological problems such as epilepsy* and chronic diseases such as liver and gastrointestinal cancers, thyroid disease, and Type 1 diabetes.

What Causes Celiac Disease?

Celiac disease results from an intolerance to gluten. Actually called gliadin, gluten is found in certain grains, such as all types of barley, rye, triticale, and wheat. Gluten is an ingredient in many common foods, such as bread, pizza, pasta, breakfast cereal, cakes and cookies, and beverages such as beer. However, it is also contained in less common products such as certain vitamins and medicines.

When digested, gluten is modified so the body's immune system* reacts abnormally to it in the intestines, creating a toxic (inflammatory) reaction, which interferes with the absorption of nutrients such as vitamins and minerals. The digestive system is unable to absorb the necessary nutrients. Even small amounts of ingested gluten cause health problems and can eventually flatten the lining of the small intestine*. This flattening, which is called villous atrophy, damages the

small intestine, reducing the ability of the body to absorb nutrients (malabsorption).

The small intestine is compromised because the modified gluten damages, and sometimes destroys, millions of microscopic-sized, finger-tip-like protrusions called villi, which line it. Under normal conditions, the villi allow nutrients to be absorbed through the walls of the small intestine and into the bloodstream. However, individuals with celiac disease do not obtain all of these nutrients so they become malnourished regardless of the quantity or quality of food they eat.

The risk of developing celiac disease may be genetically determined. Africans and Asians are less likely to get celiac disease, and Caucasians of northern European descent are more at risk for developing it. Individuals may be predisposed to the disease when they are born. Then a specific physical or emotional event may cause the disease to become apparent. A similar stressful event may also trigger celiac disease in the offspring of these parents. Having one parent with celiac disease increases the risk of the disease by 5 to 15 percent in the children. People with autoimmune disorders such as type 1 diabetes and rheumatoid arthritis* are 25 percent more at risk for celiac disease than other people.

How Is Celiac Disease Diagnosed?

To detect celiac disease several blood serum (serologic) tests must be performed. These show if levels of gluten-sensitive antibodies and certain proteins are abnormally high within the body. Tests for the following antibodies are usually performed:

- IgA antigliadin antibody
- IgG antigliadin antibody
- IgA antiendornysial antibody
- IgA antitransglutaminase antibody

If the results are “positive,” then a biopsy* is usually performed on the small intestine. The doctor performs a procedure called endoscopy*, a procedure that involves inserting a long, thin, fiber-optic tube through the mouth and stomach into the small intestine. The doctor takes a small tissue sample from the small intestine for analysis in the laboratory. The biopsy reveals the amount of damage to the villi in the lining of the intestine.

If these tests and the biopsy are inconclusive, then two genetic tests—HLA-DQ2 and HLA-DQ8—should be run to identify human leukocyte antigen (HLA) genes, which are present in people with celiac disease. These tests are not conclusive because one-third of all people in the United States have these genes without having celiac disease. However, people with these genes are considered to be highly susceptible to the disease. By contrast, if these genes do not appear in the tested person, then their absence essentially rules out celiac disease as the problem. Other tests can be performed in order to reach a definite diagnosis.

Saliva Test May Reveal Celiac Disease

As of 2009, medical researchers were evaluating the use of saliva to test the progress of celiac disease. The test could one day help patients who try to improve their celiac disease condition by following a gluten-free diet. The test was also anticipated to assist people who are at increased risk for getting celiac disease.

* **rheumatoid arthritis** (ROO-mah-toyd ar-THRY-tis) is a chronic disease characterized by painful swelling, stiffness, and deformity of the joints.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **endoscopy** (en-DOS-ko-pee) is a type of diagnostic test in which a lighted tube-like instrument is inserted into a part of the body.

How Is Celiac Disease Treated?

The basic treatment for CD is a gluten-free diet. After gluten is removed from the diet, the small intestine is able to repair itself and return to normal function. Many, if not all, symptoms disappear over a few months. Any lingering imbalances in the body can be corrected with nutritional supplements. Physicians usually do not prescribe medicines; however, regular examinations are highly recommended so the progress and health of the patient can be monitored. According to the Celiac Disease Foundation, the most common medical complication is osteoporosis; three-fourths of all diagnosed people with CD have some degree of bone loss.

The gluten-free diet is challenging to maintain. Grains are common ingredients, second only to sugars, in the average diet. Gluten in tiny amounts may be present and yet not listed in food labels. Obvious foods that must be avoided are those including the following ingredients: binders, fillers, extenders, malt, modified food starch, and unidentified starch.

All types of wheat, such as durum, einkorn, farina, faro, kamut, emmer, semolina, and spelt, contain gluten. Cracked wheat, hydrolyzed wheat protein, wheat bran, wheat germ, and wheat starch also contain gluten. Other grains such as barley, rye, and triticale (a wheat-rye blend) include gluten. Oat may not cause a CD reaction; however, it is wise to avoid oat products as well.

Basic foods that do not contain gluten include buckwheat, chia seed, corn (maize), flax, legumes, millet, nuts, quinoa, rice, and wild rice. Non-cereals that do not contain gluten include potatoes and bananas.

Many processed foods contain gluten. These include candy, luncheon meats, potato chips and french fries, rice mixes, sauces and gravies, soups, and many others. People with celiac disease should discuss their gluten-free diet with their family doctor, along with a dietitian. Such experts can recommend and guide patients in their food selections.

Although a gluten-free diet is essential for all celiac sufferers, the bright side is that most foods containing gluten can be made by substituting ingredients. Many grocery stores carry gluten-free foods, and some restaurants carry gluten-free meals. Online health-food stores sell gluten-free foods. For celiac sufferers, local and national support groups provide information and a sense of community with others facing the same problem.

Resources

Books and Articles

Green, Peter H. R. *Celiac Disease: A Hidden Epidemic*. New York: Collins, 2006.

Thompson, Tricia. *Celiac Disease Nutrition Guide*. Chicago: American Dietetic Association, 2003.

Organizations

American Celiac Disease Alliance. 2504 Duxbury Place, Alexandria, VA, 22308. Telephone: 703-622-3331. Web site: <http://americanceliac.org>.

Celiac Disease Foundation. 13251 Ventura Boulevard, Suite 1, Studio City, CA, 91604. Telephone: 818-990-2354. Web site: <http://www.celiac.org>.

Celiac Sprue Association/United States of America. P.O. Box 31700, Omaha, NE, 68131-0700. Toll free: 877-272-4272. Web site: <http://www.csaceliacs.org>.

National Foundation for Celiac Awareness. P.O. Box 544, Ambler, PA, 19002-0544. Telephone: 215-325-1306. Web site: <http://www.CeliacCentral.org>.

<p>Cellulitis <i>See Abscesses.</i></p>
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Cerebral Palsy

Cerebral palsy (sa-REE-brul PAWL-zee) is a group of several conditions characterized by a loss or limitation of movement or other nerve functions caused by brain injuries that typically occur before, during, or shortly after birth.

Marsha's Story

Marsha could not help comparing her baby to the others at the park. At 10 months old, Sam could hardly sit up on his own, but most of the other babies Sam's age were crawling and pulling up to a standing position. Marsha also noticed that Sam often felt stiff when she picked him up. When Marsha took Sam to the doctor and described his symptoms, the doctor suspected that Sam had a form of cerebral palsy. Sam's doctor explained that cerebral palsy occurs when parts of the brain that control movement are injured or fail to develop properly during pregnancy.

What Is Cerebral Palsy?

Cerebral palsy is not a single condition but instead identifies a group of movement disorders caused by a brain injury. The period before birth and shortly after birth is typically defined as the perinatal period. At some point during this time the developing brain tissue may be injured by

- * **trauma** refers to a wound or injury, whether psychological or physical. Psychological trauma refers to an emotional shock that leads to lasting psychological damage.
- * **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.
- * **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.
- * **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.
- * **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

trauma* or by diseases such as meningitis* or encephalitis*. Brain damage may also result from severe dehydration*, lack of oxygen, or a variety of other problems. In some cases, ill health in the mother while she is pregnant may lead to cerebral palsy in her child. In addition, infants who are born prematurely have a higher risk of developing cerebral palsy.

According to the United Cerebral Palsy Research and Educational Foundation, 1.5 to 2 million U.S. children and adults have cerebral palsy, and 10,000 new cases of cerebral palsy are diagnosed in the United States each year.

What Are the Signs and Symptoms of Cerebral Palsy?

Cerebral palsy is divided into three main types based on symptoms, although many people may have symptoms that span more than one type.

Spastic (SPAS-tik) syndromes are the most common form of cerebral palsy and account for 70 to 80 percent of cases. People with spastic syndromes move in a stiff or jerky way. Spastic movements may affect one limb, one side of the body, both legs, or both arms and legs, and the affected limbs are usually underdeveloped and have rigid muscles. For those people with mild cases, the symptoms may only become obvious during certain activities such as running, whereas those with severe cerebral palsy may require a wheelchair. People with spastic syndromes also may experience seizures*, partial or full loss of movement (paralysis), sensory abnormalities, and problems with speech, hearing, and vision.

Athetoid, or dyskinetic, cerebral palsy affects 10 to 20 percent of patients. Individuals with this form of the disease experience slow, writhing, involuntary muscle movements in the arms and legs, meaning their movements happen automatically as in a reflex rather than by choice.

CEREBRAL PALSY AND WILLIAM JOHN LITTLE

William John Little (1810–1894) developed a deformity in his foot at a young age as a result of polio infection. At the age of 16, Little decided to pursue a career in medicine, hoping to find a cure for his condition. Although Little never found his cure, his research did lead to the description of another disease. In 1853, Little published *On the Deformities of the Human Frame*, in which he first described cerebral palsy. Little's medical practice focused on the musculoskeletal system, and his research contributed to advances in both neurology and orthopedics.

“Little's Disease” is the name now used to designate a congenital form of cerebral palsy.

The symptoms usually increase with stress and disappear when the person is sleeping.

Ataxic cerebral palsy is the least common form, affecting about 5 to 10 percent of people with the disease. This form is characterized by weakness, uncoordinated movements, and shaking, and often leads to difficulties with rapid and fine motor movements.

Many people with cerebral palsy, even some who experience very severe physical disabilities, have normal intelligence, but about two-thirds have intellectual impairments, according to the National Institute of Neurological Disorders and Stroke. Some of these children may attend regular classes but have trouble with reading or math, while others may need special learning assistance.

How Is Cerebral Palsy Diagnosed and Treated?

As of 2009 there was no assessment to test for cerebral palsy before a baby is born. In fact, physicians are often unable to make a clear diagnosis until a child is six months to two years old, and this is frequently aided by a parent's own observations and concerns. A doctor will typically perform a physical examination that includes a test of the child's reflexes, often by tapping specific tendons in the body with a reflex hammer, to see if the child's brain and nervous system are functioning properly. In individuals with spastic symptoms of cerebral palsy, the reflex responses are more pronounced. In some instances, simple bending of a leg or arm can trigger it to jump. The exaggerated reflex response may arise from damage to the upper motor neurons, nerve cells that run from an area called the motor cortex, which lies within the brain's cerebral cortex—the main thought-processing region—to the spinal cord. The neuronal damage affects the ability of the motor cortex to control voluntary muscle movements*. The doctor's exam may also include an evaluation of the child's gait, or walking pattern, detailed inquiries about perinatal* health history, and various diagnostic tests, by such means as x-rays, magnetic resonance imaging, or computed tomography.

In addition, because children who are born with very low birth weights (less than two pounds) are more prone to cerebral palsy, physicians and parents should be vigilant in monitoring the children's progress over time.

Treatment for cerebral palsy is tailored to each individual's specific symptoms. Doctors and therapists work together to set up a treatment program that will help the patient deal with the challenges of day-to-day living, such as dressing, grooming, and eating. Glasses and hearing aids may improve sight and hearing. Children may have mild to significant communication difficulties that require a range of care from visits to a speech therapist to communication tools, such as alphabet boards they can use to point to letters or specially designed computers. For mobility problems, leg braces, walkers, wheelchairs, and other equipment are available. Some patients may also need special positioning aids for sitting, standing, and even lying. In addition, physical therapy can

* **voluntary muscle movements**

are those physical actions, such as moving a hand or blinking an eyelid, over which an individual has conscious muscle control

* **perinatal** (per-ee-NAY-tal) means existing or occurring around the time of birth, with reference to the fetus.

Tools That Help

Many different kinds of equipment are available to help people with cerebral palsy to do everyday things. Wheelchairs with and without motors help those who cannot walk to get around, whereas walkers assist those who can walk but are unsteady on their feet. Spoons, toothbrushes, and pencils with special handles and shapes make it easier to hold and use them. Alphabet and picture boards make it possible for people who have trouble speaking to communicate. A computer is even available to talk for people who cannot.

help people with cerebral palsy build strength and improve function in their limbs.

Again depending on the symptoms, a doctor may prescribe muscle relaxants to reduce muscle tone and the related spastic movements or medications to control seizures. Occasionally, a doctor may recommend surgery to treat disease-related muscle, hip, or extremity problems.

Is Cerebral Palsy Preventable?

Because the cause of cerebral palsy is unknown in the majority of cases, no definite prevention methods are available. Nonetheless, an expectant mother can increase the chances that her baby will be healthy by eating properly, getting regular checkups, and refraining from activities such as smoking, drinking alcohol, or drug use, that may harm the fetus. After giving birth, a parent can take steps to provide the child with a safe environment that reduces the potential for accident or injury.

Living with Cerebral Palsy

Cerebral palsy is a lifelong disorder. The extent of disability caused by cerebral palsy varies with the severity of the symptoms. Some people have mild forms that are barely noticeable. For example, a child may have a limp when walking or running. Other people have more severe symptoms and may require a wheelchair to get around and/or experience severe mental retardation. While severely affected persons may need long-term care, such as institutionalization, a large proportion of people with cerebral palsy lead full and happy lives. Most children with cerebral palsy engage in many of the activities their friends enjoy, including attending school, participating in summer camp, reading, listening to music, talking on the phone, using the computer, and playing sports. As they grow older, many continue their education at college, enter the job market, form personal relationships, and raise their own children.

▶ *See also* **Amyotrophic Lateral Sclerosis • Birth Defects and Brain Development • Brain Injuries • Disability • Epilepsy**

Resources

Books and Articles

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Martin, Sieglinde. *Teaching Motor Skills to Children with Cerebral Palsy and Similar Movement Disorders: A Guide for Parents and Professionals*. Bethesda, MD: Woodbine House, 2006.

Miller, Freeman, and Steven Bachrach. *Cerebral Palsy: A Complete Guide for Caregiving*, 2nd ed. Baltimore, MD: Johns Hopkins University Press, 2006.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: http://www.cdc.gov/ncbddd/autism/ActEarly/cerebral_palsy.html.

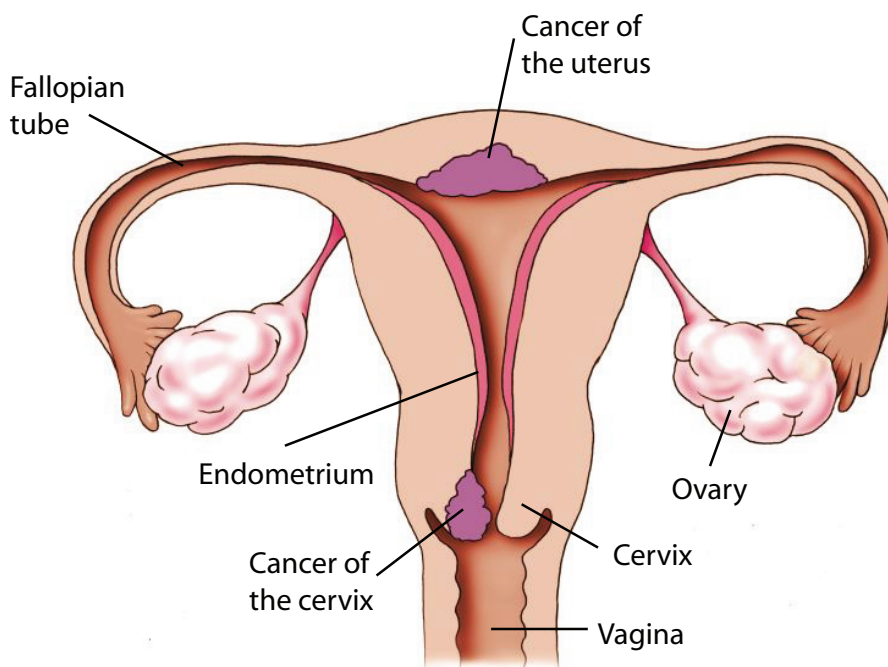
National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Toll free: 800-352-9424. Web site: http://www.ninds.nih.gov/disorders/cerebral_palsy/cerebral_palsy.htm.

University of Virginia (UVa) Health System. 1215 Lee Street, Charlottesville, VA, 22908. Telephone: 434-924-0211. Web site: <http://www.healthsystem.virginia.edu/internet/pediatrics/patients/Tutorials/CP/home.cfm>.

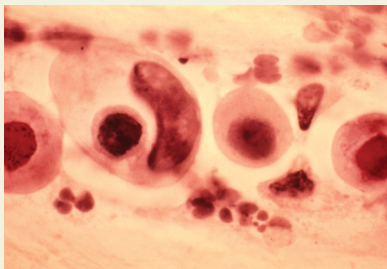
United Cerebral Palsy. 1660 L Street NW, Suite 700, Washington, DC, 20036. Toll free: 800-872-5827. Web site: <http://www.ucp.org>.

Cervical Cancer

Cervical (SER-vi-kal) cancer is a highly curable condition that occurs in the female reproductive tract.



◀ Anatomy of the female reproductive system showing cervical and uterine cancers. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



▲ Cells from Pap smears like the ones seen here help to find cancerous cells in the cervix. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

* **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **carcinoma** (kar-sih-NO-muh) is a cancerous tumor that arises in the epithelium (eh-puh-THEE-lee-um), the sheets of cells that line body surfaces, such as the insides of hollow organs and cavities.

What Is Cervical Cancer?

Cervical cancer develops in the part of a woman's reproductive tract called the cervix. The uterus is the hollow, pear-shaped organ in which the fetus develops when a woman is pregnant. The cervix is the lower, narrow part of the uterus (cervix is Latin for "neck"). The cervix lies between the main body of the uterus and the vagina (va-JY-na), or birth canal, which opens to the outside of the body.

Cancer* is a condition in which cells undergo abnormal changes and start dividing without control or order, usually forming tumors*. Scientists are not exactly sure why these changes happen, but they believe that something occurs in the abnormal cells that turns off certain genes* that control orderly cell growth. When these genes are turned off, abnormal cells are free to grow wildly. In some cases, these abnormal cells are cancerous; in other cases, they are not.

Cancers are named for the type of cell that becomes abnormal. There are two main types of cervical cancer. Between 80 and 90 percent of all cervical cancers are squamous cell carcinomas*. Squamous cells are a layer of cells that cover the outside of the body (e.g., skin cells) and the internal surface of the body (e.g., the lining of the cervix). The other type of cervical cancer is called adenocarcinoma. This type of cancer begins in cells of the mucus glands that line the cervix.

How Does Cervical Cancer Develop?

Cervical cancer generally develops slowly. At first, certain cells, called precancerous cells, begin to show abnormalities. These cells are not yet cancers, and in many women they change back into normal cells without any treatment. In some women, however, the precancerous cells continue to change and turn into cancer cells. This process usually takes several years, although it can happen in a shorter period. Precancerous cells look

DETECTING CERVICAL CANCER WITH A PAP TEST

In the late 1920s, the scientist George Papanicolaou (1883–1962) developed a simple method for examining cells of the cervix for precancerous abnormalities. To perform this test, later called a Pap test, the doctor scrapes some of cells from the surface of the cervix and places them on a microscope slide. Under a microscope, a trained examiner can tell the difference between normal, precancerous, and cancerous cells.

When found early, cervical cancer is highly curable. Therefore, doctors recommend that women have their first Pap test within three years of the time when they start having sex or at age 21, whichever comes first. Women should then have a repeat Pap test every year.

different from normal cells under the microscope and can be detected in a Pap smear*, also called a Pap test or cervical smear.

About 6 percent of Pap tests show that abnormal cells are present. Not all of these abnormalities become cancer. However, if a Pap test comes back as abnormal, the doctor is inclined to do further tests. One test, called colposcopy (kol-POS-ko-pee), involves applying a vinegar-like solution to the cervix and then using a very thin, lighted instrument to examine the cervix closely. Doctors may also remove a small amount of tissue from the cervix and have it examined under a microscope, a procedure called biopsy (BY-op-see).

Having a Pap test is particularly important because even when cervical cells become cancerous, a woman often has no symptoms until the cancer is far advanced and has grown through the wall of the uterus or spread to other parts of the body. Symptoms of advanced cervical cancer are similar to symptoms caused by many other diseases and disorders. They include:

- Abnormal vaginal bleeding
- Increased vaginal discharge
- Pain during sexual intercourse

What Causes Cervical Cancer?

Scientists know that cancer is caused by the faulty regulation of cell growth. They are not exactly sure what happens to trigger cervical cancer, but they do know that it appears to be related to becoming infected with the human papilloma virus (HPV), a group of about 100 viruses, not all of which cause cancer. In fact, about two-thirds of all cancers are caused by only two viruses, HPV 16 and HPV 18. Most HPV infections occur in women between the teenage years and age 30.

What is confusing to scientists about the relationship between HPV and cervical cancer is that a great many women are infected with the HPV virus, but only a very few develop cancer. In most cases, the body's immune system* fights the HPV infection and the body shows no ill effects of the infection. In some women, however, infection with certain HPV viruses triggers a change in cervical cells, which then become cancerous. A test is available that can tell whether a woman has been infected with the HPV virus. This test is not routinely used, but may be done on women who have abnormal Pap tests.

Who Gets Cervical Cancer?

The American Cancer Society estimated that in 2008 about 11,000 new cases of cervical cancer would be diagnosed in the United States and that about 3,900 women would die of the disease that year. Cervical cancer does not occur evenly throughout the population; some women are more likely to develop it than others. For example, in the United States Hispanic women are twice as likely to develop cervical cancer as non-Hispanic women, and African American women are more likely to develop the disease than white women. Most cervical cancers are diagnosed in women between the ages of 20 and 50, but 20 percent occur in

What Is a Papilloma?

A papilloma is what people ordinarily call a wart. Human papilloma virus got its name because some of these viruses cause small warts to grow around the anus and the male and female genitals. Other HPV viruses cause warts in other parts of the body, including the hands, feet, and mouth.

* **Pap smear** is a common diagnostic test used to look for cancerous cells in the tissue of the cervix.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

Cervical Cancer Is Decreasing

In the United States, the death rate from cervical cancer decreased 74 percent between 1950 and 1992. The rate was expected to continue to decline given that a vaccine that protects against the some of the viruses that trigger cervical cancer is available.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

* **chlamydia** (kla-MIH-dee-uh) are microorganisms that can infect the urinary tract, genitals, eye, and respiratory tract, including the lungs.

* **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.

* **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.

* **chemotherapy** (KEE-mo-THER-ah-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

women over age 65. Other factors that increase the chances of developing cervical cancer are as follows:

- Infection with the HPV virus
- Infection with the HIV* virus
- Infections with the chlamydia* bacteria
- Smoking
- Long-term use of oral contraceptives (birth control pills)
- Poverty that results in poor diet and lack of access to routine health care
- Family history of cervical cancer

How Is Cervical Cancer Treated?

Cervical cancer is staged using an international system (Federation of International Gynecology and Obstetrics or FIGO system) that classifies cancer according to stages of its development, from stage 0 to stage IV. The stages are determined by the extent of the spread of malignant* cells from the primary lesion to other locations in the body. The stage is determined primarily by a doctor's examination and the results of several tests. The lower the stage number, the less advanced and more curable the cancer is.

The recommended treatment depends on the stage of the cancer. It is wise to get a second opinion from an independent doctor before beginning treatment. Some lesions* that have a close-to-normal appearance do not require treatment, but they do need to be checked regularly. Other growths that appear likely to develop into cancer may need to be removed, which is often done by using a special instrument to freeze them off, a procedure called cryosurgery (KRY-o-sur-jer-ee), to burn them off by cauterization (kaw-ter-i-ZAY-shun), or to direct high-energy laser beams at them. These procedures can destroy the abnormal areas without affecting nearby healthy tissue.

These procedures also may be used to remove tumors that definitely are cancerous but have remained on the surface of the cervix. However, if the cancer has penetrated or grown into the wall of the cervix or has spread, surgeons either need to remove the tumor and the surrounding tissue, or they need to remove the entire uterus and cervix, an operation called a hysterectomy (his-ter-EK-to-mee). Surgery is the most common treatment for cervical cancer, but it also may be used together with radiation therapy and chemotherapy*. These treatments can help kill any cancer cells that remain after surgery or they help destroy cancer cells that already have traveled to other parts of the body. Radiation therapy uses high-energy rays to damage cancer cells and stop them from growing. Chemotherapy involves giving powerful anticancer drugs either by injection into a vein or by mouth.

How Can Cervical Cancer Be Prevented?

In 2006, the Food and Drug Administration approved a vaccine (Gardasil) that prevents infection against four types of HPV infection that cause about 90 percent of all cervical cancers. The vaccine is designed to be

given to young women ages 9 to 26 who are not pregnant or breastfeeding. Immunization requires three injections of the vaccine over a six-month period. Two months after the first injection, a second injection is given. A third injection is given four months after the second injection. All three injections must be given for the vaccine to be effective. As of 2009, questions about potentially dangerous side effects of the vaccine remained unanswered and concerns about the safety of this vaccine remained.

Because cervical cancer is so closely connected with the sexually transmitted virus called HPV, not having sexual intercourse is an effective way to prevent HPV infection. When engaged in sexual intercourse, men should always use a condom, which helps to protect their partner from possible infection. A condom offers good, but not total, protection against both the HPV virus and the HIV virus. Maintaining a healthy lifestyle by not smoking, eating a balanced diet, and maintaining a healthy weight also reduce the risk of developing cervical cancer.

▶ See also **Cancer: Overview • Genital Warts • Human Papilloma Virus (HPV)**

Resources

Books and Articles

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Markovic, Nenad, and Olivera Markovic. *What Every Woman Should Know about Cervical Cancer*. New York: Springer, 2008.

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Tewari, Krishnansu Sujata Tewari, and Bradley J. Monk. *Myths & Facts about Cervical Cancer: What You Need to Know*. Manhasset, NY: Oncology Group, CMPMedica, 2007.

Organizations

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-ACS-2345. Web site: <http://www.cancer.org>.

Gynecologic Cancer Foundation. 230 W. Monroe, Suite 2528, Chicago, IL, 60606. Toll free: 800-444-4441. Web site: <http://www.thegcf.org>.

Health24. P.O. Box 2434, Cape Town, 8000 South Africa. Web site: http://www.health24.com/medical/Condition_centres/777-792-4101.asp.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov/cancertopics/types/cervical>.



Reduviid bugs, like this assassin bug, live in the cracks and crevices of poorly built houses. Reduviid bugs can pick up the *Trypanosoma cruzi* parasite that causes Chagas' disease when they bite an infected person or animal. They pass along the parasite to the next person they bite. *Image copyright Bidouze Stéphane, 2008. Used under license from Shutterstock.com.*

* **parasite** (PAIR-uh-site) an organism such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

* **blood transfusions** (trans-FYOO-zhunz) are procedures in which blood or certain parts of blood (such as specific cells) are given to a person who needs them due to illness or blood loss.

* **host** is an organism that provides another organism (such as a parasite or virus) with a place to live and grow.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

Chagas' Disease

Chagas' disease is a parasitic infection common in South and Central America that is spread to people by blood-sucking insects called reduviid bugs.

What Is Chagas' Disease?

Chagas' disease is a parasitic infection common in South and Central America. It is chronic (long-lasting) and can seriously damage the heart and the digestive system many years after infection. Another name for Chagas' disease is American trypanosomiasis (tri-pan-o-so-MY-a-sis).

What Is Infection with Trypanosomiasis?

Chagas' disease is an infection with a protozoan (pro-to-ZO-an), a tiny parasite* called *Trypanosoma cruzi*. This parasite infects many kinds of mammals in South and Central America. It is spread to people by blood-sucking insects called reduviid (re-DOO-vi-id) bugs. These insects, also called kissing or assassin bugs, pick up the parasite when they bite an infected person or animal. The parasites multiply inside the insect and are excreted in their feces and urine. When the insects bite people, they deposit parasite-laden feces and urine on the skin at the end of their blood meal. If the feces get into the bite or are accidentally rubbed into a cut or scratch, the eyes, or the mouth, the person may be infected with the parasite. Approximately 80 percent of infections are through this route. Other routes of infection include contaminated food or water or anything that introduces the parasite into the blood such as blood transfusions* or organ transplantation from an infected donor.

The parasite must invade the cells of a mammalian host* such as humans in order to complete its lifecycle. Once the parasite invades the cells of a human host, it multiplies within those cells. The cells contain the multiplying parasites until they rupture, releasing chemicals that cause inflammation* as well as the new parasites. This process of cells rupturing and inflammation causes much damage to the body tissues and consequent health problems. When a damaged area is able to heal, the remaining scar tissue may also cause health problems. The most commonly affected organs are the heart, esophagus, and colon.

Reduviid bugs tend to live in the cracks and crevices of poorly built houses in rural South and Central America and in Mexico. Chagas' disease used to be largely an illness of the rural poor in those areas. But in the 1970s and 1980s, many people moved from the countryside to Latin American cities, bringing the parasite and disease with them. In the cities, from 5 to 20 percent of cases are caused from ingesting contaminated food, transfusions of contaminated blood, and organ transplants. More rarely, it can also be transmitted to the fetus at a rate of 2 to 10 percent

of infected pregnant women. Chagas' disease is estimated to kill up to 50,000 people per year.

What Are the Symptoms of Chagas' Disease?

Chagas' disease has incubation, acute, indeterminate, and chronic phases. Upon infection, the incubation phase passes without symptoms and lasts seven to ten days when infected by the insect, 20 to 40 days when infected by blood transfusion.

Acute and indeterminate phases Symptoms most often appear in infected children and usually resolve within three to eight weeks. Symptoms include fever, headache, muscle pain, general malaise, lost appetite, rash, and lethargy. When an insect bites the skin it causes a characteristic lesion called a chagoma. When the insect bites the eye it causes swelling around the eye known as the Romana sign, present in 20 to 50 percent of acute cases. In rare cases, there may be heart damage even as early as the acute phase. In people with weakened immune systems*, such as those with AIDS*, the acute stage can recur later, in a very severe form. In the indeterminate phase, the parasite is still present in the body but causes no symptoms. This stage lasts a lifetime in many infected people. There are blood tests that can identify infection in this phase.

Chronic phase In about one-third of infected people, serious symptoms develop 10 to 20 years or more after infection occurred. The most common problems are enlargement and weakening of the heart, a condition called cardiomyopathy, which can make a person feel tired, weak, and short of breath; ventricular dysrhythmias, a form of irregular heartbeat that can cause sudden death; and heart failure, which may lead to death. Heart failure due to Chagas' disease is the most common form of cardiovascular death in patients who are 30 to 50 years old and live in areas of South America where Chagas' disease is prevalent. Other complications include megacolon, an enlargement of the colon (large intestine) that can cause extreme constipation and require surgical treatment, and enlargement and inflammation of the esophagus, which can make eating difficult and lead to severe weight loss.

Where Does Chagas' Disease Occur and Who Are Affected?

Chagas' disease occurs only in the Americas, mainly in South and Central America and in Mexico. It is believed to create a greater economic burden than any other tropical disease except malaria and schistosomiasis. In South and Central America, about 16 million to 18 million people are infected with Chagas' disease. Many live in thatch, mud, or adobe houses in poor areas. In the United States, many people who emigrated from South and Central America are thought to be infected with Chagas' disease, chiefly in the indeterminate or chronic stages. However, it is extremely rare for someone to catch the disease in the United States. Between about 1980

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

and 2000, fewer than 20 newly acquired U.S. cases were reported, including three from blood transfusions. About 50,000 people die each year from the disease. The World Health Organization (WHO) reports that about 100 million people are at risk of developing Chagas' disease. Illness and death are most common in black individuals as opposed to white or mixed race in the acute phase. There is no difference between genders for the acute phase, but males tend to have more severe cases of cardiomyopathy in the chronic phase.

How Is Chagas' Disease Diagnosed and Treated?

In the acute stage, the parasites can be seen when blood is examined under a microscope. In the later stages, diagnosis is more difficult, and an array of different blood tests are used. In the acute stage, the parasites often can be eliminated by prescription medication taken for several months. In later stages, there is no proven cure. Instead, doctors try to treat the symptoms of the organ damage the parasites cause.

How Is Chagas' Disease Prevented?

In Latin America, many countries took part in a campaign to wipe out Chagas' disease. They used pesticides to kill the insects that transmit the disease, and they upgraded housing so the insects could not hide in cracked walls and thatched roofs. They also tried to screen blood supplies more thoroughly. This campaign progressed best in the countries of the Southern Cone: Argentina, Brazil, Chile, Paraguay, and Uruguay. In this area, new infections of children and young adults reportedly were reduced by almost 70 percent in the late 1990s. Travelers to areas where Chagas' disease is common should use insect repellent. If possible, people should avoid sleeping in thatch, mud, or adobe homes, or should use bed nets at night.

▶ See also **Trypanosomiasis**

Resources

Books and Articles

Kruel, Donald. *Trypanosomiasis*. New York: Chelsea House, 2007.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/chagas.htm>.

World Health Organization. Avenue Appia 20, CH-1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/ctd/html/chag.html>.

Charcot-Marie-Tooth Disease

Charcot-Marie-Tooth disease is an inherited nervous system disorder which causes progressive degeneration of the nerves that supply the muscles of the limbs, resulting in gradually increasing muscle weakness.

What Is Charcot-Marie-Tooth Disease?

Named for the three physicians who discovered the disorder in 1886, Charcot-Marie-Tooth disease is the most common inherited nervous system (neurological*) disorder. About 2.6 million people have the condition. The disease causes progressive degeneration of the nerves that supply the muscles of the limbs, resulting in gradually increasing muscle weakness.

What Causes Charcot-Marie-Tooth Disease?

Charcot-Marie-Tooth disease runs in families and is caused by a genetic defect. genes* (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes* found in the body's cells. Under normal circumstances, long nerve fibers (called axons) that carry signals from the brain and spinal cord to the muscles are covered with a special sheath called myelin. Myelin allows the electrical signal to travel quickly and efficiently along the nerve, and it also provides some nutrition for the continued health of the nerve. In Charcot-Marie-Tooth disease, defective genes do not produce the appropriate proteins necessary for the normal composition of the axons or of the myelin sheath. Abnormal axons result in weaker than normal transmission of electrical signals; abnormal myelin results in slower than normal transmission of electrical signals. This genetic disease causes weakness in limbs, generally beginning in the legs and then affecting the arms.

Who Gets Charcot-Marie-Tooth Disease?

Most forms of Charcot-Marie-Tooth disease are inherited in an autosomal dominant fashion. This means that an individual only has to have one parent with the disorder in order to inherit the disease. A couple in which only one member has the disorder has a 50 percent chance of passing it on to their offspring. A few forms of Charcot-Marie-Tooth disease are inherited in an autosomal recessive fashion, meaning that an affected individual has to receive a copy of the defective gene from each parent. Type 1X is x-linked, which means that it is passed by the mother to the son, on the X chromosome, and only males will display symptoms of the disorder. In some cases, Charcot-Marie-Tooth disease can occur as a spontaneous mutation, in which case neither parent of the affected individual had the disorder, but offspring of the affected individual are at risk of inheriting the defective gene.

* **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **chromosomes** (KRO-mo-somz) are threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.

* **neurologist** (new-RHAL-eh-jist) a physician who specializes in diagnosing and treating diseases of the nervous system.

* **electromyogram** (ee-lek-tro-MY-eh-gram) (EMG) a visual record made by an electromyograph, which measures the electrical activity associated with functioning muscle.

What Are the Symptoms of Charcot-Marie-Tooth Disease?

About 10 to 20 percent of all people with Charcot-Marie-Tooth disease do not develop any symptoms of the disorder at all. The other 80 to 90 percent experience gradually increasing muscle weakness. Muscles grow smaller, walking becomes difficult, and balance is affected. There may be decreased sensation or painful numbness and tingling (paresthesias) in the feet, lower legs, hands, and forearms. If the muscles become abnormally tight, joints may become stiff. In some cases, people with Charcot-Marie-Tooth disease develop a curved spine (scoliosis) or foot sores (ulcers) that do not heal. Although most people with Charcot-Marie-Tooth disease live a normal lifespan, the disease can be associated with significant disability, particularly by the time afflicted individuals reach their 60s or 70s.

How Is Charcot-Marie-Tooth Disease Diagnosed?

The diagnosis of Charcot-Marie-Tooth disease is straightforward among people who already know the disorder runs in their family. Others are examined by a neurologist* who takes a detailed family history, does a thorough examination (such as observing walking and testing reflexes). Electro-diagnostic testing may be performed, including an electromyogram* (EMG) to test how strong the electrical signals are in the muscles and a nerve conduction velocity test, to see how quickly and strongly the electrical signal travels along nerves. Some forms of Charcot-Marie-Tooth disease can also be diagnosed through genetic testing.

How Is Charcot-Marie-Tooth Disease Treated?

As of 2009 there was no known cure for Charcot-Marie-Tooth disease. Treatment in the early 2000s addressed the weakness and deformity that may be caused by the disease. Braces and appropriate footwear may improve mobility, and physical therapy and an appropriate exercise program may help optimize muscle strength and flexibility. Occupational therapy can also help people learn how to function better, despite their impairment. In some cases, an orthopedic surgeon may recommend surgery to help improve tight heel cords, lower the arch of the foot, fuse the ankle joint, or straighten toes that have been deformed by the condition. Pain medications or consultation with a pain specialist may be helpful for people with paresthesias.

Can Charcot-Marie-Tooth Disease Be Prevented?

Charcot-Marie-Tooth disease cannot be prevented, but genetic counseling can help an affected individual understand the risk of passing the defective gene on to his or her offspring.

Resources

Books and Articles

Goetz, C. G. *Goetz's Textbook of Clinical Neurology*, 3rd ed. Philadelphia, PA: Saunders, 2007.

Organization

Charcot-Marie-Tooth Association. 2700 Chester Street, Philadelphia, PA, 19013. Toll free: 800-606-2682. Web site: <http://www.charcot-marie-tooth.org>.

Chemical Poisoning

Chemical poisoning is the state of a person who has been poisoned with chemicals, which may include household cleaners, drugs, pesticides, herbicides, environmental toxins, such as radon and carbon monoxide, and others.

What Is Chemical Poisoning?

Chemical poisoning occurs when individuals have been exposed to and are harmed as a result of chemicals having made their way into their bodies. This may occur because the person has eaten, drunk, or inhaled chemical toxins or has absorbed them through the skin. A child who drinks a poisonous household cleaner, a person who takes an overdose of a drug, a worker who inhales a toxic gas at a work site, all are victims of chemical poisoning.

Poisoning is divided into two types: acute and chronic. Acute poisoning occurs following a single exposure to a toxin, and the person has symptoms shortly after the exposure. Chronic poisoning develops slowly, often over many months or even years of exposure. Because the symptoms of chronic poisoning can occur quite a long time after the exposure has stopped, medical professionals may have difficulty diagnosing the illness and treating patients. An example of chronic chemical poisoning is radon exposure. Radon is a colorless, odorless gas that may be present at very low levels in buildings, especially in basements. After long-term exposure, individuals may develop lung cancer. Lung cancer, however, can have many causes, so doctors may not be able to pinpoint radon as the culprit.

How Widespread Is Chemical Poisoning?

Chemical poisoning is a common form of poisoning. It may occur accidentally or intentionally. An accidental poisoning happens when a person ingests a poison by mistake, such as when an adult grabs the wrong bottle

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **chronic fatigue syndrome** (KRON-ik fat-TEEG) a debilitating and complicated disorder in which individuals feel intense fatigue that lasts six months or longer. Symptoms may include insomnia, muscle pain, and impaired concentration. Since other illnesses have these symptoms, doctors must rule out a number of conditions in order to make a diagnosis.

* **Parkinson's disease** is a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.

of medicine or when a toddler gets into a cupboard and drinks a household cleaner. Intentional poisoning occurs when individuals ingest or inhale a poison deliberately and with the intent of self-harm. When individuals attempt to commit suicide by overdosing on a drug, the chemical poisoning is called intentional. By contrast, if individuals overdose on a drug but did not mean to harm themselves, the poisoning is called accidental. Poisoning with chemicals, whether intentional or accidental, makes up 95 percent of all poisonings in the United States. About 90 percent of all chemical poisonings are accidental, and most of these involve toddlers and small children who swallow household cleaners. In fact, poison control centers in the United States respond to hundreds of thousands of calls each year regarding poisoning of children younger than six years of age.

Are Some Diseases Associated with Chemical Poisoning?

Researchers have linked many diseases to chemical exposure, particularly low level chemical exposure that occurs over long periods of time. These diseases include the following:

- Breast cancer, which has been associated with a variety of chemicals, including some that mimic female hormones* or that are found in certain plastics
- Lung cancer, which has been associated with exposure to asbestos or to radon, among other chemicals
- Gulf War illness, which affects many soldiers and has been tied to chemicals that are found in pesticides and nerve agents, as well as pills designed to protect against nerve agents
- Chronic fatigue syndrome*, which has been associated with insecticide exposure
- Asthma attacks and other respiratory allergies, which can be triggered by or worsened by cigarette smoke, pollutants, and other chemicals
- Parkinson's disease*, which some studies have connected to long-term, low-dose exposure to certain pesticides

Various studies have also linked certain chemicals to memory loss, infertility, learning disorders, behavioral disorders, birth defects, and many other conditions and diseases.

What Are Some Common Toxic Household Chemicals?

Common toxins household chemicals include the following:

- Volatile organic hydrocarbons
- Carbon monoxide
- Lead and other heavy metals
- Insecticides and other pesticides
- Radon

Volatile organic hydrocarbons Volatile organic hydrocarbons (VOCs) are chemicals that are found in paint and paint strippers, carpet backing, plastics, wood preservatives, and other household products. VOCs typically become airborne and may especially accumulate in a building that is undergoing construction or renovation. Typical symptoms of exposure to VOCs are headaches; eye, nose, and/or throat irritation; dizziness and/or nausea; a dry cough; and fatigue. These symptoms usually disappear once the person leaves the building. This collection of symptoms is sometimes called “sick building syndrome.”

Carbon monoxide Carbon monoxide is a colorless, odorless gas that may accumulate in a house due to a faulty appliance, such as a furnace, or to improper use of an appliance, which may include the use of a space heater without adequate ventilation. Symptoms of carbon monoxide poisoning include headaches, nausea, and fatigue. After prolonged exposure, carbon monoxide poisoning can cause brain damage and death. In some cases, entire families have died in their sleep of carbon monoxide poisoning.

Lead and other heavy metals Lead poisoning is more common in children than in adults, and typically it results when children put a lead-containing item, such as paint, toys, or art supplies, into their mouths. Although paint in the early 21st century no longer contains lead, older homes sometimes still have lead paint on their walls or on windowsills. When the paint peels, toddlers may pick up pieces of the paint and eat them. If they swallow these low doses of lead over a prolonged period of time, they may experience serious health conditions that affect the development of the brain or the nervous system. This exposure can lead to slow development of the body, hearing problems, behavioral problems, kidney damage, and other problems. Symptoms of lead poisoning include aggressiveness, lack of appetite, low energy, headaches, trouble sleeping, constipation and/or abdominal cramps, and in some cases, seizures* and coma*.

Other dangerous heavy metals are arsenic, mercury, cadmium, and thallium, as well as such elements as zinc, copper and iron. It is best to read the contents of all substances in the house and store those with dangerous contents in safe locations, especially out of reach of children.

Insecticides and other pesticides Insecticides and other pesticides are chemicals used to kill insects and other pest animals, such as mice. Poisonings can occur when people eat or breathe pesticides or absorb them through their skin. Typical symptoms of insecticide and pesticide poisoning include headache; runny nose and watery eyes; considerable saliva in the mouth; diarrhea; abdominal pain, cramps, and/or vomiting; fatigue; dizziness and/or shallow breathing; twitching muscles and/or seizures; loss of consciousness; constricted (small) pupils; and heavy sweating. Exposure to rat poison has different symptoms, some of which may occur hours or even days after exposure. These include easy bruising,

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **leukemia** (loo-KEE-me-uh) is a form of cancer characterized by the body's uncontrolled production of abnormal white blood cells.

* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

AGENT ORANGE AND VIETNAM

During the Vietnam War, at various times from the late 1950s until 1975, the U.S. government used a powerful herbicide, which is a chemical that causes plants to lose their leaves, to uncover the enemy hiding in the jungles of Vietnam and Laos and also to destroy crops the enemy was using for food. That herbicide was called Agent Orange. After studies showed that the herbicide caused birth defects in laboratory animals, the government stopped using Agent Orange. But by that point, the U.S. military had already sprayed nearly 19 million gallons of the chemical on millions of acres and exposed many U.S. soldiers and thousands of citizens in Vietnam and Laos to it. After that, U.S. soldiers and their families were concerned about the health effects of that exposure, and many believed it led to an increased risk of cancer later in life and birth defects in children of exposed parents. Moreover, Agent Orange contaminated soil and ground water, making affected areas toxic for decades after the war ended.

The American Cancer Society reported that some studies showed an association between a father's exposure to Agent Orange and the later occurrence of acute myeloid leukemia* in biological children he subsequently fathered. Other studies suggested that exposure may be associated with various forms of cancer in soldiers, such as Hodgkin's disease, multiple myeloma, prostate cancer, and lung cancer. Additionally, research linked exposure to increased incidence of diabetes in soldiers. Ongoing studies are being conducted to verify these results and to determine whether Agent Orange exposure was associated with any other illnesses.

Increased rates of miscarriage* and birth defects, along with higher than normal rates of other diseases, were experienced for decades among citizens who lived in contaminated areas in Vietnam and Laos. Environmental damage in these areas was acute and long-lasting, with the rain forest not able to grow back and long-term contamination of ground water.

nosebleeds, bloody urine and/or bloody diarrhea, hair loss, shortness of breath, and fatigue.

Radon Radon is a radioactive material that occurs naturally in the soil and seeps into the air. Outdoors, it is typically at such low concentrations that it causes no health problems. When it seeps through walls and into buildings, however, it can reach unhealthy levels. It is typically most concentrated in basements, although not all basements have levels of radon that present a health concern. Radon produces no short-term symptoms, but prolonged exposure to high enough levels can cause lung cancer. According to the Environmental Protection Agency, radon is the second leading cause of lung cancer after smoking, and it is the number one cause of lung cancer among non-smokers. Overall, it causes approximately 21,000 lung-cancer deaths each year, including nearly 3,000 to non-smokers.

How Is Chemical Poisoning Treated?

In the event of any acute poisoning that happens anywhere in the United States, an immediate call should be made to the Poison Help Hotline at 1-800-222-1222. If possible, callers should have information about the chemical that caused the poisoning. This information helps hotline personnel determine the best course of action. Sometimes, people think the first response in the case of acute chemical poisoning should be to induce vomiting, but medical professionals recommend against it. Some chemicals burn the esophagus (e-SOF-uh-gus), so making the victim vomit may only serve to damage the esophagus again. Hotline personnel explain the best way to care for the victim, and if professional help is needed, they will call an ambulance as well as the hospital, and provide both with the needed information to assure the best care for the patient.

If a patient requires hospital care, the specific treatment depends on the type of poison and the extent of exposure. Some patients require stomach pumping, in which medical professionals use a tube to remove the contents of the stomach, but others may need more extensive care. Doctors may also perform blood tests or other exams if the cause of the poisoning is unknown.

How Is Chemical Poisoning Used as a Weapon?

An especially disturbing type of poisoning can result from chemical weapons. These are toxic chemicals that are used as weapons, such as the mustard gas used in World War II by the Nazis. Although the production, stockpiling, and use of chemical weapons was made illegal by the Chemical Weapons Convention, some countries, including the United States, did stockpile them, and the possibility of their use remained. As a result, many government agencies around the world take steps to prepare for the possible use of these weapons. In the United States these include the Centers for Disease Control and the Federal Emergency Management Agency.

▶ See also **Bioterrorism • Environmental Diseases**

Resources

Organizations

American Association of Poison Control Centers. 515 King Street, Suite 510, Alexandria, VA, 22314. Telephone: 703-894-1858. Web site: <http://www.aapcc.org/DNN>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.bt.cdc.gov/chemical>.

Environmental Protection Agency, Office of Radiation and Indoor Air Indoor Environments Division. 1200 Pennsylvania Avenue,

* **autism** (AW-tih-zum) is a developmental disorder in which a person has difficulty interacting and communicating with others and usually has severely limited interest in social activities.

NW, Mail Code 6609J, Washington, DC, 20460. Telephone: 202-343-9370. Web site: <http://www.epa.gov/radon/healthrisks.html>.

Federal Emergency Management Agency. 500 C Street SW, Washington, DC, 20472. Toll free: 800-621-FEMA. Web site: <http://www.fema.gov/hazard/chemical/index.shtm>.

Chicken Pox See *Varicella (Chicken Pox) and Herpes Zoster (Shingles)*.

Childhood Disintegrative Disorder (Heller's Syndrome)

Childhood disintegrative disorder (CDD) is a rare medical disorder that occurs in children usually after the first three years of life. Also called Heller's Syndrome, CDD also goes by such names as childhood disintegration disorder, disintegrative psychosis, and social development regression. The progressively deteriorating condition is characterized by severely slowed mental developmental especially in the areas of cognitive skills (such as language), motor skills (such as walking), and social functions (such as interest in playing with other children). Often classified as a pervasive developmental disorder (PDD), a cure for CDD had as of 2009 not been discovered.

Why Do Some Children Lose Abilities Once Learned?

Children who eventually contract CDD do so after having developed normally, or almost normally, for the first couple years of life. They suddenly, in some cases, begin to regress, losing skills that they had already learned successfully. In these situations, childhood disintegrative disorder, as the name implies, can be the cause of such regression of skills.

Sometimes CDD is mistaken for autism-spectrum disorder (ASD), what is commonly called autism*. For this reason, the medical community generally considers autism to be a similar condition to CDD. But unlike autism, CDD is not present at birth and appears later. CDD may occur any time between two to ten years of age.

Who Discovered Childhood Disintegrative Disorder?

Australian educator and remedial teacher Theodor Heller (1869–1938) first described the syndrome in 1908. Heller studied six children in Vienna, Austria, who after normal childhood development suddenly developed

severe mental problems that began between the ages of three and four years. Heller used the name *dementia infantilis* to identify this group of similar problems. However, little notice was made of his discovery within the medical community. At that time, the group of problems was associated with specific problems involving the nervous system*.

What Are the Signs and Symptoms of Childhood Disintegrative Disorder?

Children with CDD generally have normal developmental skills until two years of age. However, around this time, their ability to communicate, socialize, and perform other such skills begins to deteriorate and, in some cases, is totally lost. Sometimes this regression is slow acting (over several years), but in other cases, it is abrupt, occurring over only a few days or weeks. Often, children with CDD have higher incidences of seizures and related disorders.

Children with CDD tend to lose skills and abilities in at least two of the following areas:

- Motor skills
- Toileting, including bladder and bowel movements
- Social interaction and self-care skills
- Receptive behavioral skills, along with interest in the surrounding environment
- Language and communication skills
- Play skills

For instance, a child with CCD may not be able to say words and sentences that they were able to earlier. They may lose the ability to understand verbal and nonverbal communications. The child with CDD is often mistakenly thought to have autism. However, the occurrence of CDD is less frequent than autism. Boys, rather than girls, are more likely to be affected with CDD.

What causes Childhood Disintegrative Disorder?

The exact medical or neurological cause for CDD had as of 2009 not been found. Some scientific evidence with CDD points toward problems with the central nervous system*. Other studies show that children with CDD possess excessive deposits of lipids (fats) within the brain and nervous system. CDD has also been associated with chronic infections of the brain and various tumors* within the brain and major body organs. Although CDD children are more likely to have seizures, they are not considered a cause of the condition.

How Is Childhood Disintegrative Disorder Treated?

No cure was known for childhood disintegrative disorder as of 2009. Treatment for CDD involves behavior therapy*, which helps children to relearn skills lost by the disease. Medications indirectly alleviate some of

* **nervous system** is a network of specialized tissue made of nerve cells, or neurons, that processes messages to and from different parts of the human body.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **behavior therapy** is a type of counseling that works to help people change their actions.

* **antipsychotic drugs** are medications that counteract or reduce the symptoms of a severe mental disorder such as schizophrenia.

* **anticonvulsants** (an-tie-kon-VUL-sents) are medications that affect the electrical activity in the brain and are given to prevent or stop seizures.

* **microorganism** is a tiny organism that can be seen only by using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

the symptoms but do not treat the disease directly. Medications commonly prescribed include antipsychotic drugs* (to control behavior problems) and anticonvulsants* (to control seizures). Many children with CDD are left with permanent and serious disabilities that need long-term care.

▶ See also **Pervasive Developmental Disorders: Overview**

Resources

Books and Articles

Jacobson, John W., James A. Mulick, and Johannes Rojahn, eds.
Handbook of Intellectual and Developmental Disabilities New York: Springer, 2007.

Organizations

National Dissemination Center for Children with Disabilities.

P.O. Box 1492, Washington, DC, 20013. Toll free: 800-695-0285.
Web site: <http://www.nichcy.org/Pages/Home.aspx>.

Yale Child Study Center. 230 South Frontage Rd., New Haven, CT, 06520. Telephone: 203-785-2540. Web site: <http://www.med.yale.edu/chldstdy/autism/cdd.html>.

Chlamydial Infections

Chlamydial (kla-MID-ee-al) infections are caused by three species of microorganism. Chlamydia trachomatis can cause eye or lung infections and can also infect the urinary and genital areas of both men and women. Chlamydia pneumoniae causes infections of the respiratory tract, and Chlamydia psittaci causes ornithosis, known as parrot fever, that is similar to the flu.*

What Diseases Are Caused by Chlamydial Infections?

Chlamydia trachomatis In the United States, Chlamydia trachomatis (tra-KO-ma-tis) is responsible for more cases of sexually transmitted diseases (STDs) than any other organism. Sexually transmitted diseases are passed from one partner to another during sexual activity. It is estimated that between 4 and 8 million people are annually infected in the United States by Chlamydia trachomatis.

Chlamydia trachomatis also causes an eye infection called trachoma (tra-KO-ma). This inflammation of the membrane covering the eye

causes the eye to become irritated and red with a thick discharge. Infants whose mothers' have chlamydial infections may become infected during birth. These infants can develop eye infections a few days after birth or pneumonia several weeks after birth.

Chlamydia pneumoniae *Chlamydia pneumoniae* (noo-MO-nee-eye) can cause infections in the respiratory tract. The result can be bronchitis*, pneumonia*, or pharyngitis*. In the United States, chlamydia pneumoniae is one of the leading causes of pneumonia in people between the ages of 5 and 35.

Chlamydia psittacosis The illness psittacosis (sit-a-KO-sis), also called ornithosis or parrot fever, is caused by *Chlamydia psittaci* carried by birds (mainly parrots, parakeets, and lovebirds). In human beings, it causes an illness that is like the flu. Only people who work closely with birds, such as pet-store employees or trainers of carrier pigeons, are liable to contract this disease.

How Are Chlamydial Infections Transmitted?

Chlamydial infections are passed from one person to another through direct contact. Sexually transmitted chlamydia is passed from one person to another by direct sexual contact, and the people at most risk are those who have unprotected sex (sexual intercourse without use of a condom) or multiple sex partners.

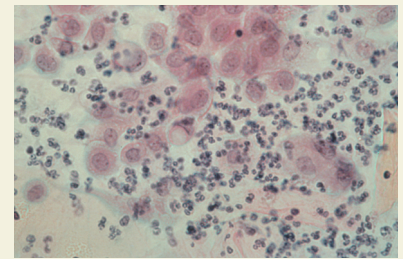
Parrot fever is caused by inhalation of dust from feathers and droppings or by the bite of an infected bird. Trachoma is transmitted by eye-to-eye or hand-to-eye contact, eye-seeking flies, or by sharing contaminated articles such as towels, handkerchiefs, or eye makeup.

Who Are at Risk for Chlamydial Infections?

Those at greatest risk for chlamydia trachomatis infections include sexually active individuals, especially those with partners who have the infection. Unborn babies of mothers with the disease are also at risk for infection during birth. People who work with birds that are illegally brought into the United States are at risk of infection with *Chlamydia psittaci*.

What Are the Symptoms of Chlamydial Infections?

The most common symptom of chlamydia trachomatis infections in men or women is a burning sensation during urination. Unfortunately, many women who are infected do not have any symptoms. If they are pregnant and do not know that they have been infected, they may unknowingly pass the disease to their baby during birth. Besides a burning sensation when urinating, a person with chlamydia trachomatis may have an abnormal discharge from the genital area. The genital area may become inflamed, and in women the inflammation can spread to the internal reproductive organs. Women may then develop pelvic inflammatory disease (PID), a condition that cause a woman to become infertile (unable to become pregnant and give birth).



▲
A microscopic image of a smear of material taken from the cervix of a woman infected with chlamydia shows the presence of the bacteria. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **bronchitis** (brong-KYE-tis) is a disease that involves inflammation of the larger airways in the respiratory tract, which can result from infection or other causes.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **pharyngitis** (far-in-JI-tis) is inflammation of the pharynx, part of the throat.

* **cornea** (KOR-nee-uh) is the transparent circular layer of cells over the central colored part of the eyeball (the iris) through which light enters the eye.

* **incubation** (ing-kyoo-BAY-shun) is the period of time between infection by a germ and when symptoms first appear. Depending on the germ, this period can be from hours to months.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

* **endemic** (en-DEH-mik) describes a disease or condition that is present in a population or geographic area at all times.

* **quarantine** is the enforced isolation (for a fixed period) of apparently well people or animals who may have been exposed to infectious disease.

Trachoma (chlamydial eye infection) is found in poor areas of the southeast United States and in poor areas of other countries around the world. This eye infection is closely associated with poor nutrition and inadequate hygiene. Trachoma infection causes eyelid swelling, tearing, and sensitivity to light. Seven to ten days after the symptoms start, small lumps develop inside the eyelid and gradually increase in size and number. If not treated, scarring of the cornea* occurs, and vision is diminished or completely lost.

Parrot fever has an incubation* period of one to three weeks. There is then a sudden onset of fever, chills, loss of appetite, and fatigue. Later a cough develops, which progresses to pneumonia. Up to 30 percent of people who have untreated parrot fever die.

How Are Chlamydial Infections Treated?

Chlamydial infections can be successfully treated with antibiotics*. Because untreated chlamydial infections can lead to serious and permanent problems, possible infections should be treated and evaluated by a doctor as soon as possible. While being treated for genital infections due to chlamydia, individuals should inform their sexual partners who should be tested and treated, if necessary. Parents of newborn children should be alert to the condition of the baby's eyes. If they become red, swollen, or have a thick discharge, a physician should be contacted immediately. Persistent coughing by a newborn is also a signal to call a doctor.

Can Chlamydial Infections Be Prevented?

The best prevention for genital infection by chlamydia is to avoid sexual contact with an infected person. Abstaining from sexual relations is the only certain way to avoid contracting chlamydia trachomatis because it is common for infected people not to know they have the infection.

Blindness due to trachoma infection can be prevented by giving a single dose of the antibiotic azithromycin to individuals who live in areas where the condition is endemic*.

Parrot fever can be prevented by buying birds from reputable pet stores or breeders who sell imported birds that have been quarantined*, examined, and fed antibiotic-treated bird feed for 45 days.

▶ See also **Pelvic Inflammatory Disease (PID)** • **Sexually Transmitted Diseases (STDs)** • **Zoonoses**

Resources

Books and Articles

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Marr, Lisa. *Sexually Transmitted Diseases: A Physician Tells You What You Need to Know*. Baltimore, MD: Johns Hopkins University Press, 2007.

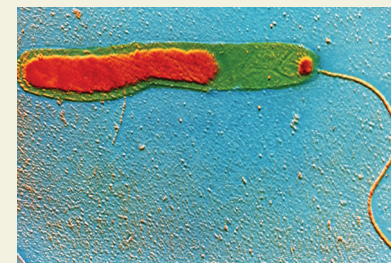
Organizations

American Social Health Association. P.O. Box 13827, Research Triangle Park, NC, 27709. Telephone: 919-361-8400. Web site: <http://sunsite.unc.edu/ASHA>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/std/Chlamydia/STDFact-Chlamydia.htm>.

Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 888-INFO-FDA. Web site: http://www.fda.gov/fdac/features/1999/499_std.html.

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web site: <http://www.4woman.gov/faq/chlamydia.cfm>.



▲
Vibrio cholerae bacterium seen under an electron microscope. Color has been added to show the nucleic acid (orange) and the flagellum (tail), which is used by the bacterium to move. CNRI/Photo Researchers, Inc.

Cholera

Cholera (KAH-luh-rub) is an acute infection of the small intestine* that can cause severe diarrhea (dye-uh-REE-uh).*

What Is Cholera?

Cholera is an illness caused by the bacterium *Vibrio cholerae*, which is contracted by eating contaminated food or drinking contaminated water. The bacteria can cause severe diarrhea* by producing a toxin that makes the intestines release more water and minerals than usual. The disease has a one- to five-day incubation period (the time between infection and when symptoms appear) and progresses very quickly. Most cases of cholera are mild, but in about one of 20 cases, the disease is serious. If left untreated, severe cholera can lead to death from dehydration* within hours. With treatment, the death rate is less than 1 percent.

Is Cholera Common?

Cholera has been rare in industrialized (or highly developed) countries such as the United States since the early 1900s, thanks to improved sanitation and water treatment. However, cholera is still common in other parts of the world, including India and southern Asia, parts of Africa, and Latin America.

In 1991 an epidemic* of cholera occurred in South America and some cases appeared in the United States shortly thereafter. Most cases of cholera reported in the United States can be traced to travel to an area where cholera is endemic*.

* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

* **small intestine** is the part of the intestines—the system of muscular tubes that food passes through during digestion—that directly receives the food when it passes through the stomach.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.

* **endemic** (en-DEH-mik) describes a disease or condition that is present in a population or geographic area at all times.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

In 2008 an epidemic of cholera occurred in Zimbabwe, a country in the southern part of Africa. The World Health Organization reported that as of December 1, 2008, a total of 11,735 cholera cases with 484 deaths had been reported since the previous August. Given widespread deterioration in water and sewage systems and crowded living conditions in the country, cholera outbreaks occurred frequently during the early 1990s. Large outbreaks also occurred in 1999 and 2002.

How Do People Contract Cholera?

Cholera is spread when people eat food or drink water that has been contaminated with feces* containing *Vibrio cholerae*. Risk factors for epidemics of cholera include unsanitary and crowded living conditions, war, famine (scarcity of food), and natural disasters that disrupt clean water delivery. For example, following a natural disaster such as a hurricane or flood, supplies of drinking water can become contaminated. The disease is most frequently spread in areas with poor sanitation and water treatment facilities.

During outbreaks of the disease, cholera may spread by contact with the feces of an infected person; *Vibrio cholerae* can live in feces for up to two weeks. It also spreads when people use contaminated water for cleaning or waste disposal. Eating raw or undercooked shellfish can be another way of contracting the disease because the bacteria can survive in slow-moving rivers and coastal waters. The few cases in the United States are typically caused by contaminated seafood from the Gulf of Mexico or seafood brought home by people who have traveled to other countries.

What Happens to People Who Have Cholera?

Signs and symptoms The major symptom of cholera is diarrhea, which can be severe and cause up to a quart of fluid loss per hour from the body. Diarrhea caused by cholera is painless, with stools that are fishy smelling

CONCERN OVER CHOLERA

Until the late 1800s, cholera was a serious threat in the United States, and the numbers of cases often reached epidemic proportions. In 1849, the immigrant boat *John Drew* brought cholera to Chicago, where 678 people died of the disease that year.

By 1870 cholera was no longer a major threat in the United States due to improved sanitation and water treatment. However, the disease continued to be a significant concern in other parts of the world. In 1961 a pandemic (an epidemic that occurs over a large geographic area) that began in Indonesia spread to Bangladesh, India, Iran, and Iraq by 1965. In 1970 cholera appeared in West Africa, where it had not been seen in 100 years. It eventually became endemic to most of the continent.

and watery, often with flecks of mucus* in them (these are sometimes called “rice water” stools, because they look like rice floating in water).

Most cases of cholera are mild or moderate, and disease can be difficult to distinguish from other ones that cause diarrhea. More serious cases can cause severe diarrhea, vomiting, and dehydration. Signs of dehydration include decreased urination, extreme tiredness, rapid heartbeat, dry skin, dry mouth and nose, thirstiness, and sunken eyes.

Diagnosis Because the symptoms of cholera are often identical to those of other illnesses that cause diarrhea, knowing that a person has traveled to a country where cholera is endemic is important in helping a doctor make the diagnosis. Blood and stool samples can be taken to look for evidence of the bacteria.

Treatment Treatment of cholera can be simple and effective, especially if it is given soon after symptoms appear. Rehydration, or replenishing the body with fluids, is the most important part of treatment. People can rehydrate effectively by drinking a mixture of sugar, salts, and clean water, known as an oral rehydration solution. The World Health Organization has an oral rehydration solution that is distributed worldwide through the efforts of the United Nations. In the United States, solutions can be bought or mixed at home. Such solutions replenish the fluid and salts lost by the body due to diarrhea and vomiting.

More serious cases of cholera may require intravenous (in-tra-VEE-nus) fluids, or fluids injected directly into a vein. Antibiotics, which are given in severe cases, can shorten the time that the symptoms last and help prevent spread of the disease to others. But widespread use of antibiotics for large populations is discouraged.

* **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.



◀ Cholera bacteria live in water. At this crossroads near Capetown in South Africa, human waste contaminates the drinking water and the water used for cleaning and cooking food.
M. Courtney-Clarke/Photo Researchers, Inc.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

* **kidneys** are the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **vaccines** (vak-SEENS) are preparations of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

Complications from cholera are usually the result of severe dehydration. Seizures*, abnormal heart rhythms, shock*, damage to the kidneys*, coma*, and death can occur. Children, especially infants, are more likely to develop complications than adults because they are more prone to developing severe dehydration and body mineral imbalances.

How Can Cholera Be Prevented?

Steps people can take to prevent contracting cholera when traveling or after a natural disaster include the following:

- Drinking only bottled water, water that has been boiled or treated with chlorine or iodine, or bottled, carbonated beverages
- Eating only food that has been thoroughly cooked and is still hot
- Not eating raw fruit or vegetables unless they have been peeled
- Avoiding food and drinks sold by street vendors
- Avoiding raw or undercooked seafood
- Not bringing seafood from abroad back to the United States

Vaccines* for cholera exist, but their effectiveness is short lived, and none is provided or recommended in the United States.

▶ See also **Bacterial Infections • Intestinal Infections**

Resources

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Hempel, Sandra. *The Strange Case of the Broad Street Pump: John Snow and the Mystery of Cholera*. Berkeley: University of California Press, 2007.

Johnson, Stephen. *The Ghost Map: The Story of London's Most Terrifying Epidemic*. New York: Riverhead Books, 2006.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

Doctors without Borders. 333 Seventh Avenue, 2nd Floor, New York, NY, 10001. Telephone: 212-679-6800. Web site: <http://www.doctorswithoutborders.org>.

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905. Web site: <http://www.mayoclinic.com/health/cholera/DS00579>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/MEDLINEPLUS/ency/article/000303.htm>.

World Health Organization. Avenue Appia 20, 1211, Geneva 27, Switzerland. Telephone: 011-41-22-791-2111. Web site: <http://www.who.int>.

Cholesterol *See Hyperlipidemias.*

Chorea *See Huntington's Disease.*

* **psychological** (SI-ko-LOJ-i-kal) refers to mental processes, including thoughts, feelings, and emotions.

Chronic Fatigue Syndrome

Chronic fatigue syndrome (KRAH-nik fuh-TEEG SIN-drome), or CFS, is a condition that makes people feel exhausted and affects their participation in normal activities, such as work or school. The cause of the syndrome was not fully understood in the early 2000s, and researchers were investigating the possibility that an infection might trigger the condition in some cases.

Keith Jarrett's Story

In November 1996, the enormously popular American jazz pianist and composer Keith Jarrett found himself completely drained of energy in the middle of a concert tour in Italy. The only way he could get through his performances was to stay in bed most of the day and get up just for the concert at night. Too tired even to cross the street, Jarrett did not play in public again for two years. The illness was so severe that he said he felt as though aliens had entered his body. He was eventually diagnosed with chronic fatigue syndrome.

What Is Chronic Fatigue Syndrome?

Chronic fatigue syndrome is a condition that causes almost constant exhaustion. People with CFS typically cannot get more sleep to feel better, because their fatigue does not improve with rest. In addition, physical or mental work may make the fatigue worse. Doctors and scientists do not know what causes CFS. In the mid-20th century, people with CFS were often told their symptoms were psychological*.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **mononucleosis** (mah-no-nuklee-O-sis) is an infectious illness caused by a virus with symptoms that typically include fever, sore throat, swollen glands, and tiredness.

* **hepatitis** (heh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **hypoglycemia** (hi-po-gly-SEE-mee-uh) is a condition that occurs when the amount of glucose, or sugar, in the blood becomes too low. Symptoms can include dizziness, trembling, sweating, and confusion.

* **candidiasis** (kan-dih-DYE-uh-sis) is an overgrowth of *Candida*, a type of yeast, in or on the body.

* **Lyme disease** (LIME) is a bacterial infection that is spread to humans by the bite of an infected tick. It begins with a distinctive rash and/or flu-like symptoms and, in some cases, can progress to a more serious disease with complications affecting other body organs.

Then in the 1980s, healthcare professional began to recognize CFS as a medical condition associated with the physical symptoms of severe fatigue and weakness.

CFS affects all racial groups and occurs in teens and adults. According to the National Institutes of Health, females are at least two to four times more likely than males to develop CFS. Some studies have estimated that as many as one million people in the United States have the syndrome.

What Are the Symptoms of Chronic Fatigue Syndrome?

For a diagnosis of CFS, individuals must have a sudden onset of exhaustion that continues for six months or recurs during that length of time. For a doctor to diagnose CFS according to guidelines from the Centers for Disease Control and Prevention, individuals must also have experienced at least four of the following eight symptoms after the fatigue began:

- Malaise, such as intense exhaustion, that occurs after physical activity and lasts more than 24 hours
- Feeling of tiredness despite having slept
- Difficulty in concentrating or short-term memory problems
- Muscle pain
- Pain in more than one joint, but without accompanying redness or swelling
- Headache
- Tender lymph nodes*
- Sore throat

Just because individuals experience the symptoms of CFS does not necessarily mean they have this condition. Other medical problems may be the cause of the symptoms. For this reason, medical professionals order many tests in order to rule out other health conditions. If these tests are negative, the CFS is considered as the diagnosis.

What Causes Chronic Fatigue Syndrome?

Doctors do not know what causes CFS. Because many people first experience the symptoms of CFS after an illness caused by a virus (such as mononucleosis* or hepatitis*), some scientists think that a viral illness can trigger the condition. Some researchers have also suggested toxins (poisons), stress, and physical or emotional injury as possible causes of CFS. In addition, some researchers think that CFS stems from a problem in the immune system*, which helps the body fight disease. Because many people with CFS experience depression, other doctors believe that a psychological condition produces the physical symptoms of CFS. Previously CFS was blamed on many other conditions, such as allergies, hypoglycemia*, infection with Epstein-Barr virus (the virus that causes mononucleosis), candidiasis*, and Lyme disease*.

How Is Chronic Fatigue Syndrome Diagnosed and Treated?

CFS is diagnosed if a person has at least four of the specified symptoms, described above, and medical professionals have ruled out other causes, such as multiple sclerosis*, hypothyroidism*, or heart or kidney disease.

Individuals need to undergo blood tests and physical examinations to eliminate other possible causes of symptoms, because no specific laboratory tests can confirm the diagnosis of CFS. A diagnosis of CFS often is made when nothing else is found to account for the symptoms.

Because the cause of CFS was unknown as of 2009, treatment for CFS involved relieving the symptoms. Treatment or recommendations for handling symptoms include engaging in moderate exercise, such as yoga or tai chi; taking a prescribed antidepressant (medication to ease depression); and taking a nonsteroidal over-the-counter anti-inflammatory drug, such as ibuprofen. People with CFS should also watch their stress levels, because mental, physical, or emotional overexertion can aggravate CFS symptoms. Some patients with CFS may respond to drinking extra fluids and eating extra salt. Some people also find cognitive behavioral therapy* and rehabilitative therapy* helpful in decreasing or coping with their symptoms. For most patients, the symptoms of CFS are most severe in the beginning, and later they may come and go. Some people recover completely from CFS, although it is not clear why this happens. Most CFS patients recover gradually within five years after symptoms begin.

▶ See also **Lyme Disease • Mononucleosis, Infectious**

Resources

Books and Articles

Bested, Alison C., and Alan C. Logan, with Russell Howe. *Hope and Help for Chronic Fatigue Syndrome and Fibromyalgia*, 2nd ed. Nashville, TN: Cumberland House, 2008.

Campling, Frankie, and Michael Sharpe. *Chronic Fatigue Syndrome (CFS/ME)*, 2nd ed. New York: Oxford University Press, 2008.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/cfs>. Web site: <http://www.cdc.gov/cfs/pdf/HCPManaging.pdf>.

International Association for CFS/ME. 27 N. Wacker Drive, Suite 416, Chicago, IL, 60606. Telephone: 847-258-7248. Web site: <http://www.iacfsme.org>.

* **multiple sclerosis** (skluh-RO-sis), or MS, is an inflammatory disease of the nervous system that disrupts communication between the brain and other parts of the body. MS can result in paralysis, loss of vision, and other symptoms.

* **hypothyroidism** (hi-po-THY-royd-ih-zum) is an impairment of the functioning of the thyroid gland that causes too little thyroid hormone to be produced by the body. Symptoms of hypothyroidism can include tiredness, paleness, dry skin, and in children, delayed growth and mental and sexual development.

* **cognitive behavioral therapy** (KOG-nih-tiv be-HAY-vyuh-rul THAIR-uh-pee) is treatment that helps people identify negative ways of thinking and behaving and change them to more positive approaches.

* **rehabilitative therapy** helps people return to more normal physical, mental, or emotional function following an illness or injury. Rehabilitative therapy also helps people find ways to better cope with conditions that interfere with their lives.

- * **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.
- * **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.
- * **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. A virus can only reproduce within the cells it infects.
- * **muscular dystrophy** (DIS-tro-fee) is a group of inherited disorders that causes muscle weakening that worsens over time.
- * **cystic fibrosis** (SIS-tik fy-BRO-sis) is a disease that causes the body to produce thick mucus that clogs passages in many of the body's organs, including the lungs.
- * **multiple sclerosis** (skluh-RO-sis), or MS, is an inflammatory disease of the nervous system that disrupts communication between the brain and other parts of the body. MS can result in paralysis, loss of vision, and other symptoms.
- * **Parkinson disease** is a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.
- * **Alzheimer (ALTS-hy-mer) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-6612. Toll free: 866-284-4107. Web site: <http://www.niaid.nih.gov>.

Chronic Illness

A chronic illness is a mental or physical disorder that lasts for a long time, perhaps even a lifetime.

What Is Chronic Illness?

Chronic (KRAH-nik) illnesses are different from illnesses such as flu or chicken pox, in which a person becomes sick for a short time and then returns to health. These short-term illnesses are called acute (a-KYOOT) illnesses. Unlike people with acute illnesses, people with chronic illnesses usually do not return completely to normal health. The illness does not go away, even when the symptoms are controlled.

What Are Different Types of Chronic Illness?

There are many types of illnesses that are chronic, each with its own symptoms, causes, and course. Some chronic illnesses affect people of any age or ethnic background, whereas others are more likely to appear in a particular age or ethnic group. Some chronic illnesses are present at birth, whereas others develop later in life. Chronic illnesses are sometimes inherited. Diseases that are inherited develop because a person has certain genes*, the material in the body that helps determine physical and mental characteristics, such as hair and eye color. An example of an inherited chronic illness is sickle-cell anemia. This disease affects the blood's ability to carry oxygen through the body. Sickle-cell anemia is more likely to occur in people of African descent who carry the gene for the disease. Sometimes the symptoms of inherited chronic illnesses appear early in childhood. At other times, symptoms of an inherited chronic illness do not show up until much later in life.

Some chronic illnesses are caused by environmental factors such as exposure to pollutants. Coal miners may breathe so much coal dust in the air that they begin to show symptoms of a chronic lung disorder called black lung disease. Bacteria* or viruses* can cause chronic illnesses. For example, Lyme disease, a bacterial disease spread by the bite of ticks, causes an acute flu-like illness at first, but it also can cause longterm joint, heart, and nervous system problems that may not show up for months or years. Some chronic illnesses are progressive. Progressive illnesses such as muscular dystrophy*, cystic fibrosis*, multiple sclerosis*, Parkinson disease*, or Alzheimer (ALTS-hy-mer) disease* can get worse as time passes.

How Is Chronic Illness Treated?

When doctors diagnose a chronic illness, they also recommend treatments that can relieve symptoms or keep the body functioning at its healthiest. Sometimes treatments involve medications the doctor prescribe. Sometimes managing the illness also depends on behaviors the ill person can do to remain as healthy as possible, such as making changes in diet, quitting smoking, or exercising more. People with chronic illness seem to do best when they work as partners with their doctors to take an active role in caring for their health.

The symptoms of many chronic illnesses can be controlled with medication or changes in diet and activity. For example, people with diabetes (dy-a-BEE-teez) are unable to process sugars properly for use by the body. By taking insulin* or other medications and by eating properly, people with diabetes can lead very active, normal lives. Bobby Clarke, who played professional ice hockey for many years, is an example of a person with diabetes who has had a vigorous and demanding career, even though he has needed to take insulin every day.

Some people with chronic illnesses have symptoms that appear only under certain conditions. For example, some people with asthma (AZ-ma), a chronic illness that affects the lungs, may experience difficulty breathing only when they exercise, breathe in pollutants, or are under stress. Others with asthma may need to take medications or use inhalers daily to prevent wheezing. When the symptoms of a chronic illness are not present or are minimal, the illness is said to be in remission (ree-MI-shun). Having an illness that is in remission is not the same as being cured because the disease that causes the illness is still present.

Coping with Chronic Illness

Accepting that one must live with the limitations of a chronic illness can be difficult. How people react to the diagnosis of a chronic illness and how they cope depend partly on the nature of the illness and the age and resilience of the person. The changes they believe the illness will make in their lives and how the illness will change their family and social support also influence how people cope. Many people go through a process of grieving for the health and freedom of activity that they have lost. They may also feel anger, depression, and worry when they find out that they have a chronic disease.

Self-image and self-esteem* may suffer when a person must cope with a chronic illness, especially if that illness is painful or imposes limitations that interfere with social activities, school, or work. Chronic illness may be difficult for other family members, who frequently must take on additional responsibilities at home. Many chronic illnesses may get better or go into remission, only to reappear unexpectedly, sometimes with worse symptoms. Uncertainty about the course of the illness can be stressful. This uncertainty also may make planning for vacations or special activities difficult.

Support groups dedicated to specific illnesses are often effective in helping the person with a chronic illness and that person's caregivers make

* **insulin** is a kind of hormone, or chemical produced in the body, that is crucial in controlling the level of glucose (sugar) in the blood and in helping the body use glucose to produce energy. When the body cannot produce or use insulin properly, a person must take insulin or other medications.

* **self-esteem** is the value that people put on the mental image that they have of themselves.

emotional and physical adjustments to the disease. Counseling and therapy for both the chronically ill person and caregivers or family members may help people find ways of dealing with the stress of chronic illness. Many people with chronic illness, even children, cope well with their condition and find ways of adjusting to their disease and leading full and meaningful lives.

▶ See also **Depressive Disorders • Disability • Stress and Stress-Related Illness**

Resources

Books and Articles

Kaufman, Miriam. *Easy for You to Say: Q and As for Teens Living with Chronic Illness or Disability*. Buffalo, NY: Firefly Books, 2005.

Libal, Autumn. *Chained: Youth with Chronic Illness*. Broomall, PA: Mason Crest, 2004.

Lorig, Kate, et al. *Living a Healthy Life with Chronic Conditions: Self-management of Heart Disease, Arthritis, Diabetes, Asthma, Bronchitis, Emphysema & Others*, 3rd ed. Boulder, CO: Bull Publishing Company, 2006.

Organization

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/copingwithchronicillness.html>.

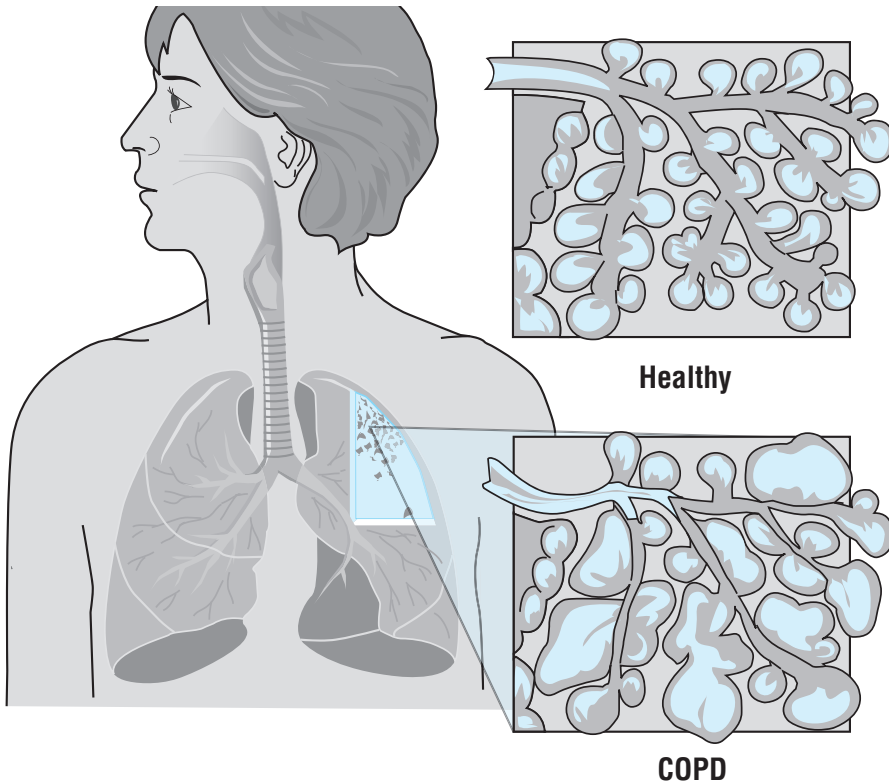
Chronic Obstructive Pulmonary Disease (COPD)

Chronic obstructive pulmonary disease, or COPD, known as the thief of breath, causes long-lasting obstruction of the respiratory airways, resulting in damaged lungs and making it hard to breathe. Emphysema and chronic bronchitis are forms of COPD.

Daughter Knows Best

Chrissy's father had been smoking cigarettes since he was a teen. In the past few years, though, her father had developed a nasty cough that never seemed to go away. Her father said it was just a "smoker's cough" and nothing to worry about, but Chrissy was concerned. Finally, she convinced her father to see a doctor. The doctor said that her father had an

COPD



The respiratory system with cross-sections of healthy alveoli and alveoli with Chronic Obstructive Pulmonary Disease (COPD). *Illustration by GGS Information Services, Inc. Reproduced by permission of Gale, a part of Cengage Learning.*



SOURCE: Diseases and Conditions Index (DCI), National Heart, Lung and Blood Institute, National Institutes of Health, U.S. Department of Health and Human Services

early stage of chronic obstructive pulmonary disease or COPD, an illness that affects a large number of smokers. The doctor pointed out that too many smokers do not take this condition seriously until the lungs have been badly damaged. At that point, smokers can develop life-threatening breathing problems or heart failure. Surprised by what he had learned, Chrissy’s father thanked his daughter for urging him to get help before it was too late. The next day, he joined a group for smokers who want to stop smoking.

How Does the Respiratory System Work?

Air reaches the lungs through a series of ever-smaller tubes that appear like an upside-down tree. As people breathe air in through their nose and mouth, it passes through the long pipe called the trachea (TRAY-kee-a), which passes from the throat down the neck. Then the trachea branches into two large tubes or bronchi (BRONK-eye), and then into even

Did You Know?

- Approximately 11.2 million adults have been diagnosed with COPD in the United States; an additional 14 million may have COPD but are not diagnosed.
- Since 1982, the number of people with COPD has increased 41.5 percent.
- An estimated 9.1 million people were diagnosed with chronic bronchitis in 2002.
- An estimated 3.1 million have emphysema.
- An estimated 8 to 17 percent of American men and 10 to 19 percent of women suffer from some type of chronic airway obstruction.
- Death rates for female patients with COPD have been consistently higher than death rates for males with COPD. In 2002, 61,422 women with COPD died compared to 59,133 men.

* **emphysema** (em-fuh-ZEE-mah) is a lung disease in which the tiny air sacs in the lungs become permanently damaged and are unable to maintain the normal exchange of oxygen and other respiratory gases with the blood, often causing breathing difficulty.

smaller bronchi called bronchioles (BRONK-kee-olz) that branch still further deep into the lungs. The bronchioles end in tiny air sacs called alveoli, which have very small blood vessels called capillaries that run in the walls.

The thousands of tiny alveoli provide a surface about the size of a football field for the exchange of oxygen and carbon dioxide. It is here that the body takes in oxygen to nourish the body cells and gives off carbon dioxide, which is exhaled. Normally, the airways and air sacs are elastic and spring back to their original shape after filling with air, acting like a new rubber band or balloon. This flexibility allows the oxygen and carbon dioxide exchange to take place efficiently. A slice of a normal lung looks like a pink sponge filled with tiny bubbles or holes.

What Happens in COPD?

In COPD causes less oxygen-laden air gets in and less air gets out for the following reasons:

- Airways and air sacs lose elasticity and become like old rubber bands or worn out balloons.
- Walls between many of the alveoli are destroyed.
- Walls of the airways become thick and inflamed or swollen.
- Cells in the airways may produce more mucus or sputum than usual and block airways.

In the emphysema* type of COPD, the bronchi and bronchioles are inflamed and continually swollen and clogged. This condition causes the alveoli to swell, burst, and merge. Instead of the healthy pink tissue with small holes, the lungs look like a dirty sponge with many large bubbles or holes in it. Deposits of tar from smoking make the tissue dark and spotted. Because there is less air surface, the damage to the alveoli makes it more difficult for the transfer of oxygen and carbon dioxide to take place and for the person to breathe.

There are three types of emphysema depending on the location of the inflammation. Panlobular or panacinar emphysema is characteristic of a weakening and inflammation of alveoli at the end of the bronchioles. When destruction is severe, the lungs appear like a spider web in x-rays. A mild version of this type of emphysema occurs in aging; in younger people it is caused by the body's ability to produce sufficient amounts of the protein Alpha-1 antitrypsin (ATT). The second type, centrilobular or centriacinar emphysema, affects single alveoli, destroying them and causing the airway walls to enlarge. This type is commonly associated with chronic bronchitis. A third type, distal acinar emphysema or paraseptic, is rare.

An acute type of bronchitis is one that anyone can get, usually from contact with viruses or bacteria. With rest and care, it disappears after a brief period of time. However, in chronic bronchitis the lining of the bronchial tubes become inflamed and swell up inside. This interferes

with the flow of air into and out of the lungs. The swollen and inflamed tissues also make large amounts of a thick, slippery substance called mucus*. People with bronchitis bring up mucus when they cough. Chronic bronchitis lasts for a long period of time, and it can come and go over several years.

What Are the Causes of COPD?

COPD, including emphysema, are very rare in young people, but the incidence* steadily increases as people grow older, particularly during or after middle age. The repeated breathing of cigarette smoke is the most common irritant that causes COPD; however, pipe, cigar, and other types of tobacco smoke can also cause COPD, especially if the smoke is inhaled. Secondhand smoke that is in the air from other people’s smoking cigarettes can also play a part in developing COPD, due to the cumulative effect on the lungs of breathing tobacco smoke. However, one person cannot catch COPD from another.

Emphysema is more common in men than in women, probably because more men smoke cigarettes than women. However, it is believed that this difference will become smaller because more teenage girls and young women are smoking cigarettes in the early 2000s than in years before. Heavier smoking among men over the last several decades of the 20th century is believed to account for the imbalance in numbers in the early 2000s. COPD occurs in 15 percent of cigarette smokers, and tobacco use accounts for a much as 90 percent of the risk for developing the disease.

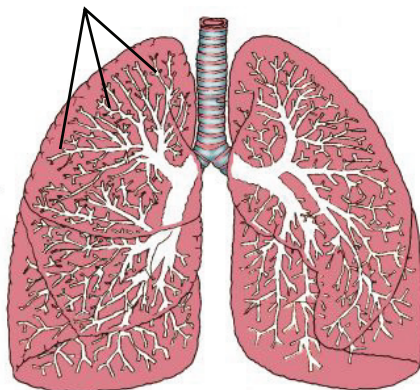
In some cases, a rare gene for a condition called Alpha-1 antitrypsin deficiency may play a role in COPD. In normal and healthy individuals, the protein Alpha 1 antitrypsin (ATT) protects the lungs from an enzyme that may attack lung tissue. Without ATT lung tissue may be destroyed. The gene carrying ATT is recessive, and the American Lung Association

* **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

* **incidence** means rate of occurrence.

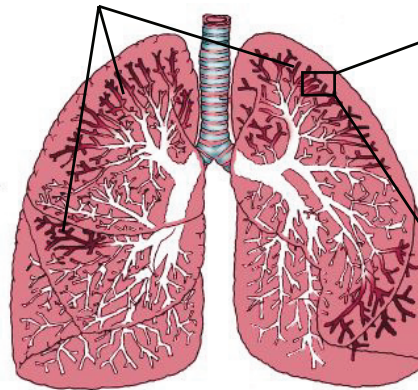
Healthy lungs (left). Lungs with emphysema showing damaged alveoli (center). Close-up of damaged alveoli (right). *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Normal alveoli and bronchioles

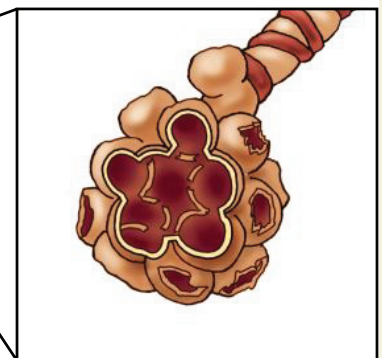


Healthy lungs

Damaged alveoli in selected areas



Lungs with emphysema



Damaged Alveoli

300 YEARS AGO: NO SMOKING PLEASE

Sir John Floyer (1649–1735), an English physician who had asthma, first described emphysema in the 17th century. Floyer was studying pulmonary (lung) disorders and described the characteristic prolonged expiration and progressive nature of emphysema.

Floyer warned his patients to avoid tobacco smoke, metallic fumes, and other potential irritants because he believed that they caused pulmonary disorders. He was right.

estimates that about 100,000 Americans in the early 2000s were born with the deficiency. If these people smoke, their risk of developing emphysema is increased. The onset of Alpha-1 related emphysema symptoms often appear between the ages of 32 and 41. It is estimated that 25 million Americans carry the gene, and most carriers are not aware of it.

The lungs and airways are very sensitive, and other irritants can inflame them and destroy the elasticity of the sensitive structures. Such activities as working around certain kinds of chemicals and breathing those fumes for many years, working in dusty areas over the years, and heavy exposure to air pollution can cause COPD. Environmental air pollution may also make a person more likely to develop chronic bronchitis and emphysema. With on-the-job exposure to mineral dusts, such as coal dust in a mine, emphysema may occur as part of a disease known as pneumoconiosis (noo-mo-ko-nee-O-sis).

Emphysema may also accompany diseases such as asthma and tuberculosis that can obstruct the airways in the lungs. A less serious form of emphysema sometimes develops in elderly people whose lungs have lost elasticity only as a part of the aging process. Another usually mild form, called compensatory emphysema, results when a lung overexpands to occupy the space of another lung that has collapsed or has been removed surgically. However, the effect of all these groups or conditions is small compared to cigarette smoking.

The great majority of emphysema cases are associated with cigarette smoking. It has been found that people who are heavy smokers of cigarettes are 10 to 15 times more likely to develop emphysema than are nonsmokers.

What Are the Signs and Symptoms of COPD?

COPD is usually not diagnosed until about the sixth decade (between the ages of 50 and 59) in a person's life. Most of these people have smoked at least 10 to 20 cigarettes per day for 20 or more years before experiencing any symptoms. The signs of COPD are as follows:

- Cough and chest illness are common. The cough is usually worse in the morning and produces a small amount of colorless sputum. The irritated bronchial tubes also are an ideal breeding ground for repeated infections.
- Shortness of breath is common but does not occur until about the sixth decade.
- A whistling or squeaky musical-like sound occurs when breathing, especially after exercise or exertion.
- As the condition worsens, shortness of breath occurs more frequently.
- Discoloration of the skin and failure of the right side of the heart may occur.
- Anorexia and weight loss often develop.

With any of the above symptoms, the person is encouraged to seek medical attention.

How Is COPD Diagnosed?

The healthcare provider asks about symptoms and whether the person has smoked, currently smokes, or is exposed to second-hand smoke or air pollutants. The physician first takes a medical history, physical exam, and listen to the lungs. A sample of sputum may be collected and sent to a laboratory for analysis.

Tests for the chest and breathing A chest x-ray or a high-resolution computerized tomography (CAT) scan may be taken. The CAT scan provides more detail than a chest x-ray and is useful especially in diagnosing emphysema.

Spirometry (speh-ROM-eh-tree) is an easy and painless breathing test to help determine the working of the lungs. This pulmonary function test detects and assesses the severity of the disease. In this test, the person breathes as hard as he or she can into a large hose connected to a machine called a spirometer. When the person breathes out, the machine measures how much air the lungs can hold and how fast he or she can blow air out of the lungs after taking a deep breath. Spirometry measures the amount of air that the person can exhale—the forced expiratory volume or FEV in one second (FEV1). The test, which shows the narrowing of airways, bases the normal value at 70 to 80 percent of the forced volume capacity (FVC). The device is quite sensitive and can detect COPD before serious symptoms appear. Based on the result of tests, doctors divide COPD into three categories according to severity:

1. Mild COPD or Stage 1 is FEV1 in which breathing is equal or more than 50 percent of the predicted normal value of 70 to 80 percent. The breathing test shows mild airflow limitation. Signs may include a chronic cough and sputum productions.

2. Moderate COPD or Stage 2 is FEV1 in which breathing is 35 to 49 percent of the predicted value. The breathing test shows a worsening airflow limitation. Usually the symptoms have increased, including shortness of breath that develops when the person is working hard, walking fast, or doing strenuous activities. The person begins to realize that he or she must seek medical attention.
3. Severe COPD or Stage 3 is FEV1 in which breathing is less than 35 percent of the predicted value. Breathing test shows severe airflow limitation. The person is exhausted after little activity. Other complications such as signs of heart or respiratory failure may develop. Now the person has a greatly impaired quality of life. The worsening symptoms become life threatening.

The test is also used to diagnose the severity of asthma and to assess the suitability of patients for treatment, such as oxygen therapy.

The doctor may recommend other tests to rule out conditions that may have similar signs and symptoms. The tests may include an arterial blood gas test that measures how well lungs are transferring oxygen into the blood and how efficient the lungs are removing carbon dioxide. Another test uses a pulse oximeter, which is attached to a finger, to measure the percentage of oxygen saturation in the blood.

How Is COPD Treated?

The goals of COPD treatment are to improve the quality of life of the person by preventing symptoms of the condition, to slow the progress of the disease, to prevent complications and sudden onset of problems, and to improve overall health. COPD treatment is different for each person, and the general practitioner may recommend a pulmonologist (pull-mon-OL-o-gist), a specialist who works with diseases and disorders of the respiratory system. Three types of treatment are self-help at home, medications, and surgery, and treatment may depend on whether the symptoms are mild, moderate, or severe.

Self-care At Home The most important step that a person with COPD can take is to stop smoking in order to possibly reduce the progress of the disease. A plan to stop smoking is essential, and help from outside sources may be necessary. However, most patients have trouble stopping their habit of smoking. The addictive power of nicotine, the conditioned response to smoking-associated stimuli, and psychological problems, which may include depression, the tobacco industry's forceful promotional campaigns, and poor education about the nature of nicotine make it difficult for individuals to stop smoking. A smoking cessation program may involve the following techniques and tools:

- Patient education, which involves revealing the harmful effects of smoking and what is happening in COPD.
- A designated date for quitting.

- Follow up support. This encouragement may be individual or in a group setting
- Relapse prevention. This support system tries to catch the signs and symptoms that indicate the person may relapse into smoking and act immediately.
- Advice for healthy lifestyle changes. Good nutrition and the value of exercise—although limited in advanced stages—are important for the person's well being.
- Social support systems. The encouragement of family and friends helps individuals stop smoking.
- Other adjuncts to treatment such as medication that replaces nicotine.

Several nicotine replacement therapies are available. Nicotine polacrilex is a chewing gum, which comes in two strengths and are designated for those who smoke less than one pack per day and those who smoke more than a pack per day. The person may chew hourly and as needed for any initial cravings within the first two weeks and then gradually reduce the amount of use over the next three months. Transdermal nicotine patches are available and generally well tolerated; these products are scheduled for decreased use over 6 to 10 weeks. The antidepressant bupropion is a non-nicotine aid for stopping smoking and may also be effective for those people who have not been able to stop with other nicotine replacement therapies. Some people have had success with hypnotherapy.

Withdrawal from nicotine may cause unpleasant side effects, such as anxiety, irritability, difficulty concentrating, anger, fatigue, drowsiness, depression, and sleep disruption. If the person requires the first cigarette within 30 minutes of waking up, he or she is highly addicted and likely would benefit from nicotine replacement therapy. A nicotine replacement program is an important part of smoking cessation but must be used only under the supervision of a physician.

Medications for COPD Several types of medication are used to treat COPD. Following are medications that may be recommended depending on the nature and progress of the disease:

- Inhaled steroids. Some people with mild to moderate COPD respond to inhaled steroids, also called glucocorticosteroids or corticosteroids. (Corticosteroids are different from the anabolic steroids that athletes may use for bodybuilding.) Inhaled corticosteroids act to reduce airway inflammation and have fewer side effects than oral steroids, although they might not be as effective even at high doses.
- Oral steroids. Oral steroids are sometimes used to improve symptoms and lung function when inhaled drugs do not work. They are not recommended for long-term use because of potential side effects.

* **aerosolize** (AIR-o-suh-lize) is to put something, such as a medication, in the form of small particles or droplets that can be sprayed or released into the air.

- **Bronchodilators.** Prescription bronchodilators work by relaxing muscles around the airways to make breathing easier. Most of these are inhaled and the medicine goes directly into the lungs where it is needed. There are many kinds of inhalers, and they can be either short or long acting. Short-acting bronchodilators last about 4 to 6 hours and are used only when needed. Long-acting dilators last about 12 hours and are used every day.

Several types of medication are bronchodilators. The first group, the Beta 2 agonists, is quickly taken into the lungs and is the first treatment of choice, especially for acute symptoms such as coughing or shortness of breath. Two long-lasting beta 2 agonists, formeterol and salmeterol, may be especially effective for people who have symptoms at night. A second group of bronchodilators, the anticholinergic agents, such as ipratropium bromide, are aerosolized* to deliver the medication in tiny droplets and open breathing passages with minimal side effects. A group of long-acting bronchodilators use methylxanthines, chemicals related to the caffeine family. Caution is recommended with this group due to unwanted side effects.

- **Antibiotics.** In people with COPD chronic infection is common. Use of antibiotics helps people who have shortness of breath and increased sputum production.
- **Oxygen therapy.** People with COPD have worsening levels of oxygen in their bloodstream, especially during periods of exercise. Home oxygen supplements are often recommended. A tube inserted in the nose delivers oxygen from small portable tanks. Because oxygen is flammable, people who have these devices must be cautious about fire and never smoke around the oxygen tank.

Surgery for COPD Surgical approaches are probably the last measure to consider in treating COPD. Three major surgical approaches emerged in the late 1990s: bullectomy, lung volume reduction surgery (LVRS), and lung transplantation:

- **Bullectomy.** Giant bullae are air-filled spaces that form when the walls of the air sacs break to join together to form a large space. Removing them surgically is called bullectomy, an approach that has been standard for many years. Bullae in patients can range in size from 1 to 4 centimeters in diameter and occupy more than 33 percent of a lobe of the lung on one side of the chest. The giant bullae can push against surrounding lung tissue, reducing blood flow and ventilation to healthy tissue. Surgical removal can reduce the pressure and improve lung function.
- **Lung volume reduction surgery (LVRS).** In this type of surgery first performed in the 1950s, surgeons remove 20 to 30 percent from the upper part of each lung, the area most damaged by cigarette smoking. Early successes led to rapid spread of the procedure. The basic assumption behind this type of surgery is that removal of part of the diseased lung increases the airway flow to the remaining

lung and reduces the symptoms. This procedure is mostly used on people with severe emphysema. The National Emphysema Treatment Trial (NETT) supported by the National Heart, Lung, and Blood Institute (NHLBI) and two other government agencies was the first multi-center clinical trial designed to determine the role, safety, and effectiveness of LVRS in the treatment of emphysema. The massive trial took five years to complete and results were presented in May 2003 at a meeting of the American Thoracic Society. The study revealed that patients who received LVRS, along with rehabilitation efforts and counseling, were more likely to function better than those who just received medical treatment.

- Lung transplant. This relatively new surgery may be suggested for those with advanced COPD and a life expectancy of only two years. This procedure involves taking a lung from a healthy donor to replace the diseased lung.

How Can COPD Be Prevented?

Because the damage that COPD, emphysema, and bronchitis do cannot be undone, it is especially important to prevent this disease from developing in the first place. Adopting healthy habits early in life—especially not smoking—is very important. Avoiding exposure to second-hand smoke and staying clear of wood and cooking smoke are also wise. Trying to limit air pollutants in the home is wise, too. It is very important to avoid respiratory infections during cold and flu seasons. Vaccines for flu and pneumonia are recommended for those who are prone to chest disorders and for those older than 65. People can take an active role in fighting for clean air laws to prevent air pollution.

The Global Initiative for Chronic Lung Disease (GOLD) works with healthcare professionals and public health officials around the world to raise awareness of COPD and to improve prevention and treatment of the disease. GOLD works to improve the lives of people with COPD around the world. Launched in 1997 in collaboration with the NHLBI, the National Institutes of Health, and the World Health Organization, the program recommends effective COPD strategies for use in all countries. A major initiative is sponsoring World COPD Day each year in November.

▶ See also **Asthma • Bronchiolitis and Infectious Bronchitis • Pneumoconiosis • Tobacco-Related Diseases • Tuberculosis**

Resources

Books and Articles

Felner, Kevin, and Meg Schneider. *COPD for Dummies*. Waterville, ME: Thorndike Press, 2008.

- * **chronic** (KRAH-nik) lasting a long time or recurring frequently.
- * **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.
- * **bile** is a greenish-brown fluid manufactured in the liver that is essential for digesting food. Bile is stored in the gallbladder, which contracts and discharges bile into the intestine to aid digestion of fats after a person eats.

Quinn, Campion E. *100 Questions & Answers about Chronic Obstructive Pulmonary Disease (COPD)*. Sudbury, MA: Jones and Bartlett, 2006.

Shimberg, Elaine Fantle. *Coping with Chronic Obstructive Pulmonary Disease*. New York: St. Martin's Griffin, 2003.

Organizations

American Lung Association. 1301 Pennsylvania Ave. NW, Suite 800, Washington, DC, 20004. Toll free: 800-LUNG-USA. Web site: <http://www.lungusa.org>.

COPD International. 131 DW Highway #627, Nashua, NH, 03060. Web site: <http://www.copd-international.com>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: http://www.nhlbi.nih.gov/health/dci/Diseases/Copd/Copd_WhatIs.html.

Cirrhosis of the Liver

Cirrhosis (sir-RO-sis) damages liver cells and replaces them with scar tissue that prevents the normal flow of blood through the liver and interferes with many of the liver's vital functions.

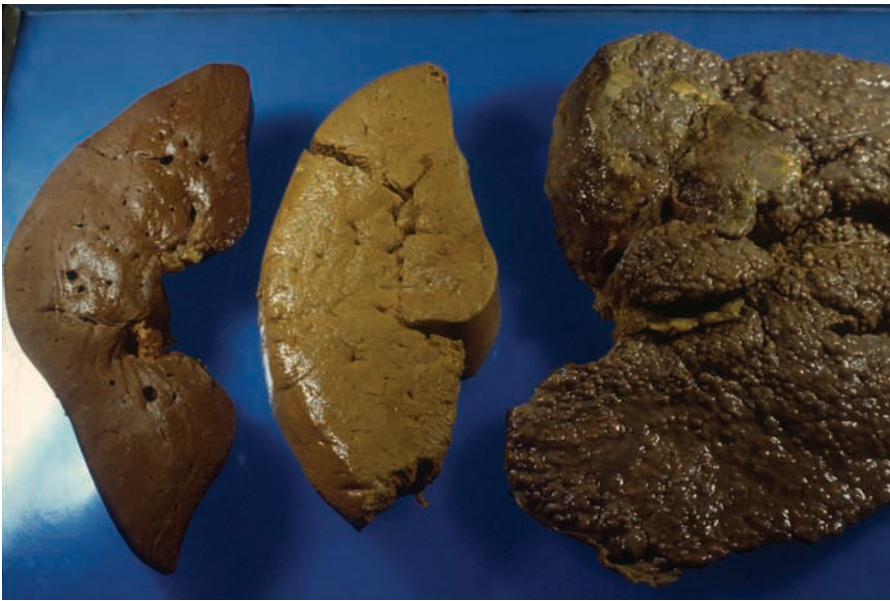
Who Gets Cirrhosis of the Liver?

Many people believe that only heavy drinkers can get cirrhosis of the liver. Although it is true that the number one cause of cirrhosis in the United States is drinking alcohol, a person need not be a heavy drinker to get the disease. The chance of developing cirrhosis depends on the amount and frequency that individuals drink, as well as their weight and height, and their body's ability to metabolize, or process, alcoholic products in the blood stream.

What Is Cirrhosis of the Liver?

Cirrhosis is a chronic* liver disease in which normal liver cells are damaged and replaced by scar tissue. The disease prevents the normal flow of blood through the liver and prevents the liver from functioning properly. It is most often (but not always) the result of severe liver damage or chronic liver disease. Although some liver tissue can regenerate or repair itself when injured, the extent to which damaged cells are able to regenerate varies with each person. If cirrhosis is not treated, it can eventually lead to liver failure, or death.

The liver is a large, complex organ, about the size of a football and weighing around three pounds. It is located beneath the ribs in the upper right side of the abdomen* and is connected to the small intestine by the bile duct, which transports bile* from the liver to the intestines. A healthy liver is soft and smooth.



A healthy adult liver (left) weighs about 3 pounds. A liver damaged by alcoholism shows a buildup of fatty tissue (middle). A liver with cirrhosis is enlarged and swollen (right). *A. Glauber/Photo Researchers, Inc.*



The liver is one of the most important organs, serving as the body's most comprehensive chemical factory and refinery. Almost all of the blood that leaves the stomach and intestines passes through the liver. The liver is responsible for cleansing the body of toxic or poisonous substances; processing nutrients, hormones, and medications; and for making proteins and clotting* factors that are crucial to healing. In a person with cirrhosis, toxic substances and bile remain in the bloodstream because the liver has not removed them.

What Causes Cirrhosis?

Cirrhosis is not contagious; it cannot be passed on from one person to another. Cirrhosis has many possible causes:

- Drinking alcohol, the most frequent cause. About one-third of all heavy drinkers eventually develop cirrhosis; the rest may suffer from other forms of liver disease, but not cirrhosis.
- Chronic viral hepatitis (inflammation of the liver). Hepatitis (usually types B, C, and D) is the second most common cause of cirrhosis.
- Wilson's disease, which causes a buildup of copper in the liver, brain, kidneys, and eyes.
- Cystic fibrosis, which causes a buildup of mucus in the lungs, liver, pancreas, and intestines.
- Hemochromatosis (he-mo-kro-ma-TO-sis), which causes a buildup of iron in the liver and other organs.
- Blockages or inflammation of the bile ducts, called biliary (BIL-ee-ar-ee) cirrhosis.
- Congestive heart failure.

* **clotting** is a process in which blood changes into a jellylike mass that stops the flow of blood.

Did You Know?

- Almost 800,000 people die from cirrhosis each year worldwide.
- Cirrhosis is the fourth disease-related cause of death in the United States for people aged 24 to 44.
- Alcohol-related cirrhosis of the liver more than doubled among 25 to 34-year-olds from 1997 to 2007.
- Experts estimate that more than half of all liver diseases could be prevented if people acted upon knowledge that is already available.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be woken up, and cannot move, see, speak, or hear.

- Glycogen storage disorders, which prevent the body from using sugars properly.
- Parasitic infections.
- Reactions to prescription drugs, environmental toxins, and inhalant abuse (sniffing toxic substances).

What Are the Signs and Symptoms of Cirrhosis?

In the early stages, cirrhosis is considered a “silent” disease because people show few symptoms. Over time, however, people with cirrhosis begin to experience fatigue, weakness, exhaustion, and loss of appetite. Weight loss and nausea are common. As cirrhosis worsens, the liver manufactures fewer of the proteins that the body needs and other symptoms develop:

- As less of the protein albumin (al-BYOO-min) is made, water accumulates in the person’s legs, a condition called edema, or abdomen, a condition called ascites (a-SITE-eez).
- A slowing down of the production of plasma proteins such as fibrinogen (fy-BRIN-o-jen), essential for blood to clot, makes it easier for a person with cirrhosis to bruise or to bleed.
- Jaundice, a yellowing of the whites of the eyes or skin, may occur in a person with cirrhosis. This is caused by the buildup of bilirubin (bil-e-ROO-bin) or bile pigment that is normally passed by the liver into the intestines.
- Some people with cirrhosis also experience intense itching due to the bile products deposited in the skin.
- Cirrhosis prevents the liver from cleansing toxins, poisons, or drugs from the bloodstream. As these build up, they can lead to changes in mental function and personality. Early signs of cirrhosis may include neglect of personal appearance, forgetfulness, trouble concentrating, or changes in sleeping patterns. Later signs may include loss of consciousness or coma*.
- Cirrhosis also can affect abdominal blood vessels. Normally, the huge portal vein transports blood from the intestines and spleen through the liver. Cirrhosis blocks the flow, causing a condition called portal hypertension. As the spleen swells, the body attempts to divert blood through other blood vessels. But these new vessels are often not strong enough for the job. If they break, people can vomit blood, a highly dangerous situation.

How Do Doctors Diagnose and Treat Cirrhosis?

Diagnosis Doctors always begin with a medical history and a physical exam. Evidence of an enlarged or swollen liver; evidence of edema or ascites; and signs of mental confusion caused by the buildup of toxic substances in the brain all can lead a doctor toward a diagnosis of cirrhosis.

The doctor also may order CT scans* or ultrasound* scans of the liver to see if it is scarred. A needle biopsy*, in which a needle is put through the skin to take a sample of tissue from the liver, can be useful in diagnosing cirrhosis. The liver also can be inspected through a laparoscope (LAP-a-ro-scope), a viewing device inserted through a tiny incision in the abdomen. The presence of telangiectasia (tel-an-je-ek-TAY-ze-a), which are tiny, expanded, “spidery” blood vessels in the skin, particularly in the face and upper chest, may indicate cirrhosis.

Treatment Treatment depends on the type and stage of the cirrhosis. The goal is to stop the progress of the disease while trying to reverse damage to the liver. If the cirrhosis is caused by alcohol, stopping drinking is the first step.

As of 2009, there is no one treatment to cure cirrhosis. Symptoms such as itching can be treated with medications. Diuretics (drugs that help remove excess salt and water from the body) also may be prescribed to treat edema or ascites. In severe cases of liver failure, when the liver cells have completely stopped working, a liver transplant may be the only solution.

How Is Cirrhosis Prevented?

Adults who eat a nutritious diet and limit their alcohol consumption can help prevent destruction of healthy liver cells. Other tips that can help prevent the disease include:

- Never mixing drugs, in particular alcohol and over-the-counter medications.
- Closely following label directions when using chemicals: ensuring good ventilation, never mixing chemicals, avoiding inhaling any chemical products, avoiding getting chemicals on the skin, promptly washing any accidentally exposed area, and wearing protective clothing.
- Avoiding any type of inhalant abuse.
- Avoiding intravenous drug use by which hepatitis B, C, and D may spread.

Living with Cirrhosis

People with cirrhosis can live for many years. Even when complications develop, they usually can be treated. Many people with cirrhosis have undergone successful liver transplantation and gone on to live healthy lives.

People recovering from cirrhosis are advised not to drink alcohol. Poor nutrition, particularly associated with alcohol or drug abuse, is believed to play a role in how cirrhosis develops, although physicians did not understand this completely as of 2009. In the meanwhile, eating a healthful, well-balanced diet is recommended.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **biopsy** (Bl-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

▶ See also **Alcoholism • Cystic Fibrosis • Gallstones • Heart Disease • Hepatitis • Jaundice • Parasitic Diseases: Overview • Schistosomiasis**

Resources

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Miskovitz, Paul, and Marian Betancourt. *The Doctor's Guide to Gastrointestinal Health: Preventing and Treating Acid Reflux, Ulcers, Irritable Bowel Syndrome, Diverticulitis, Celiac Disease, Colon Cancer, Pancreatitis, Cirrhosis, Hernias and more*. Hoboken, NJ: Wiley, 2005.

Organizations

American Gastroenterological Association. 4930 Del Ray Avenue, Bethesda, MD, 20814. Telephone: 301-654-2055. Web site: <http://www.gastro.org/wmspage.cfm?parm1=681>.

American Liver Foundation. 75 Maiden Lane, Suite 603, New York, NY, 10038. Telephone: 212-668-1000. Web site: <http://www.liverfoundation.org>.

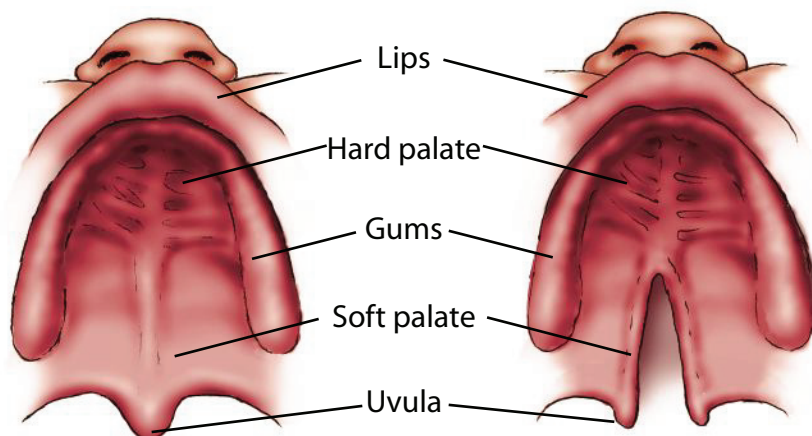
National Digestive Diseases Information Clearinghouse (NDDIC). 2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/cirrhosis/index.htm>.

Cleft Palate

A cleft palate is a gap or split in the roof of the mouth (the palate). It occurs when the palate of a fetus does not develop properly during the first months of pregnancy.

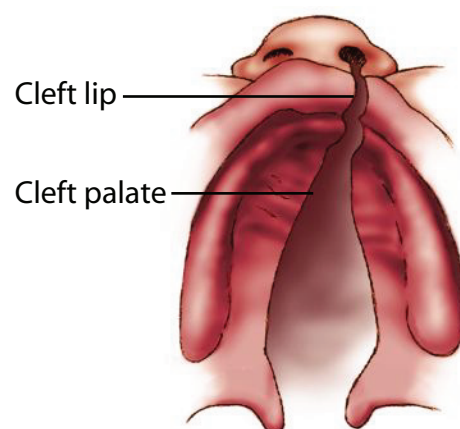
Mixed Feelings

Tonya and Phil were excited to hear their newborn son's first cry, but they were shocked when they saw him for the first time. Baby Philip's upper lip was split up the middle. The doctor told them that Philip had a cleft palate as well as a cleft lip and that both are fairly common birth defects. The doctor reassured Philip's parents that their son was otherwise a healthy baby: The cleft lip and palate would cause Philip some problems, but none that could not be overcome. A plastic surgeon would repair Philip's lip and palate, and a team of specialists would work on related problems with his teeth, ears, and speech.



Normal palate in infant

Partial cleft palate



Complete cleft palate and cleft lip

What Is a Cleft Palate?

Cleft means gap or split, and the palate is the roof of the mouth. A cleft palate occurs when the roof of the mouth in a fetus* does not develop properly, leaving a hole between the nose and the mouth.

The palate extends from the top teeth to the uvula (YOOV-u-la), which is the little piece of tissue that hangs in the back of the throat. A bony hard palate can be felt just behind the top teeth and a muscular soft palate is located just behind the hard palate. A fully formed palate is necessary to close off the nose and throat from the mouth. It keeps food from going up the nose, and it pushes food and saliva to the back of the throat when a person is eating and swallowing. The palate also is important for speaking because it keeps air from going out of the nose instead of the mouth.

The mouth and nose develop early during pregnancy, between the fifth and twelfth weeks of gestation. Three developing areas must fuse (close) together to form the face. The pieces that form the palate usually unite like a zipper. When the growth process is disturbed for some reason, the “zipper” does not close all the way, leaving a cleft. Formation of the palate and the upper lip are separate but linked processes, and many children born with a cleft palate also have a cleft lip. A cleft lip impairs sucking, speech, and appearance. The size and severity of a cleft depends on how much of the palate or lip has not fused together. Clefts can consist of one split down the middle (a unilateral cleft) or two splits (a bilateral cleft).

Why Are Babies Born with Cleft Palates and Cleft Lips?

Cleft palates and lips probably are the result of a number of factors acting together. One in five cases is inherited, probably through the interaction of many different genes*. In most cases, however, clefts seem to result from

▲ A cleft palate is a gap or split in the roof of the mouth (palate). The palate fuses closed as a normal part of fetal development (left). If the palate does not fuse correctly, it can result in a partial cleft palate (middle), or a complete cleft palate and cleft lip (right). *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

The United States and the World

- Worldwide clefts are one of the most common birth defects. Approximately one in 700 babies is born with a cleft palate and/or cleft lip.
- More than 5,500 babies are born in the United States each year with these problems.
- Among people with clefts, 50 percent have both a cleft palate and a cleft lip; 30 percent have only a cleft palate; and 20 percent have only a cleft lip.
- Boys are twice as likely as girls to have a cleft lip or a cleft lip and palate, whereas girls are twice as likely as boys to have just the cleft palate.
- People of Asian, European, and Native American ancestry are more prone to clefts than other ethnic groups.
- Clefts are least likely to occur in people of African ancestry.

Operation Smile

Cleft palate repair requires multiple surgeries, and many people do not have access to or money for the needed medical care. In 1982, plastic surgeon William P. Magee and his wife Kathleen, a nurse and social worker, founded Operation Smile to help make a difference.

Operation Smile and its volunteers provide free reconstructive (repair and rebuilding) surgery and other medical services for children in the United States and in 20 developing countries. Operation Smile volunteers have treated more than 100,000 children since 1982. Even so, many children go untreated, which can lead to medical complications later in life.

environmental factors to which the fetus is exposed early in gestation. The German measles (rubella) virus, other infections, vitamin deficiencies, some medications, and maternal alcohol and drug use during pregnancy all seem to increase the risk that a child will be born with a cleft lip or palate. Prevention efforts are focused on teaching people about these risk factors regarding pregnancy.

What Happens to Children with Cleft Palate and Cleft Lip?

Symptoms An improperly formed palate and/or upper lip affects a child's physical and emotional health in many different ways:

- A cleft lip is a highly visible disfigurement, and a cleft palate can cause abnormal growth of the face. Uncorrected, this abnormality can lead to serious self-esteem problems.
- When a person speaks, sounds result from air that is directed through the nose or the mouth. A complete upper lip also is required to make certain noises. A cleft palate allows air to escape from the nose all of the time, resulting in unusual sounds.
- A hole in the palate can allow food or liquid to come out of the nose. Usually, the normally formed palate acts as a barrier and prevents this problem.
- Because a cleft palate allows liquid to invade the sinuses (facial air cavities) and ear tubes, children with cleft palates are prone to ear and sinus infections.
- Many children with cleft palates and/or cleft lips have dental problems such as missing bone, missing or malformed teeth, and malocclusion (an incorrect bite, meaning top and bottom teeth do not fit together properly). Such problems interfere with chewing and cause facial disfigurement.
- Some children with clefts also have congenital heart problems, growth disorders, or learning problems.

Treatment Fixing Philip's cleft lip and palate requires several surgeries, the first two of which occurred during the baby's first year. In the first surgery when Philip is three months old, a plastic surgeon repairs the lip by stitching together its edges using flaps of skin from other parts of Philip's mouth. In the second surgery when Philip is six months to a year old, the surgeon repairs the cleft palate. If Philip is prone to ear infections, the doctor puts tubes in the baby's ears to help drain them of the fluid that otherwise may lead to infection. These repairs, which are done as early as possible, help prevent hearing and speech problems.

Philip also may require several cosmetic surgeries to adjust his facial features as he grows older. He may need dental work to encourage jawbone growth and to straighten his teeth. He will have his hearing checked frequently by a hearing specialist (an audiologist), and he will need to

work regularly with a speech therapist to learn how to train his palate muscles to work properly.

Philip and his parents will have a lot to deal with over several years, but his prognosis is good. The doctor expects that when Philip enters first grade, he will be speaking well, and he will have barely a scar where his cleft lip once was.

Not all children are as lucky as Philip, who had good medical coverage. Many other children in the United States and elsewhere in the world do not, which leaves a great number of children with no access to medical care. Without proper treatment, cleft palate and cleft lip can lead to myriad health, social, and emotional challenges, and these birth defects can also limit an individual's ability to become a productive member of society. Medical professionals and other advocates often point to this treatable condition as a strong argument for universal healthcare coverage.

▶ See also **Alcoholism • Birth Defects and Brain Development • Genetic Diseases • Growth and Growth Disorders • Infection • Pregnancy • Rubella (German Measles) • Substance Abuse**

Resources

Books and Articles

Berkowitz, Samuel. *The Cleft Palate Story: A Primer for Parents of Children with Cleft Lip and Palate*. Thorofare, NJ: Slack, 2006.

Gruman-Trinkner, Carrie, and Blaise Winter. *Your Cleft-Affected Child: The Complete Book of Information, Resources, and Hope*. Alameda, CA: Hunter House, 2001.

Organizations

American Speech-Language-Hearing Association. 2200 Research Boulevard, Rockville, MD, 20850-3289. Toll free: 800-638-8255. Web site: <http://www.asha.org>.

Cleft Palate Foundation. 1504 E. Franklin Street, Suite 102, Chapel Hill, NC, 27514-2820. Telephone: 919-933-9044. Web site: <http://www.cleftline.org>.

Operation Smile. 6435 Tidewater Dr., Norfolk, VA, 23509. Telephone: 757-321-7645. Web site: <http://www.operationssmile.org>.

Clotting See *Anemia, Bleeding, and Clotting*.

* **congenital** (kon-JEH-nih-tul)
means present at birth.

Clubfoot

Clubfoot congenital condition in which the foot is abnormally formed and twisted toward the toe. The type of treatment necessary depends on the specifics and the severity of the deformity.

What Is Clubfoot?

Clubfoot (also called Talipes Equinovarus) is a congenital* condition in which the foot is abnormally formed and rigidly twisted toward the toe. Clubfoot occurs when the bones, muscles, tendons, and blood vessels develop abnormally during the first 8 to 12 weeks of fetal development.

What Causes Clubfoot?

The tendency to develop a clubfoot is thought to be multifactorial, meaning that it occurs when there are multiple risk factors for the condition. For example, there may be genetic reasons (it may run in a family), and there may be environmental reasons (for example, an exposure in the uterus to a particular substance that predisposes to the condition).

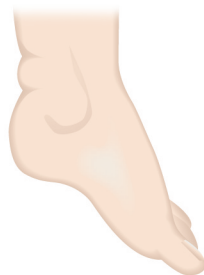
Clubfoot types



Talipes Varus



Talipes Valgus



Talipes Equinus



Talipes Calcaneus

Illustration by GGS Information Services.
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of Cengage Learning.

THE CLUBFOOT IN FICTION

Of *Human Bondage*, the 1915 novel by English author W. Somerset Maugham (1874–1965), has as its main character Philip Carey, who is born with a clubfoot. Like Philip, Maugham was orphaned in childhood and raised in the vicarage of his relative. During his early years the author developed a stutter (called a stammer in England). In writing this novel, Maugham drew on his own experience of disability and the social unease it caused, along with his grief over the loss of his parents. He created a sympathetic portrait of a child born with a clubfoot, one who is orphaned early and socially disadvantaged as he grows up. Maugham's novel is considered his masterpiece.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

Who Gets Clubfoot?

About one in 1,000 babies is born with clubfoot. A baby is more likely to be born with clubfoot if a parent and/or a sibling also has this defect. Boys are about two times more likely than girls to be born with this defect, and about half of all children with the condition are born with both feet affected.

What Are the Symptoms of Clubfoot?

The clubfoot has a characteristic appearance. The foot is often smaller than normal, and the front of the foot is twisted and drawn stiffly towards the big toe. The heel cord (Achilles tendon) may be abnormally short and tight, pulling the foot backwards towards the heel. Some people describe its appearance as “kidney-shaped.” The sole of the foot is also twisted into a more upward position than normal; if walking were to occur, weight would be born by the side of the foot, rather than the sole. Because this deformity occurs very early in fetal development (within the first trimester of pregnancy), at birth the foot is held very rigidly in this position.

Untreated, clubfoot can result in significant disability, since walking is difficult and abnormal. Without treatment, the child is forced to walk on the outside of the foot, rather than flat on the foot's sole. Other bony changes occur over time in the untreated clubfoot, which can be further disabling.

How Is Clubfoot Diagnosed?

The diagnosis of clubfoot at birth is quite simple given the characteristic appearance of the foot. Additionally, because clubfoot occurs so early in fetal development, clubfoot can sometimes be diagnosed during a routine 16-week prenatal ultrasound*.

How Is Clubfoot Treated?

Treatment usually begins almost immediately after birth. The type of treatment necessary depends on the specifics and the severity of the deformity. Most treatment entails a combination or series of casts, braces, special shoes, and therapeutic manipulation of the affected foot and leg. In some cases, surgery is necessary in order to release or reposition the overly tight tendons and/or ligaments that are keeping the joints in an abnormal position or to renovate or stabilize the bones and/or joints.

With treatment, children with clubfeet can go on to grow, develop, and function quite normally. Well-known athletes have gone on to do very well, despite having been born with clubfeet, including the Olympic gold medalist skater Kristi Yamaguchi, and the Olympic gold medalist soccer player Mia Hamm.

Can Clubfoot be Prevented?

Clubfoot cannot be prevented, but genetic counseling can help an affected individual understand the risk of passing the condition on to his or her offspring. Additionally, the general risk of birth defects is decreased in women who do not smoke, drink alcohol, use drugs or medications, or experience other potentially toxic exposures during pregnancy.

▶ See also **Birth Defects and Brain Development**

Resources

Books and Articles

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Jupiter, Jesse, Alan Levine, and Peter Trafton. *Skeletal Trauma: Basic Science, Management, and Reconstruction*, 3rd ed. Philadelphia, PA: Saunders, 2002.

Organizations

American Academy of Orthopedic Surgeons. 6300 North River Road, Rosemont, IL, 60018. Telephone: 847-823-7186. Web site: http://orthoinfo.aaos.org/topic.cfm?topic=A00255&return_link=0.

Massachusetts General Hospital Department of Orthopedic Surgeons. 55 Fruit Street, Boston, MA, 02114. Telephone: 617-726-2000. Web site: <http://www.massgeneral.org/ORTHO/ClubFoot.htm>.

CMV See *Cytomegalovirus (CMV) Infection*.

Coccidioidomycosis

Coccidioidomycosis (*kok-sih-dee-oyd-o-my-KO-sis*), also known as *Valley fever*, *San Joaquin valley fever*, or *San Joaquin fever*, is a disease that can occur after breathing in the spores* of a fungus found naturally in the soil of dry regions, such as the southwestern United States.

What Is Coccidioidomycosis?

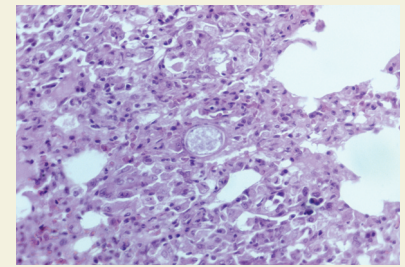
During World War II, American trainees sent to Arizona and parts of Southern California for flight training took thousands of days of sick leave due to coccidioidomycosis, a disease caused by *Coccidioides immitis* (*kok-sih-dee-OYD-eez IH-mih-tus*), a fungus that hibernates a few inches beneath semi-dry soil. The disease's other name, S.J. valley fever, comes from the San Joaquin Valley region of California, where the fungus was first identified.

After regular rainfall, the *coccidioides* fungus blooms into tiny mold spores. If the soil is stirred by events such as dust storms, earthquakes, farming, excavation, or construction work, these microscopic spores spring into the air, where they are easily breathed into the lungs of people and animals.

Coccidioidomycosis cannot be passed from person to person. People must inhale the spores of the fungus in order to contract the disease. Most people who inhale the spores develop only a mild case of disease, in which the infection results in symptoms similar to those of a cold or the flu that go away on their own. Many people are not even aware that they are infected when the symptoms are mild. People with weakened immune systems develop more serious cases. Moreover, North and Central American people with African, Filipino, or Siberian ancestry are especially susceptible. These populations get more severe forms of the disease, in which cases coccidioidomycosis can spread from the lungs to other parts of the body and even to the brain. Severe cases may result in meningitis*. *Coccidioides* infection that has spread throughout the body and occurs with arthritis* is sometimes called desert rheumatism (*ROO-muh-tih-zum*). In general, the more fungal spores inhaled by a person, the more serious the disease tends to be.

Is Coccidioidomycosis Common?

The fungus that causes coccidioidomycosis is found mainly in the desert climates of the southwestern United States, parts of Mexico, and Central and South America. The infection is considered endemic* in these regions. People who live in or visit “cocci country” and who often spend time outside for work or play are more likely to develop the disease, especially near areas of development and construction during the summer and fall.



Light micrograph of a section of human lung tissue infected with a spore (centre) of the soil fungus *Coccidioides immitis*, which causes coccidioidomycosis.

CNRI/Photo Researchers, Inc.

* **spores** are a temporarily inactive form of a germ enclosed in a protective shell.

* **meningitis** (*meh-nin-JY-tis*) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

* **arthritis** (*ar-THRY-tis*) refers to any of several disorders characterized by inflammation of the joints.

* **endemic** (*en-DEH-mik*) describes a disease or condition that is present in a population or geographic area at all times.

- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **culturing** (KUL-chur-ing) means being subjected to a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.
- * **sputum** (SPYOO-tum) is a substance that contains mucus and other matter coughed out from the lungs, bronchi, and trachea.
- * **biopsies** (BI-op-seez) are tests in which small samples of skin or other body tissue are removed and examined for signs of disease.
- * **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.
- * **antifungal drugs** (an-ty-FUNG-al drugs) are medications that kill fungi.
- * **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

Up to 50 percent of people living in such areas have antibodies* against *Coccidioides immitis* in their blood, which indicates that they have been exposed to the fungus, although many of them never developed signs of the disease. Furthermore, climate changes that bring winds can spread spores and thereby deliver the infection to new geographic areas.

Signs and symptoms About 60 percent of people infected by *Coccidioides immitis* develop no symptoms. When symptoms do occur, they are usually mild and include fever, aches, chills, headache, and tiredness. Those with weakened immune systems, such as people with AIDS*, certain types of cancer, and diabetes*, have a greater risk of developing a more severe form of the infection.

Diagnosis A doctor diagnoses coccidioidomycosis by culturing* a patient's sputum* or by doing a skin test. If injecting the test material into the skin of the forearm causes a large circular welt to appear on the arm within two days, it is considered a positive test for the fungus. Blood tests may show antibodies to the fungus, which helps confirm the diagnosis. Examination of lung or skin biopsies* may reveal the fungi. A chest x-ray is sometimes taken to look for signs of infection or inflammation in the lungs.

Treatment Most mild cases of the disease can be managed with bed rest, over-the-counter pain relievers such as acetaminophen*, and sometimes oral (by mouth) antifungal medication*. In more serious cases in which the fungus has spread throughout the body, intravenous (in-tra-VEE-nus, or given directly into a vein) anti-fungal medicines and hospitalization may be necessary. Mild cases of coccidioidomycosis last about two weeks, but recovery may take up to six months in more severe cases.

Complications Pneumonia*, arthritis, meningitis, and other serious problems can result if the infection spreads throughout the lungs or to other parts of the body, such as the liver, heart, brain, bones, or joints.

Can Coccidioidomycosis Be Prevented?

No specific activities can prevent a person from becoming infected with the *coccidioides* fungus, other than avoiding the regions where it is found. Planting grass and paving roads may reduce dust in problem areas but will not kill the fungus.

▶ See also **Fungal Infections • Meningitis • Pneumonia**

Resources

Books and Articles

Cohen, Jonathon, and William G. Powderly. *Infectious Diseases*, 2nd ed. St. Louis: Mosby, 2004.

Filip, David, and Sharon Filip. *Valley Fever Epidemic*. [United States]: Golden Phoenix, 2008.

Mandell, Gerald, John Bennett, and Raphael Dolin. *Principles and Practice of Infectious Diseases*, 6th ed. London: Churchill Livingstone, 2005.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Toll free: 888-346-3656. Web site: <http://www.nlm.nih.gov>.



▲ The white, speckled skin on these fingers indicates frostbite injury. *SIU/Photo Researchers, Inc.*

Cold-Related Injuries

Cold-related injuries, such as hypothermia and frostbite, occur when low temperatures damage the body. In cases of hypothermia, the body's internal temperature falls, causing blood flow and breathing to get dangerously slow. In cases of frostbite, outer parts of the body, such as fingers and toes, start to freeze. Other cold-related injuries include chilblains and trench foot.

Who Is at Risk for Cold-Related Injuries?

Anyone who spends time outdoors in cold weather can be at risk for cold-related injuries. That includes people who fish, hunt, or hike, especially in the mountains, where temperatures can drop quickly, and icy rain or snow can blow in with little warning. In snowstorms, people trapped in their cars can suffer permanent injury or even death if they cannot keep warm until help arrives.

In cities, homeless people who remain outdoors in the cold are at special risk. Likewise, poor people who cannot afford to heat their homes or whose landlords do not provide heat face dangers from the cold.

WEATHER AND WARFARE

Throughout history armies faced the perils of winter weather. George Washington lost many men to the cold during an encampment at Valley Forge (1777–1778). Napoleon, after first successfully invading Russia in 1812, was forced to retreat from Moscow when his army faced the severe Russian winter.

The Wind-Chill Factor

The wind-chill factor can increase heat loss from the body. If the skin is wet, there is an even greater transfer of heat to the surrounding air from the body. Those who are at risk from these circumstances are people who fish on ice, hunters, skiers, campers, and hikers in the mountains. Anyone exposed to wind and low temperatures can develop serious frostbite.

The actual temperature and the wind speed determine the wind-chill temperature. The lower the wind-chill temperature, the greater risk to human beings.

Examples of wind-chill temperatures using the formula actual temperature (in degrees Fahrenheit) plus wind speed (in miles per hour) equals the wind-chill temperature (in degrees Fahrenheit):

■ $35^{\circ}\text{F} + 10 \text{ mph} = 27^{\circ}\text{F}$

■ $15^{\circ}\text{F} + 20 \text{ mph} = -2^{\circ}\text{F}$

■ $0^{\circ}\text{F} + 30 \text{ mph} = -26^{\circ}\text{F}$

■ $-15^{\circ}\text{F} + 45 \text{ mph} = -51^{\circ}\text{F}$

* **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.

Indoors or outdoors, elderly people, the very young, and those who abuse alcohol or drugs also are at extra risk. Hypothermia, in which body temperature falls, is most common in cold, wet weather. In some cases, however, people who are elderly or who have diabetes, hypothyroidism, or other underlying diseases can become hypothermic while indoors even if the heating is adequate. In these cases, hypothermia may develop gradually over days. With elderly people, in particular, it can occur at temperatures as high as 65 degrees Fahrenheit (18 degrees Celsius). This situation develops because aging can reduce the body's ability to conserve heat and to maintain an internal (core) temperature of about 98.6 degrees (37 degrees Celsius). In addition, elderly people may not feel the cold as much, so they may not take steps to get warm.

In the United States, 600 to 700 people die each year from hypothermia, but doctors suspect that thousands of elderly people may be hospitalized each year for problems caused by undiagnosed hypothermia.

What Is Frostbite?

Frostbite is the freezing of any part of the body. Ice crystals form within or between the cells. Red blood cells and platelets* clump and restrict blood flow, especially to the ears, fingers, toes, and nose. These areas usually are the first to turn cold, white, hard, and numb. Frostbite can be deceptive; because it causes numbness, rather than pain, people may not know it is happening in time to prevent serious damage, which may lead to amputation of all or a portion of the affected body part.

How Is Frostbite Treated?

In dealing with frostbite, doctors usually recommend that the affected body parts be warmed rapidly in warm, but not hot, water. Doctors warn against rubbing the frostbitten parts by hand or with snow because this action can cause more tissue damage.

The affected part begins to become pink or red when it is thawing. If it remains white, the body part requires more time to thaw adequately.

After the rapid thawing, small blisters will appear. They will break in about a week, and a black scab will form after the blisters rupture. Normal tissue may have already formed below. Treatment at this point typically involves protecting the thawed part to avoid both refreezing and excessive heat. Usually, medical professionals advise that the area be cleaned with mild soap, but they do not suggest that either bandages or dressings be used.

Doctors recommend exercises to preserve joint motion in hands and feet. In some cases, a patient may require early surgical removal of the dead tissue to save the entire part from amputation. If necessary, medical professionals may also prescribe antibiotics.

What Is Hypothermia?

Hypothermia (hy-po-THER-mee-a) is the lowering of the body temperature below 95 degrees Fahrenheit (35 degrees Celsius). This condition usually results from prolonged exposure to cold when the body heat loss

is greater than heat production. In some people, including the elderly and those with certain underlying diseases, hypothermia can occur even indoors and at temperatures that would otherwise be sufficient. Hypothermia can be life-threatening. As in cases of frostbite, the sooner a person with hypothermia receives treatment, the better the chances for survival.

What Are the Symptoms of Hypothermia?

Some symptoms of hypothermia are slurred or incoherent speech, irritability, slowed rate of breathing, and a drop in awareness. Another common symptom is violent shivering, which is the body's response to cold as it attempts to warm itself. Without treatment, a person may become exhausted and stop shivering, which leads to an even more rapid decline in body temperature. Children and the elderly are particularly susceptible to hypothermia because their body temperature lowers especially quickly.

Irritable behavior may be a sign of hypothermia. Hypothermia symptoms may emerge as anger or inability to perform physical movements. Severe hypothermia may produce rigid muscles, dark and puffy skin, irregular heart and respiratory (breathing) rates, unconsciousness, and eventually death.

How Is Hypothermia Treated?

Treatment for hypothermia includes keeping the patient warm while seeking immediate medical attention. If the clothing is wet, it should be removed carefully. Although myths exist about the value of rubbing the skin, medical professionals do not advise this tactic. If the person is unconscious and not breathing, someone who has been trained in cardiopulmonary resuscitation (CPR) should use this revival technique.

What Are Trench Foot and Chilblains?

Trench foot is a painful disorder of the foot involving damage to the skin, nerves, and muscle that is caused by prolonged exposure to cold or dampness or by prolonged immersion in cold water. World War I soldiers fighting in the trenches developed this painful condition because they did not have access to clean, dry socks and boots.

Chilblain (CHILL-blain; often referred to in the plural, "chilblains") usually affects the fingers and is characterized by redness, swelling, and itchiness caused by exposure to damp cold. Tissue damage is less severe with chilblain than with frostbite, in which cases the skin is actually frozen. Chilblain does not cause permanent damage.

Can Frostbite and Hypothermia Be Prevented?

One of the best ways to prevent cold-related injuries is to dress properly in cold, damp weather. Doing so requires wearing several layers of dry, loose-fitting clothing that allow perspiration to evaporate, and keeping gloves and socks dry. People in the cold should also protect exposed flesh from the wind. Face masks, hoods, and ear muffs are helpful. Hats are

A COLD RIDE

A description of what it might feel like to freeze can be found in *These Happy Golden Years* by Laura Ingalls Wilder (1867–1957), a memoir about living in the Dakota Territory in the early 1880s. The author describes how Almanzo Wilder (1857–1949), the young man who would eventually become her husband, picked her up from the place where she taught school to drive her home for the weekend in his horse-drawn sleigh. Unfortunately, a storm was brewing. The wind blew hard, and the thermometer dropped to 40 degrees below zero Fahrenheit (–40 degrees Centigrade). As they rode along, the cold crept through the buffalo robe covering her, her woolen coat, dress, and stockings, and her flannel undergarments. Despite all she did, Laura could not stop shivering nor could she get warm.

Almanzo does not become worried about her until she starts to feel sleepy and a sense of euphoria engulfs her. Almanzo keeps talking to Laura to keep her awake, for they both feared that were she to fall asleep, she would freeze to death.

In reality, going to sleep in the cold does not cause a person to freeze to death, although moving the body, which is more likely to occur when a person is awake, helps generate body heat. The sleepiness is a symptom of severe hypothermia (low body temperature), and asleep or not, Laura and Almanzo were certainly in danger of freezing.

One reason that Laura Ingalls Wilder excelled at describing the cold realistically is that her stories are true: She was recording her own experiences. Another one of her books is called *The Long Cold Winter*.

important because up to 40 percent of the body's heat is lost through the head. In addition, consuming adequate amounts of food and fluid helps the body to generate heat.

Another important prevention rule is to listen to highway department advisories about driving during snowstorms, because getting caught in a stalled car in a snowstorm can easily lead to frostbite and hypothermia. Safety supplies to carry along on a car trip during severe cold weather include a small shovel and rock salt, a blanket, high-energy foods such as granola bars, and a coffee can with some candles and matches. A lighted candle propped inside a large can provides a good source of heat.

▶ See also **Gangrene • Heat-Related Injuries**

Resources

Books and Articles

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Wilkerson, James A. *Hypothermia, Frostbite, and Other Cold Injuries: Prevention, Recognition, Rescue, and Treatment*, 2nd ed. Seattle: Mountaineers Books, 2006.

Organizations

Cleveland Clinic. 9500 Euclid Avenue, Cleveland, OH, 44195.
Toll free: 800-223-2273. Web site: http://my.clevelandclinic.org/healthy_living/sports/cold-related_injuries.aspx.

Outdoor Action Program, Princeton University. 350 Alexander Street, Princeton, NJ, 08540. Telephone: 609-258-3552. Web site: <http://www.princeton.edu/~oa/safety/hypocold.shtml>.

Cold Sores See *Herpes Simplex Virus Infections*.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **colon** (KO-lin), also called the large intestine, is a muscular tube through which food passes as it is digested, just before it moves into the rectum and out of the body through the anus.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

Colitis

Colitis (ko-LY-tis) is inflammation of the internal wall of the colon*.*

What Is Colitis?

Colitis is one form of inflammatory bowel disease that can occur at one point in time (acute) or continue for some time (chronic). Depending on the type of colitis, symptoms can include diarrhea, cramps, pain, nausea, vomiting, and bleeding or a bloody stool. Some types primarily affect older adults; others affect all ages. Treatment varies with type; in some cases the cause is not clear.

Ischemic (is-KEE-mik) (meaning to hold back blood) colitis occurs when blood flow to the colon is limited, often by blood clots in the arteries (acute) or atherosclerosis (fat deposits) in the blood vessels (chronic). It is a common intestinal problem among those 50 or older, especially those at risk for heart disease. If left untreated, it can damage the colon and become life threatening. Pain is often centered on the left side of the abdomen*.

Another type of colitis strikes adults over 60 by inflaming the collagen (connective tissue) inside the colon wall. This condition may progress, giving rise to an abundance of white blood cells in the colon (lymphocytic colitis). Researchers believe these two conditions are phases of the same disease, both caused by an overreaction of the body's immune system. In both, the main symptom is watery diarrhea.

People who have been treated with antibiotics for other diseases may develop colitis caused by harmful bacteria in the intestines. Normally

* **Crohn's disease** an often inherited, chronic inflammatory disease that typically affects the small and/or large intestine but which can affect any part of the digestive system. The disease causes crater-like ulcers or sores in the inner surface of the bowel. Mild cases may be treated with medication; serious cases may be treated with surgery.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.

present, these “bad” bacteria are usually kept in check by “good” bacteria that have been, in this case, neutralized by the antibiotic. Common symptoms include watery and bloody diarrhea, a high fever, pain and cramps, and pus or mucus in the stool. It can appear a few days or several weeks after taking antibiotics. Older people are at higher risk for antibiotic-associated colitis, and those taking antibiotics prior to surgery.

Ulcerative colitis inflames long stretches of the inner lining of the intestines, often starting just above the rectum. It can be misdiagnosed as Crohn's disease*, which also causes ulcers (bleeding, open sores) but may appear anywhere in the digestive system, not just the colon. The cause of ulcerative colitis is not clear as of the early 2000s, but heredity (family history), the immune system, and unintended effects of antibiotics appear to play a role. Many researchers assert that stress can aggravate it, but does not cause it. Studies show that individuals are at greater risk for ulcerative colitis if they are white, live in industrial areas or northern climates, eat processed foods, and are young, in their late 20s or 30s. Ulcerative colitis can be acute or chronic. Some extreme cases increase the risk of colon cancer by one-third.

How Is Colitis Diagnosed?

Symptoms provide a general idea of what is wrong. However, because some colitis symptoms are similar to those of other conditions, physicians may test blood and stool samples or conduct a colonoscopy (viewing the colon through a flexible tube using a miniature camera that delivers images to a computer screen). During the colonoscopy a tissue sample may be removed for testing (biopsy*).

How Is Colitis Treated?

Mild cases of colitis may be treated by changing diet; eating frequent smaller meals; and avoiding caffeine, carbonated drinks, and spicy, high fat, or gassy foods. Often medications are used to slow intestinal contractions or stop diarrhea. Anti-inflammatory drugs (traditionally sulfa-based drugs or mesalamine, which has fewer side effects) are prescribed. Corticosteroids* may be an alternative to reduce swelling, but these also have side effects. In cases in which colitis originates with the immune system, immune-system suppressors are used. Infliximab has been used successfully for some hard-to-treat cases of ulcerative colitis. Antibiotic-activated colitis is treated with antibiotics (metronidazole) to fight the “bad” bacteria and allow the “good” bacteria to recover. In severe cases persons may be hospitalized and fed intravenously (through the veins) to give the colon a chance to rest and heal. In cases in which damage cannot be reversed (usually ischemic or ulcerative colitis), sections of or the entire colon may be surgically removed.

▶ See also **Colorectal Cancer • Crohn's Disease • Diarrhea • Diverticulitis/Diverticulosis • Gastroenteritis • Inflammatory Bowel Disease • Irritable Bowel Syndrome**

Resources

Books and Articles

Dahlman, David. *Why Doesn't My Doctor Know This? Conquering Irritable Bowel Syndrome, Inflammatory Bowel Disease, Crohn's Disease and Colitis*. Garden City, NY: Madeeasy Pub., 2008.

Organizations

Crohn's and Colitis Foundation of America. 386 Park Avenue South, 17th Floor, New York, NY, 10016-8804. Toll free: 800-932-2423. Web site: <http://www.ccfa.org>.

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://www.niddk.nih.gov/health/digest/pubs/colitis/colitis.htm>.

Reach Out for Youth with Ileitis and Colitis. 84 Northgate Circle, Melville, NY, 11747. Telephone: 631-293-3102. Web site: <http://www.reachoutforyouth.org>.

- * **antigen** (AN-tih-jen) is a substance that is recognized as a threat by the body's immune system, which triggers the formation of specific antibodies against the substance.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

Collagen Vascular Diseases

Collagen vascular diseases are a diverse group of diseases in which the body reacts against its own tissues, often causing joint pain and inflammation, fever, rash, fatigue, and difficulty swallowing.

What Are Collagen Vascular Diseases?

Collagen vascular diseases, sometimes called connective tissue diseases (CTDs) or autoimmune diseases, include a wide array of disorders in which the body's natural immune or self-protection system fails to recognize its own tissues and attacks itself. Some of these diseases limit their damage to a single organ, and others create problems throughout the body.

Immune responses to foreign bodies In a healthy immune system, antigens* (foreign bodies such as viruses and bacteria) are recognized as different from regular body tissues. When an antigen enters the bloodstream, it triggers the production of antibodies*, substances that attack the alien substance. Lymphocytes (LIM-fo-sites) and leukocytes (LOO-ko-sites) are the special white blood cells responsible for creating these antibodies.

Lymphocytes include two major subtypes (T cells and B cells), which have the unique ability to recognize the invading alien and alert the immune system to destroy it. The process is highly specialized: each

- * **inflammation** is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.
- * **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.
- * **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

lymphocyte recognizes a specific antigen and produces an antibody against only that particular antigen.

Autoimmune responses In collagen vascular diseases, this immune system malfunctions. Rather than responding to foreign antigens, the body produces antibodies (autoantibodies) against its own antigens and normal proteins. Researchers do not understand what gets this autoimmune process started, but they have a fairly good idea of how it proceeds once it begins. Rheumatoid arthritis and systemic lupus erythematosus (er-i-thee-ma-TO-sis) are two types of collagen vascular disease.

Rheumatoid arthritis Rheumatoid arthritis is a chronic inflammatory* disease that causes stiffness in the joints (places where bones meet) and can lead to disfigurement. It is an ancient disease; archeologists have found skeletons thousands of years old that have bone changes showing this condition.

In rheumatoid arthritis, the autoimmune process begins in connective tissue and the cushiony membranes that surround joints and the ends of bones. Collagen (KOL-a-jen) is the tough glue-like protein that gives joints their support and flexibility, and it represents 30 percent of the body's protein. Rheumatoid arthritis is thought to begin when T cells mistake the body's own collagen cells for foreign antigens and alert B cells to produce antibodies to fight the invader. The leukocytes rush in and produce cytokines (SY-to-kines), small proteins that are essential in healing the body but which can cause serious damage in large doses. The inflammation and joint damage that result can lead to joint deformities and can spread throughout the body to other sites of connective tissue.

Systemic lupus erythematosus Systemic lupus erythematosus (SLE) is one of the major types of the chronic (long-lasting) disease known as lupus. Lupus, which was first described in 1828, causes inflammation of connective tissue, the material that holds in place the various structures of the body. While the cause or causes of lupus are uncertain, the disease was believed as of 2009 to be an autoimmune disorder. SLE affects the skin but also involves other tissues and organs. Symptoms may include a butterfly-shaped rash over the bridge of the nose and cheeks, hair loss, skin lesions that may spread and cause damage to the mucous membranes and other tissues, arthritis, weakness, extreme fatigue, fever, sensitivity to sunlight, and loss of weight. Some patients have problems with kidney function and uremia (yoo-REE-me-a), or the buildup of toxic substances in the blood due to kidney failure. These problems can be fatal. SLE can affect the nervous system and cause psychological problems, seizures, or other symptoms. The lungs, heart, liver, and blood cells may also be involved. In the blood, certain antibodies can interfere with the normal function of the blood vessels and can bring on a stroke* or heart attack. In pregnant women, the presence of these antibodies can cause a miscarriage*.

Frequently, people who have SLE also have another collagen vascular disease: scleroderma. A chronic autoimmune disease, scleroderma causes skin to thicken and tough fibrous tissue to form in the internal organs of the digestive tract, kidneys, heart, and lungs.

Raynaud's Disease Often, people who have collagen vascular diseases are also diagnosed with Raynaud's disease, although not everyone who has Raynaud's disease has a collagen vascular disease. Raynaud's disease is a disorder in which the vessels that supply blood to the fingers and toes respond to cold or other stimuli by going into spasm (contracting), which reduces the supply of blood and causes the digits to turn white, feel numb, tingle, or burn. In rare, severe cases, the restriction of the arteries may cause the fingers to thicken, which can lead to ulcerations (loss of tissue) at the finger tips as well as changes in the fingernails. Sometimes, gangrene (tissue death) can occur.

Causes Some autoimmune diseases have strong genetic components and may be passed down from parents to children. Environmental factors may act to trigger these diseases in some way. Fatigue, stress, and higher levels of certain antibodies may also lead to these diseases. Some researchers have even suggested that ultraviolet* rays of sunlight may be a contributing cause. Collagen vascular diseases are not contagious; people cannot catch these diseases from one another.

What Happens When People Have Collagen Vascular Diseases?

Signs and symptoms Signs and symptoms differ depending on the illness, but they often include joint pain, fever, rash, recurrent infections, fatigue, mouth ulcers, dry mouth and dry eyes, hair loss, difficulty swallowing, swollen glands, or fingers and toes that get overly cold when exposed to cooler temperatures. In addition to systemic lupus erythematosus, rheumatoid arthritis, and scleroderma, collagen vascular diseases include:

- **Sjögren's syndrome:** This causes dry mouth, dry eyes, and other symptoms.
- **Polymyositis and dermatomyositis:** These are inflammatory muscle disorders that may also affect the skin, heart, and lungs.
- **Mixed connective tissue diseases:** These combine features of lupus, scleroderma, and polymyositis.
- **Polyarteritis nodosa:** This disorder can damage small and medium-sized arteries of almost any organ, including the kidneys, heart, and intestines.

Diagnosis A complete medical history and a physical examination are the basis for the diagnosis of autoimmune disease. Doctors may also order a number of laboratory tests to help diagnose collagen vascular diseases. Blood tests can check levels of autoantibodies. Other tests include

* **ultraviolet** light is a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

* **remission** is an easing of a disease or its symptoms for a prolonged period.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

rheumatoid factor tests, urinalysis, blood counts, liver and kidney tests, and a sedimentation rate, which gives a nonspecific indicator of inflammation. Doctors may also order a chest x-ray and other tests of specific lung function, since collagen vascular disorders not uncommonly produce breathing difficulties.

Treatment As of 2009, no cures existed for autoimmune diseases. Some, however, may go into remission* as symptoms disappear for periods of time. Treatment depends on the extent of the disease. Doctors may prescribe steroid creams or anti-inflammatory medications to ease discomfort. In advanced cases, immunosuppressant drugs may help lessen the immune system's overreaction. Available therapies include chemotherapy*, such as mycophenolate mofetil or other agents that affect the body's immune system.

Living with Collagen Vascular Diseases

These serious diseases often require adjustments in activities of daily living. People with rheumatoid arthritis often have early morning stiffness that lasts for about an hour, after which they can go on about their activities. Avoiding certain foods and reducing physical and emotional stresses also seem to reduce symptoms for some people.

▶ See also **Arthritis • Lupus • Raynaud's Disease • Scleroderma**

Resources

Organizations

American Autoimmune Related Diseases Association. 22100 Gratiot Avenue, Eastpointe, MI, 48021. Telephone: 586-776-3900. Web site: <http://www.aarda.org>.

Lupus Foundation of America. 2000 L Street NW, Suite 710, Washington, DC, 20036. Telephone: 202-349-1155. Web site: <http://www.lupus.org>.

Scleroderma Foundation. 300 Rosewood Drive, Suite 105, Danvers, MA, 01923. Toll free: 800-722-4673. Web site: <http://www.scleroderma.org>.

Sjögren's Syndrome Foundation. 6707 Democracy Boulevard, Suite 325, Bethesda, MD, 20817. Toll free: 800-475-6473. Web site: <http://sjogrens.com>.

Colon Cancer See *Colorectal Cancer*.

Color Blindness

Color blindness is a condition caused by a defect in the eye that makes an individual unable to identify various colors and shades.

What Is Color Blindness?

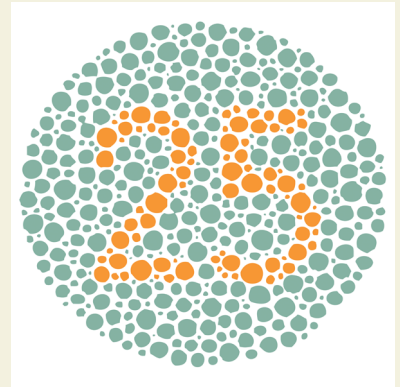
Red means stop. Green means go. It is one of the earliest lessons a child learns. For more than 10 million people in the United States, however, telling the difference between these two colors is not as simple as it sounds. These people usually are called color blind, although it is more accurate to say that they have poor color vision, since only a few people are unable to see any color at all.

How Does Color Blindness Happen?

Color blindness is almost always inherited from the mother's genes*. It affects boys most often, as girls usually have additional genetic material that overrides the vision problem. According to the Sight and Hearing Association, about one in seven males in the United States has some degree of color blindness, but fewer than one in 100 U.S. females have it. People with color blindness often have no other vision problems, but color blindness sometimes results from other eye diseases and vision problems.

Eight million colors As light passes through the eye, the image is focused on the retina. The retina contains layers of cells at the inside rear of the eyeball and acts a little like the photographic film in a camera. The retina contains millions of receptors called rods that help see light and cones that help see light and colors. Although humans typically have about seven million cones, the cones come in only three types, each of which is particularly sensitive to a different color range: blue, green, or red. These colors are also known as primary colors in the scientific community. When cones respond, they release light-sensitive chemicals that trigger electrical signals to travel along nerves, called optic tracts, and to the part of the brain known as the visual cortex (also sometimes called the striate cortex). Rather like an artist mixes different paint colors to create a vast array of hues, the visual cortex combines the information it receives from the cones and the rods to produce the large range of colors—about eight million of them—that humans can see.

Red and green People with poor color vision have cones that do not function properly, because they do not release some of the light-sensitive chemicals when light strikes them. As a result, these people see only certain colors and shades. The most common form of color blindness is a difficulty in seeing red and green correctly or the same way most people see them. Some people with this type of color vision deficiency can tell blue hues from yellow ones but cannot distinguish reds, greens, and yellows. Others



▲ Color blindness test. People with color blindness cannot distinguish the 25 in the green circle. *Image copyright Vilmos Varga, 2008. Used under license from Shutterstock.com.*

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

are able to tell red from green but only because green appears to be a little lighter rather than an entirely different color. Red-green color vision deficiency is more common among males because they only need to inherit the gene for the problem from one parent. Females, by contrast, only have the color deficiency if they get a defective gene from both parents.

Other types of color blindness Although they are much rarer than red-green color blindness, other forms of color blindness sometimes occur. One is called blue-yellow color blindness, which affects males and females equally. In this condition, a person cannot tell blues from yellows. Only a small number of people are unable to identify any colors at all. They see the world in shades of black, white, and grays—rather like a black-and-white photograph or movie. In addition, people with complete color blindness are usually very sensitive to bright light and have overall poor vision.

How Is Color Blindness Diagnosed and Treated?

The first signs of poor color vision often appear when a child enters school and begins to learn to identify colors. A simple vision test can determine if the problem is color blindness. This test involves showing a child an image made up of dots, for instance, a number made up of green dots on a background of yellow and orange dots. If the child cannot see the green number distinctly because it appears to blend in with the background, he or she may have color blindness.

Although no treatment or cure for color blindness exists, people often learn to cope with their color blindness in various ways; for example, they note that traffic lights usually have the red light on top and green on the bottom.

▶ See also **Blindness**

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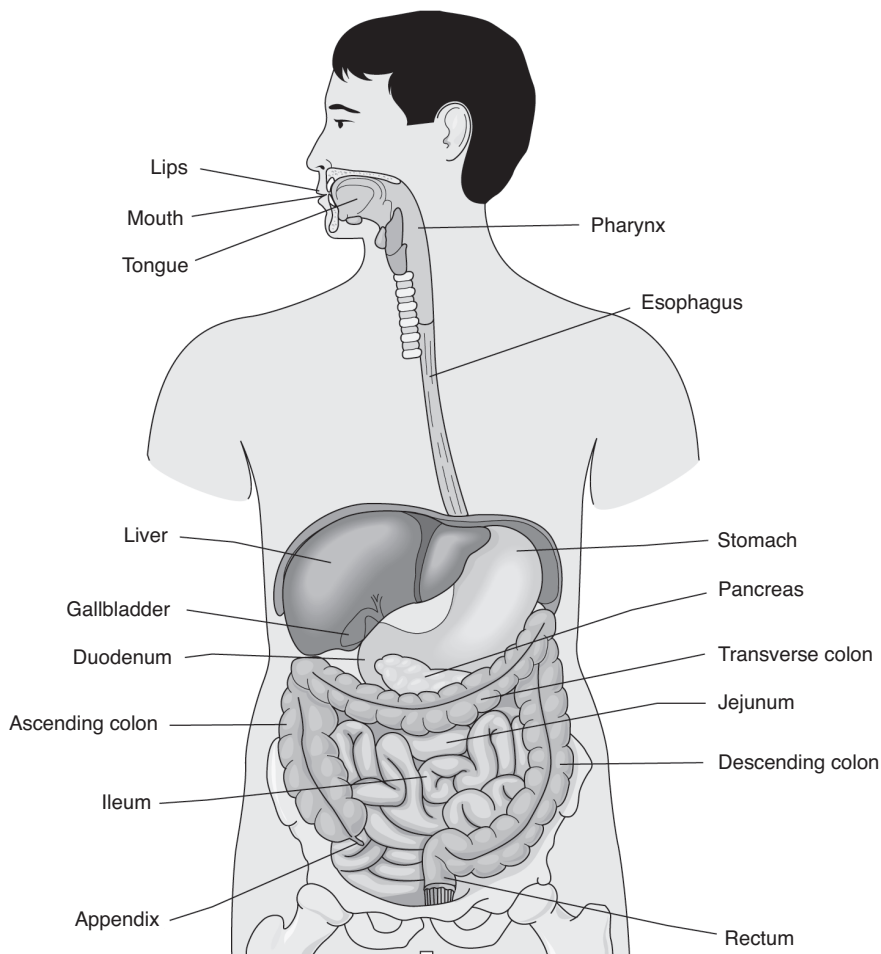
Sight and Hearing Association. 1246 University Ave. W., Suite 226, St. Paul, MN, 55104-4125. Toll free: 800-992-0424. Web site: http://www.sightandhearing.org/news/healthissue/archive/hi_0204.asp.

Colorectal Cancer

Colorectal cancer is caused by a growth that starts in the colon and/or rectum of the large intestine and may spread. The large intestine is part of the digestive tract.

A Painful Surprise

In October 1998, New York Yankees outfielder Darryl Strawberry had pain in his stomach and went to see his doctor. Surprisingly, the cause turned out to be colon cancer. Many people believe colon cancer affects only older people or only men, but anyone can get the disease. Colorectal cancer is the second leading cause of cancer death, with 55,000 Americans dying from this disease each year. When discovered early, colorectal cancer is frequently curable, and most deaths due to the disease could have been prevented by early screening and follow-up medical care. Colon cancer is not contagious.



Human digestive system. ©1999.
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Learning, a division of Cengage Learning.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

What Is Colorectal Cancer?

The colon and rectum Colorectal cancer begins in either the colon or the rectum. Both are part of the digestive tract, which consists of a series of tubes and organs that process food. Digestion begins in the stomach. From the stomach, partly digested food passes into the small intestine, the longest section of the digestive tract, which absorbs most of the nutrients. The food then continues into the large intestine (the colon), which is a muscular tube approximately five feet long. In the colon, the remaining water and nutrients are extracted from the food and the remaining matter is stored as waste. The waste moves from the colon into the rectum and then passes through the anus and out of the body during a bowel movement.

The American Cancer Society estimated that in 2008 there would be 108,070 new cases of colon cancer and 40,740 new cases of rectal cancer in the United States, and about 49,960 people would die from colorectal cancer. The number of people who die from colorectal cancer declined between 1993 and 2008.

Polyps and adenocarcinoma Colorectal cancer does not happen suddenly. It can take many years to develop, and it usually is preceded by changes in the lining of the colon or rectum that occur over several years. One of these changes is a growth of tissue into the center of the colon or rectum, called a polyp (POL-ip). Not all polyps develop into cancer; those that do are called neoplastic polyps, or neoplastic lesions. Removing a neoplastic polyp early prevents it from later becoming cancerous. Moreover, not all colon cancer begins with polyps. In the case of hereditary nonpolyposis colon cancer, polyps do not form.

Ninety-five percent of colorectal cancers are of the particular kind called adenocarcinoma (AD-e-no-kar-si-NO-ma). These cancers begin in the lining of the colon or rectum and can grow either into the center of the colon or rectum or outward through the wall. If the cancer is not treated, cancerous cells can break away into the circulatory system and travel to other parts of the body. When a cancer spreads in this way, it is said to have metastasized (me-TAS-ta-sized).

What Happens When People Have Colorectal Cancer?

Signs and symptoms Darryl Strawberry had gnawing pains in his abdomen*, and these pains caused him to go to the doctor. Another symptom is a change in bowel habits, for example, diarrhea or constipation that lasts for more than a few days. Or individuals might feel the need to have a bowel movement even after they have had one or they might notice bleeding from the rectum or blood in the stool. Some people, however, have no noticeable symptoms.

Diagnosis Just because people have symptoms does not mean that they have colorectal cancer. The only way for them to be sure is to have a medical examination. It also is possible for people to have colon or rectal cancer and not have any symptoms. Because older people are more likely to develop colorectal cancer, medical professionals recommend that all people aged 50 years and older have regular colon cancer screening tests.

The simplest test is a digital rectal exam. The doctor inserts a gloved finger into the rectum to feel for anything that is not normal. People often are uncomfortable at the thought of such a test, but it is very effective in detecting certain kinds of cancers. Other tests use special instruments to examine parts of the colon. If the doctor finds anything unusual, he or she may remove a small amount of tissue for examination under the microscope to see whether the tissue is cancerous or benign (harmless). This microscopic examination of tissue is called a biopsy.

How Is Colorectal Cancer Treated?

If cancer is found, the next step is to do tests to see whether it has spread. Doctors use a four-level system of numbers or letters to stage, or classify, the cancer. The lower the number or letter, the less the cancer has spread. A higher number, for example, stage IV, means a more serious stage of the disease.

The three main types of treatment for colorectal cancer are surgery, radiation therapy, and chemotherapy:

- **Surgery** is the main treatment for both colon and rectal cancer. In some more advanced instances of rectal cancer, a person may need to have a colostomy*. Colostomies usually are not needed in colorectal cancer.
- **Radiation therapy** uses high-energy radiation to kill cancer cells. It is used to destroy small areas of cancer that might not have been removed during surgery.
- **Chemotherapy** (kee-mo-THER-a-pee) refers to the use of anti-cancer drugs to kill cancer cells. The drugs may be given through a vein in the arm or as pills. Through either method, the drugs can enter the bloodstream and can reach any area of the body where metastasized cancer cells may have traveled.

Can Colorectal Cancer Be Prevented?

People can take steps to reduce their risk and in many cases to prevent colorectal cancer from developing.

Screening and other precautions Because finding colorectal cancer early often means it can be cured, people age 50 and older should follow the screening guidelines established by the American Cancer Society. Younger people whose close relatives (mother, father, sister, or brother) have had colorectal cancer or physical conditions that increase the risk for colorectal cancer should begin screening earlier than

* **colostomy** (ko-LOS-to-mee) is a surgical procedure in which a part of the large intestine is removed, and the end of the intestine is attached to an opening made in the abdomen. The stool is passed through this opening into a special bag.

age 50. Younger people who have had colorectal cancer already must be particularly careful to follow up with their doctors regularly to make sure the cancer does not return.

Two tests are used to detect polyps that have the potential to develop into colon cancer; the earlier these are detected and removed the more likely cancer can be prevented. In sigmoidoscopy (sig-moyd-OS-ko-pee), the doctor uses a slender, lighted tube linked to a video camera to examine the rectum and lower part of the colon, areas where most cancers and polyps are found. Another test is the colonoscopy (ko-lon-OS-ko-pee), in which a long, thin, flexible tube linked to a video camera allows the doctor to examine the entire length of the colon. If polyps are found, they can be removed using a wire loop. Because polyps take 6 to 10 years to develop into cancers, removing them early can prevent them from becoming cancerous. Colorectal cancer is highly curable if it is caught early.

Eating a healthy diet, getting plenty of exercise, and never smoking are other precautions people can take to decrease their risk.

What Is It Like to Live with Colorectal Cancer?

Caught in the early stages, colorectal cancer is one of the most curable cancers. People recover from surgery and resume their normal lives. Many people are embarrassed about having colorectal cancer, however, because it involves a part of the body they do not usually talk about. Moreover, people who have had permanent colostomies may feel different from everyone else and embarrassed by the colostomy bag. Everyone's reaction to cancer and to treatment is different. There is no single right way to handle it. Support groups can be particularly helpful for people who are living with this very curable form of cancer.



See also **Cancer: Overview • Inflammatory Bowel Disease • Polyps • Tumor**

Resources

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National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://cancernet.nci.nih.gov/cancertopics/types/colon-and-rectal>.

Coma See *Stupor and Coma*.

Common Cold

The common cold is a nickname for a group of commonly occurring viral infections of the upper respiratory tract.*

What Is the Common Cold?

More than 200 different viruses* can cause colds. Rhinoviruses are responsible for up to one-third of all upper respiratory (RES-puh-ruh-tor-e) infections. Other common viruses that lead to stuffy heads and runny noses include adenoviruses*, coronaviruses (ko-ro-nuh-VY-rus-sez), parainfluenza (pair-uh-in-floo-EN-zuh) viruses, respiratory syncytial (sin-SIH-she-ul) virus, coxsackieviruses (kok-SAH-kee-vy-ruh-sez), echoviruses* (EH-ko-vy-rus-sez), and influenza (in-floo-EN-zuh) viruses (although influenza may also trigger more serious complications). Children get colds most frequently, in part due to their close contact with so many other children in daycare or school. Younger children are more likely to cough without covering their mouths and not wash their hands.

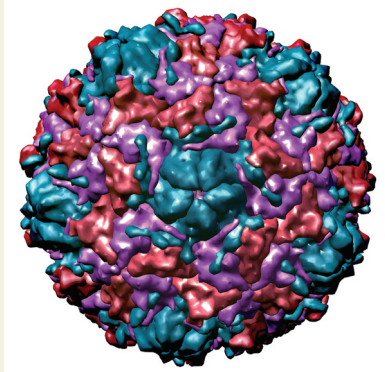
In North America, young children in daycare may catch several (sometimes as many as 10 or more) colds each year. People tend to get fewer colds as they grow older because they develop immunity* to some of these viruses after being infected with them. For this reason, healthy adults average two to four colds a year, and those over age 60 tend to get even fewer (as few as one cold per year, or less).

How Common Is the Common Cold?

As many as a billion colds occur each year in the United States. The National Center for Health Statistics, part of the Centers for Disease Control and Prevention, notes that on a yearly basis close to 22 million school days are lost due to illness from colds, and 45 million days are spent resting while recovering from colds.

Is the Common Cold Contagious?

Colds are very contagious. In general, they are most contagious during the first few days of illness, when symptoms such as congestion (stuffy nose) and sneezing are starting. Cold viruses often spread through direct



The three dimensional structure of rhinovirus—the common cold virus. Image copyright Roberto Sanchez, 2008. Used under license from Shutterstock.com.

- * **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.
- * **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. Viruses can only reproduce within the cells they infect.
- * **adenoviruses** (ah-deh-no-VY-ruh-sez) are a type of viruses that can produce a variety of symptoms, including upper respiratory disease, when they infect humans.
- * **echoviruses** a group of viruses found in the intestinal tract. The word echo in the name is acronym for enteric cytopathic human orphan viruses. When these viruses were named, they were not associated with any disease, hence the use of the word orphan. However, later these viruses were associated with various diseases, including meningitis and encephalitis.

Common Cold Myths

Colds are so common that everyone seems to have a theory on what brings them on and how to cure them. Below are two common cold myths (and some myth-busting explanations):

Myth: Running around in the cold and having a wet head or wet feet can bring on a cold.

Reality: These two beliefs probably stem from the accurate observation that more colds seem to occur in the cold, wet weather that often accompanies winter months in the United States. In fact, neither the cold nor wet brings on the illness. During colder weather people stay indoors and have increased close contact with each other, which makes them at higher risk for colds.

Myth: Taking large doses of vitamin C prevents colds.

Reality: Vitamin C may have other body-boosting benefits, but there is no scientific proof that it prevents the common cold. Although garlic (which may have antiviral properties) and chicken soup appear to have some beneficial effects, studies of other widely touted cold remedies such as echinacea (eh-kih-NAY-see-uh), a plant product, and zinc supplements have mostly yielded negative, inconsistent, or unconvincing results.

A sneeze in action. Virus-packed droplets are expelled from the respiratory system and can spread widely to contaminate surfaces. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

contact. Shaking the unwashed hand of someone with a cold (who has just touched his or her face) can easily spread the virus. When an infected person laughs, sneezes, or coughs, virus-packed droplets of moisture from the person's mouth and nose can become suspended in the air, where they can be inhaled by others. Sometimes these drops of respiratory secretions land on a surface such as a kitchen or bathroom counter, where they can infect the next person who touches the surface.

What Happens to Someone Who Has a Cold?

Signs and symptoms Cold symptoms usually appear within two to three days after the person becomes infected. They often include a runny or stuffy nose, watery eyes, coughing, mild muscle aches, tiredness, headache, low fever, and a scratchy sore throat. Sneezing and coughing up mucus* are also common.

Diagnosis Doctors diagnose colds based on a history of symptoms and findings from a physical examination. Cultures* and other tests for the viruses are available but are not done in most situations. However, the doctor will want to distinguish a cold, caused by a virus, from bacterial infections of the sinuses or throat, such as strep throat.

Treatment As of 2009, there was no known medical cure for the common cold. People who come down with colds can help themselves feel better by taking care of themselves at home until the infection goes away on its own. Bed rest helps tiredness, and inhaling mist in a steamy bathroom or running a humidifier in the bedroom to moisten dry air can relieve congestion and make it easier to breathe. Drinking plenty of clear or warm fluids may also reduce congestion, and tea with honey can soothe a scratchy throat. Over-the-counter medicines such as acetaminophen* can



ease headaches and body aches and lower fever. Over-the-counter cold medicines may also help relieve symptoms. Symptoms of a cold can last several weeks, but most people recover within a few days.

Because viruses cause colds, antibiotics are not useful in fighting these infections. Some antiviral drugs may be effective in fighting some cold-causing viruses (such as rhinoviruses). Research in the early 2000s on these medicines may change the treatment of colds in the future.

Complications Sometimes colds can cause swelling and irritation in the nasal passages, eustachian tubes*, and airways leading to the lungs. Bacteria that invade the body can flourish in these areas, causing additional infections. This is why it is not uncommon for someone to develop sinusitis*, an ear infection (otitis, o-TIE-tis), or bronchitis at the end of a bad cold. For those with weaker immune systems, such as the very young, the elderly, or those with chronic illnesses, these secondary infections can lead to severe bronchitis or pneumonia, which may sometimes be life threatening. Colds can also trigger flare-ups or worsening of respiratory symptoms in people who have asthma*.

Can Colds Be Prevented?

To lower the risk of catching (or spreading) a cold, people should wash their hands frequently and cover their mouth with a tissue when coughing or sneezing. Avoiding touching the eyes or nose as much as possible, regularly cleaning bathroom and kitchen surfaces to get rid of germs, and avoiding close, extended contact with anyone who has a cold are also helpful.

Researchers have explored the idea of a cold vaccine, but many different viruses can cause colds, making the development of a single, effective vaccine a great challenge.

▶ See also **Bronchiolitis and Infectious Bronchitis • Coxsackievirus and Other Enteroviruses • Croup • Influenza • Laryngitis • Otitis (Ear Infections) • Pneumonia • Sinusitis**

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Organization

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/commonCold>.

* **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.

* **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

* **cultures** (KUL-churz) are tests in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **eustachian tubes** (yoo-STAY-she-un) are the tiny channels that connect and allow air to flow between the middle ears and the throat.

* **sinusitis** (sy-nyoo-SY-tis) is an infection in the sinuses, which are hollow cavities in the facial bones near the nose.

* **asthma** (AZ-mah) is a condition in which the airways of the lungs repeatedly become narrowed and inflamed, causing breathing difficulty.

* **brain stem** is the part of the brain that connects to the spinal cord. The brain stem controls the basic functions of life, such as breathing and blood pressure.

Complications of Pregnancy *See Pregnancy.*

Concussion

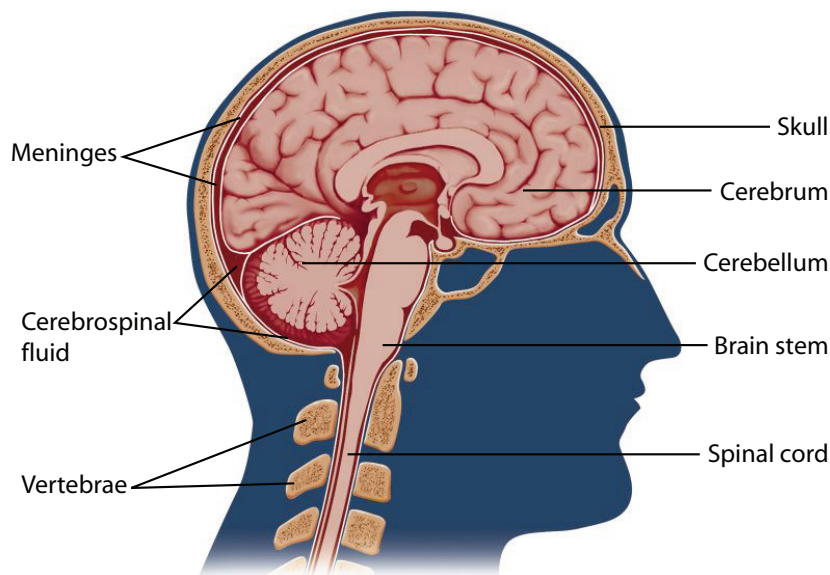
Concussion, or brain concussion, is an injury to the brain caused by a blow to the head or by violent jarring or shaking. It is a form of head trauma that often involves loss of consciousness, which may be momentary or may last for several hours. Brain concussion is a common injury that sometimes has serious consequences.

What's Happening on the Playing Field?

Most people who watch sporting events on television have seen team physicians run out to the playing field to examine athletes who receive blows to the head. The doctors often ask the injured players if they know where they are or what day of the week it is. That is one way that doctors find out whether people have concussion.

What Causes Concussion?

A blow to the head, an injury, a fall, or sudden severe shaking may cause the brain to hit the inside of the skull. If the impact affects the consciousness centers in the brain stem*, then the person with concussion loses consciousness. This effect may occur if, for example, one boxer's knockout



Concussions may result from sudden traumas, such as motor vehicle accidents or sports injuries, that cause the brain to hit the inside of the skull. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

punch makes the other boxer's head accelerate sharply, or if someone's head decelerates suddenly, as when it strikes the ground during a fall.

Participating in sports is a common cause of concussion, and engaging in sports with the most physical contact, such as football, boxing, and hockey, carries a high risk of head injuries that involve concussion. Concussions may also occur when people collide or fall while playing basketball, soccer, and baseball or while riding motorcycles or bicycles.

Motor vehicle accidents cause about half of all head injuries. A large percentage of these accidents involve drivers who have been drinking alcohol. Other causes include fights and industrial accidents.

What Happens to People with Concussion?

Concussion does not always cause complete loss of consciousness. People who get mild concussions may be temporarily stunned or dazed. They may feel dizzy, light-headed, or confused for a brief time. With loss of consciousness may also come nausea or vomiting, numbness, blurred vision or temporary blindness, or amnesia, which means loss of memory for events just before or just after the injury that caused the concussion.

The longer the period of unconsciousness, the more severe the symptoms may be, which is why a doctor should examine people with concussion as soon as possible. The symptoms of concussion usually do not last long, but in rare cases they may persist for several weeks or longer.

Do People with Concussion Need Medical Treatment?

Permanent brain damage does not normally result from a single mild concussion. A doctor must first, however, make sure that a more serious head injury, such as contusion (bruise) or laceration of the brain, has not occurred. The doctor usually gathers information about the injury that caused the concussion and notes the person's signs and symptoms.

Sometimes people worry that it is unsafe to fall asleep after a concussion, but doctors usually advise a period of bed rest, either at home or in a hospital, and not engaging in sports or riding a bicycle until recovery is complete. If headache is a symptom, the doctor may suggest pain medication. People with concussion should not drink alcohol or take sedatives*.

If unconsciousness, headache, or drowsiness returns several hours or days after the injury, the injured person should see the doctor again. The doctor may recommend hospital treatment or may diagnose postconcussion syndrome. People who have had a concussion are at higher risk of severe injury, or even sudden death, if they get a second concussion within a short time after the first injury. Under these circumstances, avoiding possible head trauma becomes vitally important.

What Is Postconcussion Syndrome?

Headache, dizziness, and other symptoms of concussion usually go away in a few minutes or days. Occasionally, however, they may persist much longer, even for years. The person may complain of a group of symptoms

* **sedatives** (SAID-uh-tivs) are drugs that produce a calming effect or sleepiness.

What Does “Punch Drunk” Mean?

Boxers are sometimes called “punch drunk” if they develop slurred speech and poor concentration after receiving repeated punches and blows to the head during their careers. Repeated concussions can cause an accumulation of injuries to the brain and may result in permanent damage.

* **syndrome** is a group or pattern of symptoms or signs that occur together.

that not only includes headache and dizziness, but also confusion, poor memory, anxiety, sleeplessness, irritability, lack of energy, and depression. A person with this group of lasting symptoms following a concussion is said to have postconcussion syndrome*. Although it is not overly common, some people who experience concussion can develop a subdural hematoma, which can be very dangerous. Caused by a torn blood vessel, a subdural hematoma is a blood clot or a collection of blood on the surface of the brain. When it occurs rapidly, usually from a very serious blow to the head, it is called an acute subdural hematoma and it can be deadly. Minor head injuries can also produce a so-called chronic subdural hematoma that seeps blood more slowly and over a several days to several weeks. These are more common in elderly people. Symptoms of subdural hematoma are like those for concussion, but also may include slurred speech or an inability to speak at all, or seizures.

Although postconcussion syndrome is not well understood, many medical researchers believe it may be the result of subtle changes in the brain that do not show up in medical tests. Because brain tests are normal, people sometimes believe that postconcussion syndrome is due to psychological factors or that people with postconcussion syndrome are faking their symptoms, especially if they are attempting to win damages in a lawsuit. This situation may be the case in some instances, but often postconcussion symptoms exist in the absence of a lawsuit or persist after a settlement has been reached.

How Do People Prevent Concussion?

Wearing a helmet Wearing a helmet is the best way to prevent a concussion in most situations in which it might occur. Boxers are at high risk for receiving this type of injury, and that is why they always wear protective headgear during training matches. The same is true for people playing football, hockey, and other sports in which frequent physical contact occurs or where falls are likely. Bicycle and motorcycle riders also need to wear helmets to protect against serious head injury in case of a fall or collision.

Seat belts, air bags, and designated drivers In automobile accidents, seat belts and air bags can prevent riders from banging their heads against the windshield or dashboard. In addition, many accidents are preventable if adults who drink alcohol designate (choose) a non-drinking friend to drive them home after they have been drinking; this person is called a “designated driver.”

▶ See also **Brain Injuries • Memory and Amnesia • Stupor and Coma • Trauma**

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Brain Injury Association. 1608 Spring Hill Road, Suite 110, Vienna, VA, 20036. Toll free: 800-444-6443. Web site: <http://www.biausa.org>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncipc/tbi/default.htm>.

* **antisocial behavior** is behavior that differs significantly from the norms of society and is considered harmful to society.

* **bullying** is when a person repeatedly intimidates or acts aggressively toward those with less power or ability to defend themselves.

* **truancy** is staying out of school without permission.

Conduct Disorder

When children or adolescents show an ongoing pattern of aggressive or destructive behavior that violates the rights of others and the basic rules of society, they may be diagnosed as having conduct disorder.

Joe's Story

Joe always seems to pick fights on the school bus. He intimidates and bullies others and has few friends. Serving detention does not seem to help Joe learn to behave. Last year he was caught writing graffiti on school property, and he was suspended once for throwing rocks at a school bus. Although he was never caught, Joe stole money from the teachers' lounge, and he was suspected of setting a fire in the school dumpster. This year, he often cuts school and hangs out behind the local convenience store smoking cigarettes that he steals from his father.

What Is Conduct Disorder?

While all children and adolescents sometimes misbehave, some individuals seem to do so all the time. Conduct disorder refers to serious and frequent antisocial behavior* in young people. Conduct disorder involves any of four types of behaviors:

- Aggression, such as cruelty toward people or animals, bullying*, threatening, physical fights, or using weapons to hurt others
- Destruction of property, such as writing graffiti, setting fires, or slashing automobile tires
- Lying (purposefully telling an untruth) and stealing, such as cheating, shoplifting, or burglary
- Violating major age-appropriate rules, such as staying out all night, running away, or school truancy*

Individuals with conduct disorder will have demonstrated three or more of these serious behaviors over the past year. In the United States,

* **delinquent** is a legal term that refers to a juvenile (someone under the age of 18) who has committed an illegal act. Delinquent behavior includes any behavior that would be considered a crime if committed by an adult as well as specific behaviors that are illegal for youth, such as school truancy, violating curfew, or running away.

* **empathy** the action of being aware or understanding the feelings of others without having those feelings explained.

* **bipolar disorder** a group of mood disorders that are characterized by alternating episodes of depression and mania.

* **post-traumatic stress disorder** (post-trau-MAT-ik STRES dis-OR-der) is a mental disorder that interferes with everyday living and occurs in people who survive a terrifying event, such as school violence, military combat, or a natural disaster.

LEARNING TO BE AGGRESSIVE: ALBERT BANDURA'S EXPERIMENTS

In the 1960s, social psychologist Albert Bandura (b. 1925) wanted to find out whether children would learn and perform aggressive behaviors simply by watching someone else behave in aggressive ways. Learning a certain behavior by watching someone else do it is called modeling, or observational learning. Bandura conducted a series of experiments that demonstrated that aggressive behavior is indeed learned simply by observation. Whether a child actually went on to behave aggressively depended on what happened to the person the child observed. If a child saw that the other person was scolded or punished for acting aggressively, the child was not likely to perform the aggressive behavior, even though he or she had learned how. Children who saw that the other person's aggressive behavior was met with no consequence were more likely to perform the aggressive behavior they had observed as well as other aggressive behaviors.

about 9 percent of young men and 2 percent of young women are diagnosed with conduct disorder.

Young people with conduct disorder may act alone or in groups. Many become involved in gang violence or other criminal or delinquent* behaviors. When caught violating rules of conduct, these young people often deny their guilt and may shift blame onto others, trying to make themselves look as if they are the victim of the unfairness of others. They often lack remorse for their actions and lack feeling or empathy* for people or animals they have hurt. Conduct disorder may be associated with other problems such as drug abuse, mood disorders (e.g., depression, bipolar disorder*), attention deficit, post-traumatic stress disorder*, risky sexual behavior, and learning disabilities.

For some, conduct disordered behavior begins early in childhood. The earlier and more frequently the antisocial behavior occurs, the more likely it is to develop into a serious and difficult to solve problem. Other children do not develop antisocial behaviors until adolescence. Although still serious, their behavioral problems are sometimes more temporary and more successfully treated.

Young people who have conduct disorder do not necessarily go on to have serious problems in adulthood, although for some adolescent conduct disorder develops into a lifelong pattern of aggressive, antisocial behavior. In adults, a pattern of aggressive and antisocial behavior that disregards the rights of others may be diagnosed as antisocial personality disorder. All adults who have antisocial personality disorder have had symptoms of conduct disorder in their youth.

How Does Conduct Disorder Develop?

Many different theories exist about what causes conduct disorder, but there appears to be no one single cause; a number of factors seem to contribute to its development. However, conduct disorder and related antisocial behaviors tend to run in families, which may be due in part to inherited genes* that affect behavioral development, but there also is strong evidence that antisocial behavior is learned and modeled in the family environment.

Genetics and behavior Many researchers have tried to determine how genetics and biology contribute to conduct disorder. Some studies found that youth with conduct disorder may crave an unusually high amount of stimulation. They also have trouble with self-awareness and goal setting, and lack skills for forethought and planning. Other studies found that youth with conduct disorder have problems with social learning, which includes the skills needed to learn social rules and to interact well with others. Young people with conduct disorder also appear to have less empathy than do others their age. Empathy is a type of emotional feeling for others; it involves the ability to see another person's point of view and to understand how someone else might feel in a given situation.

Children who have deficiencies in empathy, social learning, planning, and self-awareness may have a harder time developing behavioral controls, good problem-solving skills, and respect for others. Because they have fewer skills to solve problems in socially acceptable ways, they may be more likely to develop conduct problems. Children who have conditions that cause them to be impulsive* may have difficulty learning social rules and developing the behavior controls to follow these rules. However, to what extent these deficiencies are part of a person's genetic makeup or are tendencies that are learned by example and behavior in the family remains unclear.

Learned behavior There is evidence that aggression, a major trait in people with conduct disorder, can be a learned behavior. People who observe others behaving in aggressive ways (and this includes watching aggression and violence on television, movies, and video games) are more likely to demonstrate the aggressive behaviors they have witnessed. Children who witness aggressive behaviors at home, such as physical fighting, pushing, and shoving, and other forms of domestic violence are at increased risk for developing conduct disorder. Children with conduct disorder often live in families in which there is a high level of conflict that takes physical form.

Certain parenting practices increase the risk that a child will develop conduct disorder. For example, parents who do not provide adequate supervision, do not consistently enforce rules for behavior, and do not administer age-appropriate discipline contribute to conduct disorder. Parents who use overly harsh or abusive discipline may contribute to the development of conduct disorder.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **impulsive** means acting quickly before thinking about the effect of a certain action or behavior.

Peers can also influence a child's behavior. Many young people with conduct disorder are rejected by their peers, which may make their conduct problems worse, particularly when conduct disorder is associated with other mental health or learning problems. Social rejection may cause these children to associate with others like themselves who have social and behavioral conduct problems, a choice that tends to reinforce unacceptable behaviors.

How Is Conduct Disorder Treated?

The earlier treatment begins for a conduct problem, the more likely it is to be cured. However, many young people with conduct disorder do not receive treatment until they come to the attention of school authorities or the juvenile justice system. Individual or group treatment for young people with conduct disorder often involves helping them to learn social skills they may be lacking, especially empathy and problem-solving skills. Good behaviors are rewarded and antisocial behaviors are punished. Parent training is an important part of many treatment programs. Training helps parents replace harsh and coercive parenting behaviors or lax, inconsistent parenting with consistent rules, appropriate consequences, and positive attention to children's good behaviors. Studies have shown that these treatment methods can be effective in reducing conduct problems. Medication may also be helpful, especially if other mental health problems, such as depression, are present. Treatment works best when it begins soon after the child or adolescent has started to show antisocial behaviors, and it is more effective when the family also participates.

▶ See also **Antisocial Personality Disorder • Oppositional Defiant Disorder • Personality and Personality Disorders**

Resources

Books and Articles

Abraham, Kimberly, Marney Studaker-Cordner, with Kathryn O'Dea. *The Whipped Parent: Hope for Parents Raising an Out-of-Control Teen*. Highland City, FL: Rainbow Books, 2003.

McIntosh, Kenneth, and Phyllis Livingston. *Youth with Conduct Disorder: In Trouble with the World*. Philadelphia, PA: Mason Crest, 2008.

Organizations

American Academy of Child and Adolescent Psychiatry. 3615 Wisconsin Avenue NW, Washington, DC, 20016-3007. Telephone: 202-966-7300. Web site: http://www.aacap.org/cs/root/facts_for_families/conduct_disorder.

Mental Health America. 2000 North Beauregard Street, 6th Floor, Alexandria, VA, 22311. Toll free: 800-969-6642. Web site: <http://www.mentalhealthamerica.net>.

National Mental Health Information Center. P.O. Box 42557, Washington, DC, 20015. Toll free: 800-789-2647. Web site: <http://mentalhealth.samhsa.gov>.

Congenital Heart Disease See *Heart Disease, Congenital*.

Congenital Infections

Congenital infections are transmitted from mother to child, either before birth across the placenta* or perinatally—after the protective membranes rupture (waters break) or during labor and delivery when the infant is exposed to maternal blood. Perinatal* transmission is more likely to occur if the membranes rupture prematurely.*

What Are Congenital Infections?

The developing fetus* and newborn are protected from most infections by antibodies* in the mother's blood. Thus, most congenital infections result from either a serious untreated maternal infection or a common—usually mild—infection for which the mother lacks antibodies.

Congenital infections can be caused by viruses*, bacteria*, or parasites*. The mother may have few or no symptoms and be unaware that she is infected. However the consequences for the fetus or newborn may be disastrous: miscarriage*, preterm labor, fetal or neonatal* death, birth defects, or serious illness. Often an infection in early pregnancy is more damaging to the developing fetus.

Sexually transmitted infections (STIs) Worldwide, HIV* is the most dangerous congenital infection. An HIV-infected mother can transmit the virus to her baby through the placenta, during labor and delivery or through her breast milk. About 15 percent of HIV-infected newborns develop serious symptoms or die of AIDS* within the first year. Almost one-half of these children die by the age of 10.

Hepatitis* B and C viruses can be transmitted to the infant during birth. In rare cases, hepatitis B can also be transmitted through the placenta and may increase the risk of premature birth*.

Genital* herpes* is caused by Type 2 herpes simplex* virus (HSV-2) or, less frequently, by HSV-1 that usually causes cold sores. A first episode of genital herpes during pregnancy can be passed to the fetus because the mother does not yet have protective antibodies. It can cause preterm birth. If a mother has active genital herpes during childbirth, the infant may be born with facial or genital herpes, which in some cases has serious effects on the neonate.

* **congenital** (kon-JEH-nih-tul) means present at birth.

* **placenta** (pluh-SEN-ta) is an organ that provides nutrients and oxygen to a developing baby; it is located within the womb during pregnancy.

* **perinatal** (per-ee-NAY-tal) means existing or occurring around the time of birth, with reference to the fetus.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. A virus can only reproduce within the cells it infects.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **parasites** (PAIR-uh-sites) organisms such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

* **neonatal** (ne-o-NAY-tal) means pertaining to the first 4 weeks after birth.

- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **hepatitis** (heh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.
- * **premature birth** (pre-ma-CHUR) means born too early. In humans, it means being born after a pregnancy term lasting less than 37 weeks.
- * **genital** (JEH-nih-tul) refers to the external sexual organs.
- * **herpes** (HER-peeZ) is a viral infection that can produce painful, recurring skin blisters around the mouth or the genitals, and sometimes symptoms of infection elsewhere in the body.
- * **herpes simplex** (HER-peeZ SIM-plex) is a virus that can cause infections of the skin, mouth, genitals, and other parts of the body.
- * **chlamydial infection** (kla-MIH-dee-ul) can occur in various forms in which the bacteria can invade the urinary and genital systems of the body, as well as the eyes and lungs. One of its most common forms is a sexually transmitted disease (STD), usually passed from one person to another through unprotected sexual intercourse.

Chlamydial infection*, caused by the bacterium *Chlamydia trachomatis* (truh-KO-mah-tis), and gonorrhea*, caused by the bacterium *Neisseria gonorrhoeae* (nye-SEER-e-uh gah-no-REE-eye), can be transmitted to the infant during passage through the birth canal, causing conjunctivitis*. Chlamydial infection can also cause premature membrane* rupture and labor.

During pregnancy, if a woman is infected with syphilis*, which is caused by the bacterium *Treponema pallidum* (trep-o-NEE-mah PAL-id-um), or was inadequately treated for a previous infection, the bacteria can be transmitted either prenatally or perinatally. Unless the woman is treated with antibiotics*, almost half of all fetuses infected during gestation die before or shortly after birth.

Other common infections Cytomegalovirus* (CMV), a member of the herpesvirus family*, is the most common virus transmitted through the placenta to the fetus. CMV infection in early pregnancy can cause miscarriage and, in later pregnancy, preterm labor or stillbirth*. CMV can also be transmitted during birth or through breast milk; however, infection by these routes is less likely to cause severe problems.

If a woman contracts chicken pox—caused by the varicella zoster (var-uh-SEH-luh ZOS-ter) virus, another member of the herpesvirus family—during the first 20 weeks of pregnancy, there is a 2-percent risk that her newborn will have congenital varicella syndrome*, including multiple birth defects. However, the greatest risk is if the mother contracts the virus just before delivery, when she has not yet produced antibodies to protect the newborn. In this case the baby may develop severe or even fatal chicken pox.

If contracted early in pregnancy, rubella* virus infection—German measles*—can be passed to the fetus through the placenta. Rubella infection during the first 10 weeks of pregnancy may cause miscarriage, fetal death, or premature delivery*. More than 50 percent of infected newborns have severe birth defects.

Parvovirus B19 causes fifth disease in children, an acute disease that causes rash on cheeks and extremities with fever and malaise. About one-third of infants whose mothers contract fifth disease during pregnancy show signs of infection at birth. Although it is not usually dangerous, fifth disease contracted early in pregnancy can cause miscarriage or severe fetal anemia* that can lead to congestive heart failure* and fetal death.

Although invasive group B streptococcal (GBS) infection usually has no symptoms, in pregnant women it can cause uterine infections called amnionitis (am-nee-o-NYE-tiss) or stillbirth. GBS bacteria also can be passed from mother to child shortly before or during birth.

Toxoplasmosis* is caused by the one-celled parasite *Toxoplasma gondii*, which is commonly found in cats. Most cats that have toxoplasmosis are only infectious through their droppings for a several week period during initial infection. Most people infected with toxoplasmosis have no symptoms and most pregnant women have antibodies that protect the fetus. However, women who become infected for the first time shortly

before or during pregnancy can pass it to their fetuses, causing congenital toxoplasmosis. If maternal infection occurs during the third trimester*, the fetal infection rate is highest. However, the most severe fetal complications occur with first-trimester infections.

How Common Are Congenital Infections?

HIV About 20 to 25 percent of pregnant women with untreated HIV transmit the virus to their fetuses or newborns. However, in the United States, widespread HIV testing and antiretroviral (ARV) therapy (drugs used against any single-strand RNA viruses) have dramatically reduced the number of congenital HIV infections.

Worldwide, an estimated 420,000 children under age 15 became infected with HIV in 2007. Most were infected by their mothers before, during, or shortly after birth. An estimated 2.5 million children under age 15 were living with HIV in 2007, almost 90 percent of them in sub-Saharan Africa. About 330,000 children under age 15 died of AIDS in 2007. However, new HIV infections and AIDS deaths among children were declining. By 2007 nearly 35 percent of HIV-positive pregnant women worldwide were receiving ARV treatment.

Other common infections CMV affects about one out of every 150 newborns. Some 50 to 80 percent of women of childbearing age have antibodies that protect against CMV. However, 1 to 4 percent of American mothers have their first or primary CMV infection during pregnancy and about one-third of these infections are transmitted to fetuses. Each year about 8,000 American children develop permanent disabilities due to congenital CMV infection.

Because most adults have chicken pox as children or are vaccinated against the disease, it is estimated that an American woman's risk of contracting varicella during pregnancy is less than one in 1,000. Likewise, in the past rubella was a major cause of birth defects; however, routine vaccinations* have made prenatal* infection rare in the developed world.

About 50 percent of all women are infected with parvovirus as children or adolescents and have protective antibodies. Miscarriage due to parvovirus occurs in less than 5 percent of women who are infected during pregnancy.

GBS disease is the most frequent cause of life-threatening infection in newborns. Up to 20 percent of women carry GBS in their vaginas during the last trimester of pregnancy, with the potential of infecting the infant during birth. However, the use of antibiotics during delivery has decreased the rate of congenital GBS infections in the United States to 0.4 per 1,000 live births.

The CDC estimates that 25 to 45 percent of childbearing-age women carry the parasite that causes toxoplasmosis. In one-third of women infected for the first time during pregnancy, the parasite infects the

How Many Children Are at Risk for Congenital STIs?

The Centers for Disease Control and Prevention (CDC) estimates that each year among pregnant American women infections are communicated to fetuses and neonates in the following numbers:

- 6,400 infected with HIV
- 16,000 infected with hepatitis B
- 880,000 infected with HSV-2
- 100,000 infected with chlamydia
- 13,200 infected with gonorrhea
- Fewer than 1,000 infected with syphilis, although as of 2008, rising syphilis rates seen among infants born with congenital syphilis

* **gonorrhea** (gah-nuh-REE-uh) is a sexually transmitted disease (STD) spread through all forms of sexual intercourse. The bacteria can also be passed from an infected mother to her baby during childbirth. Gonorrhea can affect the genitals, urethra, rectum, eyes, throat, joints, and other tissues of the body.

* **conjunctivitis** (kon-jung-tih-VY-tis), often called pinkeye, is an inflammation of the thin membrane that lines the inside of the eyelids and covers the surface of the eyeball. Conjunctivitis can be caused by viruses, bacteria, allergies, chemical irritation, and other conditions or diseases that cause inflammation.

* **membrane** (MEM-brain) is a thin layer of tissue that covers a surface, lines a cavity, or divides a space or organ.

* **syphilis** (SIH-fih-lis) is a sexually transmitted disease that, if untreated, can lead to serious life-long problems throughout the body, including blindness and paralysis.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

* **cytomegalovirus** (sy-tuh-MEH-guh-lo-vy-rus), or CMV, infection is very common and usually causes no symptoms. It poses little risk for healthy people, but it can lead to serious illness in people with weak immune systems.

* **herpesvirus family** (her-pee-z-VY-rus) is a group of viruses that can stare themselves permanently in the body. The family includes varicella zoster virus, Epstein-Barr virus, and herpes simplex virus.

* **stillbirth** is the birth of a dead fetus.

* **syndrome** is a group or pattern of symptoms or signs that occur together.

* **rubella** (roo-BEH-luh) is a viral infection that usually causes a rash and mild fever.

* **measles** (ME-zuls) is a viral respiratory infection that is best known for the rash of large, flat, red blotches that appear on the arms, face, neck, and body.

* **premature delivery** is when a baby is born before it has reached full term.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

* **congestive heart failure** (kon-JES-tiv) or heart failure, is a condition in which a damaged or overworked heart cannot pump enough blood to meet the oxygen and nutrient needs of the body. People with heart failure may find it hard to exercise due to the insufficient blood flow, but many people live a long time with this condition.

How Do Women Get Transmissible Infections?

Women get transmissible infections in various ways.

- Women contract STIs primarily through sexual contact with infected men. HIV and hepatitis B and C can also be contracted through contact with infected blood, such as by sharing needles for injecting drugs.
- CMV is transmitted through infected blood, saliva, urine, or other body fluids.
- Varicella and rubella are commonly spread through coughs and sneezes.
- Parvovirus is spread by direct contact with infected nasal* secretions, such as by sharing eating utensils or cups.
- GBS bacteria live in the human intestine, rectum*, and vagina*, where they do not normally cause disease.
- The protozoan that causes toxoplasmosis produces eggs in cat intestines. The eggs are shed in cat feces* and can survive for up to 18 months in the soil. Human infection occurs from handling contaminated soil or cat litter or by ingesting raw or undercooked meat from infected animals.

placenta and enters the fetal circulation. Congenital infection occurs in one out of every 800 to 1,400 infants born to infected mothers.

What Are the Symptoms of Congenital Infections?

Viral STIs Many HIV-infected infants do not have symptoms at birth. However, the children, especially those infected before birth, generally develop symptoms of AIDS faster than adults. They may be sick from birth or fail to grow and develop at a normal rate.

Newborns with congenital hepatitis B may initially have no symptoms. However, without vaccination about 90 percent eventually develop symptoms of chronic* hepatitis.

Congenital HSV infection may be limited to the skin or involve various organs. Widespread infection can result in permanent brain damage, mental retardation*, or death. Initial symptoms of congenital herpes usually appear within four weeks of birth and may be mild:

- Skin blisters
- Fever

- Fatigue
- Loss of appetite

More serious symptoms of congenital HSV infection include the following:

- Chronic or recurring eye and skin infections
- Cataracts*
- Widespread infection affecting many organs, including the lungs and liver*
- A life-threatening brain infection called herpes encephalitis*.

Bacterial STIs Chlamydial infection can cause newborn pneumonia*. Conjunctivitis caused by chlamydia usually appears 5 to 12 days after birth, although it may take six weeks to develop. Conjunctivitis caused by gonorrhea usually appears two to seven days after birth. Newborns with gonorrhea can also develop an eye infection called gonococcal ophthalmia (gah-nuh-KOH-kul opf-THAL-me-uh). In rare cases, gonorrheal infection may cause meningitis* or blindness.

Congenital syphilis can cause premature birth and is a severe, disabling, and often life-threatening disease. If not treated early, it may cause facial deformity, blindness, deafness, neurological* conditions, and death.

A surviving newborn with untreated congenital syphilis may have no initial symptoms but may gain little weight and, during the first month of life, may develop the following:

- A rash or small blisters on the palms and soles of the feet
- Raised bumps around the nose, mouth, and diaper region
- Cracks around the mouth
- Nasal discharge
- Enlarged lymph nodes*, liver, and spleen*
- Bone inflammation*
- Meningitis

Other early-stage symptoms of congenital syphilis include the following:

- Failure to thrive*
- Fever
- Severe congenital pneumonia
- Rash and lesions* around the mouth, genitals, and anus*
- Bone lesions
- Nose cartilage infection or saddle nose (lacking a bridge)

Common viral infections* Most infants with congenital CMV have neither symptoms nor long-term problems. However, CMV infection in early pregnancy can cause birth defects and is a leading cause of congenital deafness. In later pregnancy CMV infection may cause serious newborn illness.

* **toxoplasmosis** (tox-o-plaz-MO-sis) is a parasitic infection that usually causes no symptoms in healthy people, but it can cause serious problems in unborn babies and people with weak immune systems.

* **trimester** (tri-MES-ter) is any of three periods of approximately 3 months each into which a human pregnancy is divided.

* **nasal** (NA-zal) of or relating to the nose.

* **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.

* **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

* **vaccinations** (vak-sih-NAY-shunz), also called immunizations, are the giving of doses of vaccines, which are preparations of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself.

* **prenatal** (pre-NAY-tal) means existing or occurring before birth, with reference to the fetus.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **mental retardation** is a condition in which people have below average intelligence that limits their ability to function normally.

* **cataracts** (KAH-tuh-rakts) are areas of cloudiness of the lens of the eye that can interfere with vision.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

* **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **failure to thrive** is a condition in which an infant fails to gain weight and grow at the expected rate.

* **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.

* **anus** (A-nus) is the opening at the end of the digestive system, through which waste leaves the body.

About 10 to 15 percent of infants with congenital CMV infection have symptoms at birth that may include the following:

- Low birth weight*
- Rashes
- Small bruises
- Hernias* in the groin
- Respiratory* problems
- Jaundice*
- Enlarged liver and spleen
- Retinitis*
- Microcephaly*
- Brain damage

Over the first few years of life, 0.5 to 15 percent of CMV-infected infants develop growth, development, hearing, vision, and/or neurological problems.

A fetus infected with varicella zoster early in gestation may develop pocks that can cause limb deformities. Congenital varicella syndrome is characterized by the following:

- Small limbs and head
- Scarring
- Eye damage
- Mental retardation

Rubella infections contracted later in pregnancy do not cause congenital defects, although the newborn may become seriously ill and eventually develop diabetes*. Rubella infections early in pregnancy can result in congenital rubella syndrome (CRS), which is associated various birth defects, including the following:

- Deafness
- Cataracts
- Bone marrow* abnormalities
- Heart defects
- Microcephaly
- Mental retardation

Newborns with CRS also may have the following:

- Low birth weight
- Bruising
- Bluish-red skin lesions
- Enlarged lymph nodes, liver, and spleen
- Brain inflammation
- Pneumonia

Although not usually dangerous, symptoms of congenital fifth disease include the following:

- A bright red rash on the cheeks
- Lacy red rashes on the neck, trunk, and legs
- Joint* pain
- Fatigue
- Malaise

GBS and toxoplasmosis Maternal infection with GBS at conception or within the first two weeks of pregnancy may lead to hearing and vision loss and mental retardation. GBS transmitted perinatally is the most common cause of sepsis* and meningitis in newborns and is a frequent cause of newborn pneumonia.

Although symptoms of congenital toxoplasmosis usually are very mild or absent, it can cause premature birth, low birth weight, or severe illness or death shortly after birth. Infection occurring early in fetal development can cause learning and motor* disabilities and other neurological symptoms. Other problems that may be present at birth or may not be apparent for months or years include the following:

- Slow growth
- Fever
- Skin rashes
- Easy bruising
- Anemia
- Microcephaly or macrocephaly*
- Hydrocephaly*
- Inflammation of the brain, heart, or lungs
- Seizures*
- Severe or prolonged jaundice
- Enlarged liver and spleen
- An eye inflammation called chorioretinitis, which can lead to blindness
- Hearing loss
- Mental retardation

How Are Congenital Infections Diagnosed and Treated?

Diagnosis of maternal, fetal, and congenital infections can be difficult. An obstetrician may diagnose a maternal infection based on a woman's symptoms and blood tests. Sometimes a fetal infection can be diagnosed using ultrasound*. In newborns congenital infections may be diagnosed based on a physical exam, symptoms, and blood or urine tests. Ultrasound may

* **viral infections** cause mouth sores that are called fever blisters or cold sores. These are often caused by the herpesvirus, and they usually appear on the gums or around the mouth and lips. Unlike canker sores, fever blisters and cold sores are contagious.

* **low birth weight** means born weighing less than normal. In humans, it refers to a full-term (pregnancy lasting 37 weeks or longer) baby weighing less than 5 pounds.

* **hernias** (HER-nee-ah) are protrusions of organs through connective tissue or cavity walls.

* **respiratory** (RES-pi-ra-tor-ee) refers to the breathing passages and lungs.

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

* **retinitis** (reh-tin-EYE-tis) is an inflammation of the retina, the nerve-rich membrane at the back of the eye on which visual images form.

* **microcephaly** (my-kro-SEH-fah-lee) is the condition of having an abnormally small head, which typically results from having an underdeveloped or malformed brain.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

How Can STIs Be Prevented?

To reduce the risk of contracting an STI, pregnant women should do the following:

- Abstain from sexual contact outside a mutually monogamous relationship
- Use latex condoms correctly and consistently
- Avoid blood-contaminated needles, razors, or other items

* **bone marrow** is the soft tissue inside bones where blood cells are made.

* **joint** is the structure where two or more bones come together, allowing flexibility and motion of the skeleton.

* **sepsis** is a potentially serious spreading of infection, usually bacterial, through the bloodstream and body.

* **motor** relates to body movement.

* **macrocephaly** (ma-kro-SEH-fah-lee) means having an abnormally large head.

* **hydrocephaly** (hi-dro-SEH-fah-lee) means having an abnormally large amount of cerebrospinal fluid in the brain, resulting in an enlarged skull and brain atrophy.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

be used to image the newborn's brain and an echocardiogram* may diagnose heart problems.

Infants born with serious infections are treated in a neonatal-care unit with intravenous* (IV) drugs. Infants born to infected mothers may be treated with medications even if they show few or no signs of infection.

Viral STIs Most infants born to HIV-infected mothers test positive for maternal antibodies against HIV for 6 to 18 months after birth. Therefore, additional tests are performed to determine whether an infant is truly infected with HIV. Tests performed within 48 hours of birth detect only about 40 percent of HIV infections, so testing is repeated after one and six months. Treatment of congenital HIV infection with combination ARV drugs reduces child mortality by up to 67 percent.

Pneumonia caused by *Pneumocystis carinii* is often the first AIDS-related illness to appear in HIV-infected infants and is a major cause of death during the first year. The CDC recommends that all babies born to HIV-infected mothers be treated with anti-pneumonia drugs beginning at four to six weeks and continuing until the infant is found to be HIV-negative.

Infants born to mothers infected with hepatitis B are given both the first dose of hepatitis B vaccine* and hepatitis B immune globulin* within 12 hours of birth. The second and third doses of vaccine are given at one and six months of age.

Maternal HSV infection can be diagnosed by a culture* from an affected genital site, preferably on the first day of an outbreak, or a blood test. Newborns with congenital herpes are treated immediately with intravenous antiviral medications. Eye infections are treated with trifluridine drops. Although immediate medication may prevent or reduce the damage from HSV, one-half of infants born with severe HSV infections die and the other one-half may suffer brain damage.

Bacterial STIs Congenital chlamydial infection is treated with erythromycin eye ointment and oral* tablets. Conjunctivitis and pneumonia in newborns usually respond well to treatment with antibiotics.

An antibiotic ointment such as silver nitrate is placed under the eyelids of all newborns as preventative treatment for congenital gonorrhea. An infant born to a gonorrhea-infected mother is treated with intravenous antibiotics.

Congenital syphilis is identified during routine newborn blood testing and is treated with antibiotics. Syphilis in an older infant may be diagnosed by the following means:

- Lumbar puncture to look for signs of syphilis in the brain and central nervous system*
- An ophthalmologic* examination
- Dark-field microscopy to visualize the spirochete bacteria that cause the disease
- Bone x-rays

Other viral infections Prenatal diagnosis of CMV may include blood tests for maternal antibodies and fetal ultrasound. Symptoms of congenital CMV, including retinitis, are treated with antiviral medications. With treatment most infants with congenital CMV survive, although almost all suffer from its effects.

Congenital chicken pox is treated immediately to prevent serious complications or death. There is no specific treatment for CRS; rather, infants are treated for specific conditions.

Prenatal diagnosis of fifth disease may include blood tests for maternal antibodies and fetal ultrasound. The mother may receive medication that passes through the placenta to the fetus. Fetal anemia caused by fifth disease may resolve on its own. If the fetus is at risk for heart failure*, a fetal blood transfusion* may be performed.

GBS and toxoplasmosis GBS can be diagnosed by culturing the bacteria from the blood, spinal fluid, skin, vagina, or rectum. Newborns infected with GBS are treated immediately with intravenous antibiotics. Although antibiotic treatment is very effective, about 5 percent of newborns with congenital GBS die.

Prenatal tests for toxoplasmosis include:

- A blood test for maternal antibodies
- Testing of the amniotic fluid and fetal blood
- Fetal ultrasound

It has been suggested that all pregnant women and newborns be screened for toxoplasmosis.

Postnatal diagnosis of congenital toxoplasmosis may be based on the following:

- Antibody tests of the cord blood and cerebrospinal fluid*
- An ophthalmologic examination
- A neurologic exam*
- CT scans*

Fetal toxoplasmosis may be treated by giving the mother pyrimethamine and sulfonamides during the later second and third trimesters of pregnancy. Newborns with symptoms of toxoplasmosis are treated with the following:

- Pyrimethamine and sulfadiazine for one year
- Leucovorin for one year to protect the bone marrow from pyrimethamine toxicity
- Corticosteroids* for heart, lung, or eye inflammations

Can Congenital Infections Be Prevented?

Although the consequences of congenital infections can be devastating, they are often relatively easy to prevent, because maternal treatment with antiviral medications or antibiotics reduces the risk to the fetus. The

* **echocardiogram** (eh-ko-KAR-dee-uh-gram) is a diagnostic test that uses sound waves to produce images of the heart's chambers and valves and blood flow through the heart.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

* **immune globulin** (ih-MYOON GLAH-byoo-lin), also called gamma globulin, is the protein material that contains antibodies.

* **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **oral** means by mouth or referring to the mouth.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **ophthalmologic** (off-thal-MOLL-o-jik) means related to the function, structure, and diseases of the eye.

Should Pregnant Women Be Vaccinated?

Vaccinations can prevent varicella and rubella. Women of childbearing age who have not had chicken pox or rubella and have not been vaccinated previously should be vaccinated prior to becoming pregnant. Because these vaccines contain live viruses, women cannot be vaccinated during pregnancy due to the risk to the fetus. However, vaccinations for family members and others in close contact with a pregnant woman can help protect her from infection. Other vaccines, such as flu vaccine, which does not contain live-virus, are recommended after the first trimester of pregnancy.

* **heart failure** is a medical term used to describe a condition in which a damaged heart cannot pump enough blood to meet the oxygen and nutrient demands of the body. People with heart failure may find it hard to exercise due to the insufficient blood flow, but many people live a long time with heart failure.

* **blood transfusion** is the process of giving blood (or certain cells or chemicals found in the blood) to a person who needs it due to illness or blood loss.

* **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.

* **neurologic exam** refers to systematic tests of how well various parts of the nervous system are functioning.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

CDC recommends that on their first prenatal visit all pregnant women be screened for the following:

- HIV
- Hepatitis B and C
- Chlamydia
- Gonorrhea
- Syphilis

STIs Women who test negative for HIV early in pregnancy but are at high risk for HIV infection due to new or multiple sexual partners or intravenous drug use should be retested later in pregnancy. Women who were not tested for HIV during pregnancy may be screened during labor or delivery with a rapid test for HIV antibodies in the blood. If an HIV-infected woman is treated with ARV drugs during pregnancy and delivery and the newborn is treated immediately after birth, the baby's risk of HIV infection drops from about 25 percent to about 6 percent. If the mother's viral load (the amount of HIV in her blood) is high or if there is a prolonged period between membrane rupture and delivery, the risk of HIV transmission increases. If the mother receives ARV treatment during pregnancy and delivers by cesarean section* before labor begins and the membranes rupture, the risk of HIV infection in the newborn drops to 1 percent or less. Feeding formula* to infants prevents transmission of the virus through breast milk.

Sometimes pregnant women who are at high risk for hepatitis B infection are vaccinated. More than 95 percent of infants born to hepatitis B-infected mothers can be protected by administering the first dose of vaccine and immune globulin within 12 hours of birth.

Prevention of maternal-to-fetal HSV transmission includes the following:

- Abstaining from sexual activity during the last trimester of pregnancy or if there are signs of an outbreak or visible sores
- Using a condom even if no symptoms are present
- Postponing membrane rupture
- Avoiding a fetal monitor that makes tiny punctures in the fetal scalp
- Avoiding vacuum or forceps deliveries, which cause breaks in the infant's scalp.

An examination or HSV test can indicate whether a pregnant woman has active genital herpes near the time of delivery. Outbreaks just prior to delivery may be prevented by treatment with antiviral drugs. Women with active herpes lesions are likely deliver by cesarean section to reduce the risk of transmission.

Screening pregnant women for gonorrhea is important because women often do not know that they are infected, and antibiotic treatment can prevent congenital infection. Because women often are infected

with both gonorrhea and chlamydia, a combination of antibiotics is used to treat the infections simultaneously. Likewise, adequate antibiotic treatment of a syphilis-infected pregnant woman protects the fetus from congenital disease.

Preventing other congenital infections Pregnant women should be tested for immunity to rubella at their first prenatal visit. Exposure to chicken pox or rubella by a non-immune pregnant woman may be treated with an injection of immune globulin to help prevent fetal transmission.

Good hygiene can help protect pregnant women from infection with CMV, parvovirus, *Toxoplasma gondii*, and other infectious microorganism*. This is particularly important for women who have or work with young children and may be at risk for CMV and parvovirus. Good practices include the following:

- Frequent and thorough hand washing, especially after handling diapers or bodily fluids
- Not sharing food or drink
- Contacting a healthcare provider immediately upon exposure to a transmittable infection

Pregnant women should be tested for GBS between the 35th and 37th weeks of pregnancy to determine whether the bacteria are likely to be present during delivery. Pregnant women with GBS in their urine are treated with penicillin. Intravenous antibiotics may be administered from the moment following membrane rupture through labor and delivery. Antibiotic treatment reduces the risk of congenital GBS infection from 1 in 200 to 1 in 4,000.

Treatment with spiramycin for toxoplasmosis occurring within the first or early second trimester of pregnancy can prevent transmission to the fetus. However, it is important that pregnant women take measures to avoid *Toxoplasma* infection by taking the following measures:

- Keeping cats indoors and washing after handling them
- Using rubber gloves to handle cat litter and washing thoroughly afterwards
- Disinfecting cat boxes with boiling water for five minutes
- Covering sandboxes
- Wearing gloves for handling soil or gardening and washing afterwards
- Avoiding insects that may have been exposed to cat feces
- Avoiding raw or undercooked meat and poultry, unwashed fruits and vegetables, raw eggs, and unpasteurized* milk
- Killing *Toxoplasma* by freezing food or cooking it thoroughly

▶ See also **AIDS and HIV Infection • Chlamydial Infections • Cytomegalovirus (CMV) Infection • Fifth Disease • Gonorrhea • Hepatitis • Herpes Simplex Virus Infections • Rubella (German Measles) • Sexually Transmitted Diseases (STDs) • Streptococcal Infections • Syphilis • Toxoplasmosis • Varicella (Chicken Pox) and Herpes Zoster (Shingles)**

Should Women Be Tested Before Pregnancy?

Women who are considering becoming pregnant can be screened for antibodies to CMV and toxoplasmosis. If tests show that they have these antibodies, there is no risk of infection during pregnancy. If they do not have antibodies, women can take extra precautions to avoid exposure to these common pathogens.

* **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.

* **cesarean section** (si-ZAR-ee-an SEK-shun) is the surgical incision of the walls of the abdomen and uterus to deliver offspring in cases where the mother cannot deliver through the vagina.

* **formula** is a prepared, nutritious drink or a dry drink mix designed specifically for infants.

* **microorganism** is a tiny organism that can be seen only by using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

* **unpasteurized** (pas-CHUR-ized) refers to foods that have not undergone the process of pasteurization (pas-chu-rih-ZAY-shun), in which food is heated to a certain temperature over a period of time to kill organisms and help make the food safer to consume.



▲ Iranian conjoined twins Ladan (left) and Laleh Bijani, smiling during a press conference in Singapore, June 11, 2003. Both women died July 8, 2003, when the operation to separate them was unsuccessful. *AP Images*.

* **identical twins** are twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.

* **embryo** (EM-bree-o), in humans, is the developing organism from the end of the second week after fertilization to the end of the eighth week.

* **spina bifida** (SPY-nuh BIF-ih-duh) is a condition present at birth in which the spinal column is imperfectly closed, leaving part of the spinal cord exposed and often leading to neurological and other problems.

Resources

Books and Articles

Drake, Kendis Moore. *Preparing for a Healthy Baby: A Pregnancy Book*. Phoenix: Trimester, 2008.

Smith, Tara C. *Streptococcus (Group B)*. New York: Chelsea House, 2007.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

March of Dimes. 1275 Mamaroneck Avenue, White Plains, NY, 10605. Telephone: 914-997-4488. Web site: <http://marchofdimes.com>.

Congestive Heart Failure See *Heart Disease*.

Conjoined Twins

Conjoined twins are identical twins in which the two embryos* fail to separate completely before birth. It is thought that the condition results from incomplete splitting after the twelfth day of development. If a fertilized human egg divides into two embryos before the twelfth day, the identical twins are born normally as two separate infants. A hundred years ago conjoined twins were often called Siamese twins, after Chang and Eng Bunker (1811–1874), a pair of male conjoined twins who were born in Thailand, then called the Kingdom of Siam.*

Meet the Schappell Sisters

George (born Dori) and Lori Schappell are conjoined sisters born in Reading, Pennsylvania, in 1961. They are craniopagus conjoined twins who cannot be separated because they share about 30 percent of their brain tissue. Dori disliked having a name that rhymed with her sister's, so she changed it first to Reba and then in 2007 to George.

The Schappell sisters are an example of the physical differences that can exist between conjoined twins. Lori is physically healthy, but George was born with spina bifida*. It was this physical condition that caused the sisters to be removed from their parents by court order in the early 1960s and placed in an institution for the mentally disabled even though

neither sister has a learning impairment. After they became adults, the sisters fought to be released from the institution. They were able to attend college after their release.

The two sisters took turns working while the other attended school or began a career. George worked in a hospital while Lori finished college. Lori worked in a laundry and helped to manage George's career as a country music singer. George (who still called herself Reba when she began to sing) performed in Germany and Japan as well as in the United States, and won the L. A. Music Award for Best New Country Artist in 1997. She also worked as a designer of support equipment for disabled humans and pets and designed the custom wheelchair that she needs to use to avoid straining Lori's back and neck. George's spina bifida means that she is much shorter than her sister and must be raised to her sister's height in order to move around easily. George used a bar stool as the base of the wheelchair.

The Schappell sisters have maintained their individual personalities. Although they share an apartment, they have separate rooms, and George has pets whereas Lori does not. They have different groups of friends and attend different churches. Lori cuts her hair short and enjoys an occasional drink whereas George has colored her hair and avoids alcohol. Lori speaks in the Pennsylvania Dutch accent of the Reading area, but George has adopted a Southern drawl from her work in country music.

What Are Conjoined Twins?

Conjoined twins are identical twins that fail to separate completely during the mother's pregnancy. Identical twins are also known as monozygotic* because they are formed when a single fertilized egg from the mother divides to form two separate embryos during pregnancy. Conjoined twins are a rare subtype of identical twins that result from incomplete splitting after the twelfth day of embryonic development. The longer the delay in the separation of the two embryos, the more complicated the connections between the conjoined twins are likely to be.

The other major category of twins are fraternal* twins, who are formed when two eggs from the mother are fertilized by two different sperm from the father and implant inside the uterus, the organ in which the unborn babies develop. Fraternal twins are also known as dizygotic* twins. Dizygotic twins are more common than identical or monozygotic twins.

How Common Are Conjoined Twins?

In general, about 1 in every 90 human pregnancies results in twins. About 40 percent of all twins born are fraternal twins in which one baby is male and the other female. The next most common type is female fraternal twins, followed by male fraternal twins, female identical twins, and male identical twins. Conjoined twins are the rarest form of identical twins, occurring once in every 50,000 to 200,000 pregnancies. They are

* **monozygotic** (mah-no-zye-GOT-ik) derived from a single fertilized egg.

* **fraternal** twins are born at the same time but develop from two separate fertilized eggs. Unlike identical twins, who develop from only one fertilized egg that splits into two and who look exactly alike, fraternal twins may not look the same at all or be the same gender. Identical twins have the same genes, but fraternal twins are no more likely to share genes than non-twin siblings.

* **dizygotic** (dye-zye-GOT-ik) derived from two different fertilized eggs.

more likely to occur in Southwest Asia and Africa than in Europe or North America, but the reason for this geographical difference is not yet known.

Conjoined twins are at considerable risk of death during pregnancy; doctors estimate that between 40 and 60 percent of conjoined twins are stillborn or die shortly after birth. Male conjoined twins are more likely than females to die before birth. Of conjoined twins that are born alive, females outnumber males by a ratio of three to one. In the United States, about one live birth in every 200,000 is a set of conjoined twins.

How Are Conjoined Twins Classified?

Conjoined twins are categorized in two major ways. Some doctors distinguish between symmetrical or equal conjoined twins, a condition in which both infants are well developed, and asymmetrical or unequal conjoined twins, in which an incomplete twin is joined to a fully developed sibling. The incomplete twin is sometimes called a parasitic twin because it depends on the overall health and body functions of the complete sibling. About 10 percent of conjoined twins are asymmetrical twins.

Conjoined twins are also classified according to the points at which their bodies are joined. This system goes back to a French biologist named Étienne Geoffroy Saint-Hillaire (1772–1844), who based his terms on the medical terms for parts of the body. The conjoined twins may share tissues, organ systems, or both, depending on the areas in which their bodies are fused:

- **Thoracopagus:** 40 percent of conjoined twins are joined at the chest. These twins always share a heart. Many conjoined thoracopagus twins are also joined at the abdomen and are called thoracophalopagus twins.
- **Omphalopagus:** 10 percent of conjoined twins are joined only at the abdomen. These twins often share a liver and digestive system but not a heart.
- **Pygopagus:** 18 percent of twins are joined back to back at the buttocks. These twins sometimes share the lower part of the digestive tract or the genital organs.
- **Ischiopagus:** 6 percent of twins are joined at the pelvis or lower spine with the lower half of the bodies fused. They have four arms but may have between two and four legs.
- **Craniopagus:** 2 percent of conjoined twins are fused at the head but the bodies are separate. In some cases these twins share part of the brain as well as the skull.
- **Xiphopagus:** A rare type of conjoined twins are those joined at the xiphoid cartilage, which runs from the breastbone to the navel in infants and turns into bone by adulthood. Chang and Eng Bunker were xiphopagus conjoined twins.

How Serious Is the Conjoined Condition?

In general, as has already been noted, conjoined twins are likely to die before or shortly after birth, although the degree of risk depends on how many organs they share and how well-developed their organs are. One side effect of the incomplete separation of the two embryos in conjoined twinning is that the babies' vital organs are likely to be incomplete or abnormal in some other way. Xiphopagus twins such as the Bunkers usually share only the liver and have a higher chance of survival; craniopagus twins with shared brain tissue or thoracopagus twins with a shared heart have a much poorer outlook.

Between 40 and 80 percent of conjoined twins who need emergency surgery after birth die in intensive care following the operation. In some cases, particularly those involving asymmetrical twins, the parents must make the painful decision to allow one of the twins to die if the other is to have any chance of survival. Conjoined twins who are born alive and are healthy enough to have surgery postponed until they are older have a survival rate of 80 percent.

THE ORIGINAL SIAMESE TWINS

Chang and Eng Bunker (1811–1874) were conjoined twins whose country of origin, then called Siam, led to their being called Siamese twins, a term later considered inappropriate for the condition. Chang and Eng were joined at the breastbone by a band of cartilage, but their vital organs functioned independently. They could have been easily separated by modern surgical techniques and equipment, but 19th-century surgeons did not have the specialized diagnostic techniques, blood banks, and other equipment necessary for such operations. The boys were fortunate that their parents did not abandon them; the midwife who delivered the boys was afraid to touch them for fear that she would be cursed; and when the King of Siam heard about the unusual birth, he condemned the twins to death. Luckily, he never carried out the sentence.

Like other sets of conjoined twins in the 19th century, Chang and Eng were exhibited as a medical curiosity. They were discovered by a British business promoter in 1829 and taken on tour in England and the United States. The twins then joined P. T. Barnum's traveling circus after their contract with the Englishman expired. They left the circus in 1839 and settled in a town in North Carolina. Taking the surname Bunker, they became citizens of the United States and married two sisters in 1843. Chang had ten children by his wife while Eng had eleven. The two wives did not get along, however, and the brothers set up two separate households, spending three days a week in each home.

The twins' health grew worse in the early 1870s, partly as a result of heavy drinking and financial worries following the Civil War. Chang died on January 17, 1874, most likely from a stroke; Eng died an hour later. The twins have been the subject of several novels, plays, and short stories, as well as a musical produced in Singapore in 1997.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **electrocardiogram** (e-lek-tro-KAR-dee-o-gram), also known as an EKG, is a test that records and displays the electrical activity of the heart.

* **electroencephalogram** an instrument that records the electrical activity of the brain.

* **cesarean section** (si-ZAR-ee-an SEK-shun) is the surgical incision of the walls of the abdomen and uterus to deliver offspring in cases where the mother cannot deliver through the vagina.

How Conjoined Twins Diagnosed and Treated?

Diagnosis In some cases the mother's doctor may suspect the presence of conjoined twins early in the pregnancy by finding that the mother's uterus is larger than expected and hearing two fetal heartbeats when listening through a stethoscope. Conjoined twins can be diagnosed by ultrasound* as early as the eighth week of pregnancy. Ultrasound imaging is also useful in planning for the birth, as many conjoined twins are not in the usual head-down position before birth and the doctor needs to be prepared.

Magnetic resonance imaging* can be used to identify which organ systems are shared between the twins and which organs are abnormal or incompletely developed. In every set of conjoined twins, one will be smaller than the other and will usually have more abnormal organs as well. CT scans* are primarily useful in evaluating the bony structures of twins fused at the hips or pelvis.

An electrocardiogram* and an electroencephalogram (EEG)* may be used to evaluate the extent of shared heart or brain function, and to determine whether surgical separation of the twins will be possible after birth. Although the number of successful separations of conjoined twins increased after the first attempt in Paris in 1888—about 250 long-term successes had been reported as of 2009—some conjoined twins cannot be separated.

Treatment The treatment of conjoined twins is highly individualized. It almost always requires complicated surgery in one of a small number of medical centers (three in the United States, one in the United Kingdom, one in New Zealand, and one in South Africa). Doctors classify conjoined twins for treatment in one of three categories: those who are likely to die shortly after birth; those who require immediate emergency surgery; and those who will survive until they are old enough for surgery to have a higher chance of success (usually 6–12 months). Twins who share a heart or brain usually cannot be separated without causing the death of both twins. Emergency surgery is needed when one twin dies shortly after birth in order to save the other twin.

Conjoined twins are usually delivered by cesarean section* rather than waiting for the mother's due date, in part because conjoined twins are more likely than other babies to be born prematurely. The operation is usually scheduled for two to four weeks before the expected date of birth. Surgery to separate the twins may be performed immediately after delivery if one or both twins have a life-threatening emergency. These operations are complicated and may take as long as 35 hours to complete. Two complete surgical teams are required to care for the twins after the separation is complete. In most cases, conjoined twins who survive separation need further surgery at intervals during childhood as their bodies grow and change.

Complications Complications following the separation of conjoined twins are common in spite of the number of imaging studies and careful

planning that takes place before the operation. The younger the infants at the time of surgery, the more likely they are to have complications related to blood loss, changes in blood pressure, or the use of general anesthesia*.

Some complications related to the separation of conjoined twins concern the legal system rather than surgery. In 2000 there was a controversial case in Great Britain in which conjoined girls were separated shortly after birth by order of the High Court over the objections of the twins' parents even though it was certain that the weaker twin would die as a result of the surgery. This case raises questions about a government's right to overrule parents' wishes as well as the ethics* involved in sacrificing one child's life for the sake of the other. In the United States as of 2009, the parents' decision regarding separation was considered final.

Can Conjoined Twins Be Prevented?

As of 2009, conjoined twinning cannot be prevented because the cause of the incomplete separation of the two embryos around the twelfth day of pregnancy is not known. Avoiding the small number of medications that have been associated with conjoined twinning in a few cases may help. Although twin births in general are known to run in families, conjoined twinning is considered to be a random occurrence; the parents of conjoined twins do not have an increased risk of having a second set in a later pregnancy.

Parents can choose to terminate the pregnancy if the mother has had an ultrasound or other diagnostic examination and is known to be carrying conjoined twins. As of the early 2000s, parents were increasingly choosing to end their pregnancy.

Living as Conjoined Twins

It is possible for conjoined twins who are not separated to have productive and satisfying lives, as the example of the Schappell sisters indicates. Daisy and Violet Hilton (1908–1969) were pygopagus conjoined twins born in England who moved to the United States and worked as vaudeville singers and dancers, including a tap-dancing routine with Bob Hope. Later, a set of conjoined twins in Minnesota completed high school in 2008, began college, and obtained a driver's license. They told a *Newsweek* reporter in 2008 that they expect to marry and have children after completing their education. Alice Dreger, a medical historian from Michigan, wrote in her book that many conjoined twins are satisfied with their lives, and—contrary to popular opinion—do not feel sorry for themselves or see their lives as not worth living. The Schappell sisters, for example, are opposed to separation surgery because they do not want to risk the possibility that one of them might die.

Conjoined twins who are not separated commonly state that being stared at by strangers, regarded as objects of pity, or asked intrusive questions about their bathroom habits or sexual activities are more bothersome than the physical inconveniences of their shared lives. Although a

* **general anesthesia** (an-es-THE-zha) means using drugs or inhaled gases to create a state of unconsciousness and muscle relaxation throughout the body to block pain during surgery. Local anesthesia blocks or numbs pain in one part of the body while patients remain awake.

* **ethics** is a guiding set of principles for conduct, a system of moral values.

number of pairs of conjoined twins in the 19th and early 20th centuries ended up in circuses or other forms of show business in order to earn a living, changes in employment legislation and the widespread use of computers in schools and workplaces have made it possible for contemporary conjoined twins to go to college and enter other occupations.

Conjoined twins who are not separated, however, have shortened life expectancies; most pairs die in their twenties or early thirties. The oldest known living set of conjoined twins is a pair of brothers in Ohio born in 1951; they are also the only set of adult male conjoined twins anywhere in the world as of 2009.

Resources

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Organizations

American Pediatric Surgical Association. 111 Deer Lake Road, Suite 100, Deerfield, IL, 60015. Telephone: 847-480-9576. Web site: <http://www.eapsa.org/index.cfm>.

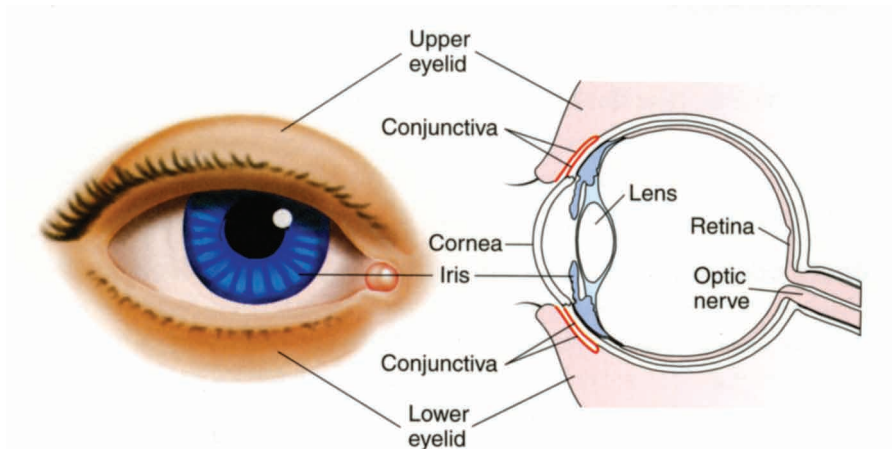
Conjoined Twins International. P.O. Box 10895, Prescott, AZ, 86304-0895. Telephone: 928-445-2777.

Conjunctivitis

Conjunctivitis (kon-jung-tih-VY-tis), often called pinkeye, is an inflammation of the conjunctiva (kon-jung-TIE-vuh), the thin membrane that lines the inside of the eyelids and covers the surface of the eyeball. Conjunctivitis can be caused by viruses, bacteria, allergies, or chemical irritation.

What Is Conjunctivitis?

Conjunctivitis is an inflammation of the thin membrane that lines the inside of the eyelids and covers the white surface of the eye. The inflammation can produce redness, burning, or itching of the eyes and sometimes a discharge. Bacterial or viral infections most often cause conjunctivitis. Many different bacteria can be the culprit, most commonly *Streptococcus*



In conjunctivitis, the membrane that lines the eyelids and covers the eye becomes inflamed and swollen. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

pneumoniae (strep-tuh-KAH-kus nu-MO-nye), *Haemophilus influenzae* (he-MOH-fih-lus in-floo-EN-zuh), and *Staphylococcus aureus* (stah-fih-lo-KAH-kus ARE-ree-us). Infections with adenovirus* and influenza viruses are common causes of conjunctivitis. About 80 percent of all cases of conjunctivitis result from viral or bacterial infection.

Rarely, parasite* and fungal infections can cause conjunctivitis. The condition also can stem from various allergies, irritants, chemicals, and pollutants. Reactions to smoke, dust, makeup, contact lenses, and pollen all can produce symptoms in some people as can contaminated contact lens solution in contact lens wearers.

The sexually transmitted diseases chlamydia* and gonorrhea*, which can be passed from infected mothers to their babies during birth, are the most common causes of conjunctivitis in newborns. These two diseases can lead to conjunctivitis in adults as well. Conjunctivitis usually does not cause problems with vision.

How Does Conjunctivitis Spread and Who Gets It?

Conjunctivitis, especially of viral origin, typically is seen in children and adults who are caregivers of children, such as parents or day-care workers. Bacterial conjunctivitis is less common in healthy older children and adults. Both the bacterial and viral forms of the condition are contagious. The germs that cause conjunctivitis may be present in nasal secretions and in the discharge from the eyes. People can become infected simply by touching the face of someone with the disease and then rubbing their own eyes without first washing their hands. Sharing contaminated towels or eye makeup also can spread the infection. Infectious conjunctivitis can spread quickly through child-care and school settings and among members of the same family. Bacterial conjunctivitis can remain contagious until treatment with antibiotics is started. The viral form is usually contagious before the symptoms appear and for as long as symptoms, including any discharge from the eye, last.

* **adenovirus** (ah-deh-no-VY-rus) is a type of virus that can produce a variety of symptoms, including upper respiratory disease, when it infects humans.

* **parasite** (PAIR-uh-sites) is an organisms such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

* **chlamydia** (kla-MIH-dee-uh) are microorganisms that can infect the urinary tract, genitals, eye, and respiratory tract, including the lungs.

* **gonorrhea** (gah-nuh-REE-uh) is a sexually transmitted disease (STD) spread through all forms of sexual intercourse. The bacteria can also be passed from an infected mother to her baby during childbirth. Gonorrhea can affect the genitals, urethra, rectum, eyes, throat, joints, and other tissues of the body.



▲
Antibiotic eyedrops or ointments are applied to the eye to treat bacterial conjunctivitis. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **herpesvirus** (her-pee-z-VY-rus) is a member of a family of viruses that can store themselves permanently in the body. The family includes varicella virus, Epstein-Barr virus, and herpes simplex virus.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **cornea** (KOR-nee-uh) is the transparent circular layer of cells over the central colored part of the eyeball (the iris) through which light enters the eye.

What Are the Signs and Symptoms of Conjunctivitis?

The first symptoms typically appear within a few days or up to a week after infection. A person may feel discomfort, a gritty sensation under the eyelids, or a feeling that there is something in the eye. Redness develops in the eye, and the eyelids may swell. Bacterial infections usually produce a thick yellowish or greenish discharge. When the person wakes up in the morning, the eyelids might stick together as the result of dried discharge. In viral conjunctivitis, the discharge is often thin, watery, and clear. Viral infections are more likely to affect both eyes and can be accompanied by other symptoms of viral infection, such as cold or flu symptoms.

How Is Conjunctivitis Diagnosed?

Eye discharge and inflammation (redness) of the conjunctiva are the hallmarks of conjunctivitis. The doctor also will ask whether the person has had recent contact with someone with conjunctivitis and will examine the eyes, making sure the person's vision is normal. Sometimes the doctor will swab the inside of the eyelids to obtain fluid for laboratory testing to determine the type of infection. This procedure is more likely to be done in newborn babies or someone at risk of a sexually transmitted disease, such as chlamydial infection or gonorrhea.

How Do Doctors Treat Conjunctivitis?

Treatment depends on the cause of conjunctivitis. If bacterial conjunctivitis has been diagnosed, antibiotic eye drops usually are prescribed for about a week. An antibiotic ointment is used for babies. Viral conjunctivitis disappears by itself and does not typically require treatment. (One exception is conjunctivitis caused by herpesvirus* infection, which is treated with antiviral eye drops.) Over-the-counter pain relievers, such as acetaminophen*, and warm compresses placed over the eyelids several times a day may ease the discomfort. Conjunctivitis usually clears up within a week. Cases of viral conjunctivitis can take longer to resolve than bacterial conjunctivitis.

Are There Complications?

Complications of conjunctivitis are rare. In newborns, untreated gonorrheal infection of the conjunctiva can cause a spreading infection of the eye that can lead to blindness. A few viruses cause conjunctivitis that affects deeper parts of the eye, resulting in keratitis (kare-uh-TY-tis), an inflammation of the cornea* that causes changes in vision and sometimes permanent scarring of the cornea. Trachoma (truh-KO-mah), a type of chlamydial conjunctivitis seen in developing countries, also can lead to blindness.

Can Conjunctivitis Be Prevented?

Good hygiene is the best way to help prevent infectious conjunctivitis. People should wash their hands frequently, especially after touching the face of someone who has the infection. Eye cosmetics should be replaced

regularly, and contact lenses should be handled and cleaned properly. It is a good idea for people with infectious conjunctivitis to wash their hands often to avoid spreading the infection. It is also wise not to share makeup; disposable items, such as paper towels and cotton balls; or towels. Washing towels and clothing in hot water can disinfect them.

▶ See also **Allergies • Common Cold • Influenza**

Resources

Books and Articles

Glaser, Jason. *Pink Eye*. Mankato, MN: Capstone Press, 2006.

Landau, Elaine. *Pink Eye*. New York: Marshall Cavendish Benchmark, 2010.

Organizations

National Eye Institute. 2020 Vision Place, Bethesda, MD, 20892-3655. Telephone: 301-496-5248. Web site: <http://www.nei.nih.gov/health/cornealdisease>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/001010.htm>.

Consciousness

Consciousness is a person's awareness of his or her inner world, the most private place where thoughts and feelings are formed and impressions and experiences are processed.

Automatic Tasks Versus Conscious Choices

Here is a test: Try to write down all the steps you followed in getting dressed this morning. Did you put on your pants or your top first? Which shoe went on first? What steps did you take to tie your shoes? This is likely to be a tough test because getting dressed, brushing teeth, or tying shoes are automatic tasks that can be done without much thought. Other examples of automatic tasks include riding a bike, playing a sport, and dialing a phone number from memory. These tasks may seem difficult when people learn them for the first time, but the tasks soon become so familiar that individuals do not have to focus their conscious minds on them. Without even realizing it, people rely on learned routines to complete lots of tasks efficiently.

- * **cerebral cortex** (suh-REE-brul KOR-teks) is the part of the brain that controls functions such as conscious thought, listening, and speaking.
- * **vegetative state** a state of extreme mental impairment in which only involuntary bodily functions are sustained.
- * **psychologists** (sy-KOL-o-jists) are mental health professionals who treat mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth. Psychologists also study the brain, behavior, emotions, and learning.
- * **ethics** is a guiding set of principles for conduct, a system of moral values.

Mindfulness

Automatic processing is not always enough for what someone needs to do. In such cases the conscious mind takes over. Whether a person is mastering a new concept, focusing on a challenging book, writing a school paper, deciding how to spend the afternoon, or reacting to criticism from a friend, for example, that person is mindful, or conscious, of what he or she is thinking, feeling, saying, or doing. These and other tasks require the mind to be aware of the inside and the outside world, instead of relying on set automatic routines. It appears that “consciousness” gives human beings the awareness to be flexible in dealing with new situations and an ever-changing environment. Consciousness is a state of being aware and paying attention to thoughts, feelings, ideas, and actions at a given moment.

Cerebral Cortex

It is generally believed that the mechanisms of consciousness are controlled by the cerebral cortex*, the upper wrinkled layer of the brain where higher functions, such as perception, memory, intelligence, and control of skilled movements, are also carried out. As of the early 2000s, however, scientists were unable to explain consciousness fully as a solely physical process carried out within the brain. Whether consciousness is solely a physical process has been debated intensely. Consciousness has proved to be one of the most difficult functions to define, even though everyone experiences it.

Philosophy, Psychology, and Neuroscience: The “Hard Problem” of Consciousness

Scientists, physicians, and psychologists who are specially trained to study the structure, function, and biology of the brain and nervous system have learned about different brain regions and how brain chemicals are involved in producing emotions such as anxiety, sadness, fear, and happiness. Using advanced brain imaging techniques, they also have gained more understanding of how different portions of the brain play a part in speaking, listening, processing information, and other activities. In addition, some medical professionals have used imaging tests to search for even slight conscious activity in the brains of patients who have suffered brain injury and appear to be in a completely vegetative state*. Further research may eventually lead to a better understanding about how to use imaging tests to determine which of these patients will eventually “wake up” and again become aware of their surroundings. As of 2009, however, even positive test results cannot predict whether a particular patient will ever regain consciousness.

Some researchers in the emerging field known as consciousness studies speculate that one day people will understand consciousness more fully in this way as well. They include not only psychologists* and scientists, but also some philosophers. Philosophy is the study of the nature of the mind and of the role of thought in how people experience and deal with the world around them, including ethics*, morality, decision making,

motivation, and beliefs. These researchers believe that eventually people will be able to “map” the process they understand as consciousness within the brain, explaining it in terms of the connections and messaging among nerve cells of the brain. They believe that consciousness will come to be understood as the product of the sophisticated machinery of the human brain, just as emotions have begun to be understood in this way.

Other researchers disagree. They contend that the so-called hard problem of consciousness will remain something of a mystery. The “hard problem” of consciousness refers to the question of how the physical brain can give rise to the unique experiences that individuals have in relation to the external world. These experts do not dispute the brain’s role in taking in, processing, and interpreting concrete information from the outside world. For example, two people at the same concert hear the same music thanks to the inner ear’s auditory nerve, which sends along impulses to the brain, where they are processed in the region that controls hearing. This statement does not, however, explain the inner aspect of thought and perception or the way the music “feels” for each person. When listeners explain their innermost thoughts while hearing the music, they describe very different responses based on personal experiences. For this reason, some experts contend that people will never be able to locate consciousness entirely within the structures and chemical processes of the brain. For them, consciousness is too complex to explain fully in terms of gray matter and brain chemicals. Instead, they argue that consciousness also draws on experiences and thoughts that are the essence of being human (and cannot be defined or measured).

The field of consciousness studies has brought together philosophers, psychologists, neuroscientists*, physicians, and other researchers to discuss this and other issues related to consciousness. Their first major gathering was held in Tucson, Arizona, in 1994, and many meetings occurred after that. This young field of study and research holds great promise for furthering people’s understanding of the mind.

▶ See also **Brain Chemistry (Neurochemistry) • Memory and Amnesia • Sleep Disorders**

Resources

Books and Articles

Blackmore, Susan. *Consciousness: A Very Short Introduction*. Oxford: Oxford University Press, 2005.

Brynie, Faith Hickman. *101 Questions Your Brain Has Asked about Itself But Couldn’t Answer ... Until Now*, rev. ed. Fairfield, IA: 21st Century Books, 2007.

Pinker, Steven. “The Mystery of Consciousness.” *Time* 169.5 (January 29, 2007): 58.

* **neuroscientists** are scientists who study the nerves and nervous system, especially their relationship to learning and behavior.

* **hypothyroidism** (hi-po-THY-royd-ih-zum) is an impairment of the functioning of the thyroid gland that causes too little thyroid hormone to be produced by the body. Symptoms of hypothyroidism can include tiredness, paleness, dry skin, and in children, delayed growth and mental and sexual development.

Organization

Center For Consciousness Studies. P.O. Box 210068, Tucson, AZ, 85721-0068. Telephone: 520-621-9317. Web site: <http://www.consciousness.arizona.edu>.

Constipation

Constipation is a condition that involves difficulty in having a bowel movement or involves having stools (solid waste material from the body) that are dry and hard.

What Is Constipation?

Normal bowel movement patterns vary from person to person. Some people move their bowels as often as after every meal. Other people may move their bowels every three days or so. Both of these patterns may be normal.

With constipation a person feels discomfort and has irregular bowel movements. The difficulty comes from the dry, hard condition of the stool. Constipation may be associated with many medical illnesses.

What Causes Constipation?

Several factors can contribute to constipation, such as not eating enough fiber or drinking enough fluids, inactivity, or not developing regular toilet habits. Certain medical conditions such as irritable bowel syndrome or hypothyroidism* are associated with constipation. Sometimes the medicine people take for other illnesses causes them to become constipated. Pregnant women frequently develop constipation, also.

Constipation can occur when a person withholds stool and the intestines reabsorb the water in the stool, causing it to become harder. Withholding the stool can happen if a person is not comfortable having a bowel movement, for example, when traveling or if the toilet area is considered unsafe or unpleasant.

What Is the Treatment for Constipation?

Although many people take laxatives (LAK-sa-tivs) for constipation, doctors warn that these should not be taken regularly because the intestines may become sluggish and dependent on laxatives. Instead, it is recommended that people eat a diet that is rich in fiber. Foods that have fiber are whole grains, such as bran or whole wheat, beans, fruits, and vegetables. Eating mostly foods that contain a lot of starch or sugar, as in cookies and cakes, does not give the body enough fiber for good

digestion and proper elimination. Also, it is important to drink sufficient amounts of water.

In serious cases of constipation, a person may need to be examined by a doctor and possibly be given an enema (EN-e-ma), which is a process of putting fluid into the rectum to loosen the stool. The doctor also may prescribe medication to help the patient regain regular bowel habits.

For a child who develops a serious case of constipation, the doctor may help by providing a habit-training program. In addition to being instructed about proper diet and increased water intake, the child may be given medicine to help develop regular toilet habits.

Can Constipation Be Prevented?

Most people can prevent constipation by following a regular routine for bowel movements. Here are some habits that help prevent constipation:

- Eating foods rich in fiber
- Avoiding junk foods
- Drinking sufficient water every day
- Having regular toilet habits
- Engaging regularly in exercise
- Getting plenty of rest

▶ See also **Diarrhea • Hemorrhoids • Irritable Bowel Syndrome**

Resources

Books and Articles

Bennett, Howard J. *It Hurts When I Poop! A Story For Children Who Are Scared to Use the Potty*. Washington, DC: Magination Press, 2007.

Organization

American Gastroenterological Association. 4930 Del Ray Avenue, Bethesda, MD, 20814. Telephone: 301-654-2055. Web site: <http://www.gastro.org/wmspage.cfm?parm1=687>.

Consumption See *Tuberculosis*.

Contraception See *Pregnancy*.

- * **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.
- * **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.
- * **psychoanalysis** (sy-ko-a-NAL-i-sis) is a method of treating a person with psychological problems, based on the theories of Dr. Sigmund Freud. It involves sessions in which a therapist encourages a person to talk freely about personal experiences, and the psychoanalyst interprets the patient's ideas and dreams.

Conversion Disorder

Conversion disorder is a psychological condition in which a person loses physical abilities such as seeing, hearing, or speaking, or becomes paralyzed, but doctors can find no physical cause to explain the symptoms. Symptoms of conversion disorder often begin after some stressful experience, and the medical community traditionally has considered them an expression of emotional conflict or need.

What Is Conversion Disorder?

Conversion disorder is a mental disorder in which psychological symptoms are converted to physical symptoms, such as blindness, paralysis*, or seizures*. Seizures may involve sudden episodes of eye staring; twitching or thrashing of arms and/or legs; and may or may not involve loss of consciousness. Unlike malingering, in which a person fakes an illness or injury, a person with conversion disorder does not intentionally produce symptoms.

Conversion disorder is rare, occurring in only about one to three out of 10,000 people. It is even less common in children younger than 10 years of age. Conversion disorder can be triggered by extreme psychological stress, such as injury, death of a loved one, or enduring a dangerous situation. For example, in wartime, some soldiers who experience heavy bombardment but are not wounded are hospitalized because they cannot walk or speak after the combat experience. Conversion disorder under these circumstances has been called shell shock and battle fatigue. In this case and for those people facing other highly stressful situations, conversion disorder appears to occur as a way to help the individual avoid or escape from a life-threatening, tension-filled conditions.

What Causes Conversion Disorder?

An earlier term for conversion disorder is “hysteria.” Physicians in ancient Greece believed that hysteria only occurred in females and that it was caused by the uterus* wandering in the body (the Greek word for “uterus” is “hystera”). For centuries thereafter, people with hysteria were regarded as fakers or as imagining their symptoms. In the 17th century, some townspeople thought that people with hysteria were involved with witchcraft and burned them at the stake.

The term “conversion disorder” came into use only in the late 20th century. It is derived from the early work of the Austrian physician Sigmund Freud (1856–1939), the founder of psychoanalysis*. Freud believed that in times of extreme emotional stress, painful feelings or conflicts are repressed (kept from awareness or consciousness) and are converted into physical symptoms to relieve anxiety. Even in the 21st century, mental health experts do not all agree on the precise psychological mechanisms underlying conversion disorder. Many mental health professionals, however, see the benefits associated with the symptoms of

conversion disorder, such as sympathy, care, and the avoidance of stressful situations, as significant to the disorder.

What Are the Symptoms of Conversion Disorder?

Sometimes people with conversion disorder have tremors or symptoms that resemble fainting spells or seizures. An individual may also experience loss of feeling in various parts of the body or loss of the sense of smell and symptoms may occur together. For instance, following an automobile accident a person may be unable to move or feel sensation in an arm or leg, even though no injury to the limb is apparent. Other people may have difficulty swallowing or feel like they have a lump in their throat. Interestingly, some people with conversion disorder may seem quite comfortable with their symptoms, even though they may be greatly handicapped by them.

How Is Conversion Disorder Diagnosed and Treated?

To diagnose conversion disorder, a doctor must first rule out other possible physical causes of a patient's symptoms. To discount some of the physical disorders, the doctor may use special instruments that measure electrical activity in the muscles and the brain. In addition, experienced physicians using close observation can often discover important diagnostic clues. For example, without realizing it, a patient may momentarily use an arm or a leg that is supposed to be paralyzed. This clue would indicate that the symptom is psychological rather than physical and might indicate conversion disorder. To make sure that the patient is not just pretending to be ill, a mental health professional conducts a clinical interview to learn about the history of the individual and family, stressors that may be present, benefits the patient derives from the symptoms, and what factors may be sustaining the symptoms.

Conversion disorder is typically treated with psychotherapy*. The therapist attempts to help the patient understand whatever unconscious emotional conflicts, needs, or gains may have given rise to the symptoms. In some instances, symptoms of the disorder may last for years. With treatment, however, the symptoms of conversion disorder frequently last for only brief periods.

▶ See also **Factitious Disorder • Hypochondria • Malingering • Munchausen Syndrome • Stress and Stress-Related Illness**

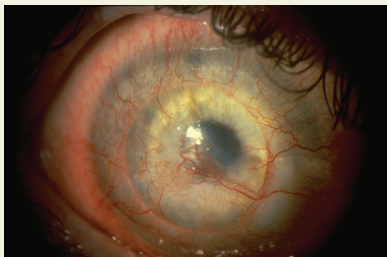
Resources

Organizations

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905. Web site: <http://www.mayoclinic.com/health/conversion-disorder/DS00877>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/000039.htm>.

* **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.



▲
Corneal abrasion with bloodshot veins on the cornea. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **cornea** (KOR-nee-uh) is the transparent circular layer of cells over the central colored part of the eyeball (the iris) through which light enters the eye.

Convulsions *See Seizures.*

COPD *See Chronic Obstructive Pulmonary Disease (COPD).*

Corneal Abrasion

A corneal abrasion is an injury to the cornea of the eye.

What Is Corneal Abrasion?

Corneal abrasion is an injury to the cornea*. When the surface cells that cover the eyeball are injured, some of these cells are removed and damaged, which can be painful.

What Causes Corneal Abrasion?

Corneal abrasion usually occurs accidentally, when something scratches the eye. Poorly cleaned contact lenses, a finger poke to the eye, a grain of sand or other foreign body can all result in corneal abrasion.

Who Gets Corneal Abrasion?

Anyone can get a corneal abrasion, although children, active teenagers and adults, and older debilitated adults are most prone to this injury. Corneal abrasion is the most frequent diagnosis given to children who seek treatment in emergency departments for eye injury.

What Are the Symptoms of Corneal Abrasion?

Corneal abrasion usually causes intense tearing and discomfort. Light often hurts the eye, and individuals may notice the uncomfortable sensation of something gritty being in their eye. Pain may be worse when attempting to open or close the affected eye, and the eye may be red, somewhat bloodshot, and swollen in appearance.

How Is Corneal Abrasion Diagnosed?

Corneal abrasion is usually suspected from a history of likely injury and the characteristic symptoms of pain, light sensitivity, and tearing. The actual abrasion can be seen by an eye examiner. Eye drops containing a fluorescein dye are put into the affected eye, and a slit lamp is used to look at the eye in an otherwise darkened room. Other tests may be performed to make sure that there is no other, more serious injury to the eye, such as checking vision, evaluating the pressure within the eye (intraocular pressure), making sure there is no deeper cut to the cornea that would require surgical repair,

identifying foreign bodies that need removal, and verifying that no other serious disease of the eye is causing the symptoms.

How Is Corneal Abrasion Treated?

Luckily, the surface of the eyeball repairs itself very quickly (within 24 to 72 hours), and without significant medical intervention. Although corneal abrasions were traditionally treated by patching the affected eye to improve comfort during the period of time when the eye is particularly light sensitive, teary, and painful, this practice was later considered controversial. Some studies have suggested that patching (especially patching that is designed to apply pressure to the eye) can deprive the eye of necessary oxygen and slow healing or may increase the risk of infection. Anti-inflammatory eye drops may be soothing. Antibiotic eye drops may be prescribed if there is any possibility of infection.

Can Corneal Abrasion Be Prevented?

Prevention of corneal abrasion is not always possible, because it usually occurs due to a random accident. However, athletes and people whose occupations expose them to dirt, dust, cement and metal particles, or chemicals should be encouraged to wear appropriate protective eyewear to decrease their risk of this type of injury.

▶ *See also* **Infection**

Resources

Books and Articles

Ferri, Fred, ed. *Ferri's Clinical Advisor 2008*. Philadelphia, PA: Mosby Elsevier, 2008.

Yanoff, Myron, and Jay S. Duker. *Ophthalmology: Expert Consult*, 3rd ed. St. Louis: Mosby, 2008.

Organization

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org/afp/20040701/123.html>.

Coronary *See Heart Disease.*

Corpus Callosum, Agenesis of *See Agenesis of the Corpus Callosum.*

* **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

* **enterovirus** (en-tuh-ro-VY-rus) is a group of viruses that can infect the human gastrointestinal tract and spread through the body causing a number of symptoms.

* **poliomyelitis** (po-lee-o-my-uh-LYE-tis) is a condition caused by the polio virus that involves damage of nerve cells. It may lead to weakness and deterioration of the muscles and sometimes paralysis.

* **hepatitis** (neh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.

* **echoviruses** A group of viruses found in the intestinal tract. The word echo in the name is acronym for enteric cytopathic human orphan viruses. When these viruses were named, they were not associated with any disease, hence the use of the word orphan. However, later these viruses were associated with various diseases, including meningitis and encephalitis.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

Coxsackievirus and Other Enteroviruses

The enteroviruses (en-tuh-ro-VY-rus-sez) are a family of viruses that usually enter the body by infecting the gastrointestinal tract. They cause several types of infection, mostly in children. Coxsackieviruses (kok-SAH-kee-vy-ruh-sez) are some of the most well known enteroviruses.*

What Are Enteroviruses?

There are many different kinds of viruses in the enterovirus* family, which cause infections with different symptoms, mostly in children. These viruses make their home in the digestive tract and are related to the viruses that cause poliomyelitis* and hepatitis*. The largest subgroups of the enterovirus family are coxsackieviruses and echoviruses*. In most cases, coxsackievirus infection causes fever and sometimes a mild rash in children, but a variety of other symptoms can occur. Coxsackievirus is well known for its link to hand, foot, and mouth disease, which causes red bumps and blisters to appear inside the mouth and on the hands and feet.

Are Enteroviruses Contagious?

Everyone is at risk of contracting enteroviral infections, but they most commonly infect infants and children younger than five years of age and spread easily among children in group settings, such as day-care centers or schools. These viruses are most likely to cause infections during late summer and early fall and are very contagious. People with coxsackievirus are most contagious during the first week that they are sick.

How Are Enteroviruses Spread?

Enteroviruses are usually spread through contact with feces*, especially on unwashed hands and on surfaces that an infected person has touched, such as a countertop, phone, or toy. The viruses can stay alive for days on these surfaces, able to infect the next person who touches the contaminated area. Parents, babysitters, and day-care workers who change diapers typically have a higher risk of becoming infected with enteroviruses and passing them on to others, especially if they do not wash their hands often. Like many other viruses, enteroviruses also can spread through tiny droplets of fluid that are sprayed into the air when someone sneezes, coughs, or stands close to another person while talking. A person can become infected by breathing in these droplets or by touching something that the infected person has handled, sneezed at, or coughed on.

What Are the Signs and Symptoms?

Many people who become infected with enteroviruses have no symptoms or experience only mild symptoms that do not require medical attention. Some have a fever and a rash, whereas others may get a sore throat,

headache, mild abdominal* pain, or nausea. Fever can be as high as 104 degrees Fahrenheit and may come and go over the course of several days. Some enteroviruses can cause conditions characterized by groups of specific symptoms:

- Hand, foot, and mouth disease: red, painful blisters on the tongue and gums, inside the cheeks, on the palms of hands and the soles of feet, and sometimes on the buttocks.
- Herpangina (her-pan-JY-na): sore throat with blisters that appear on the tonsils and palate*.
- Pleurodynia (ploor-o-DIN-e-uh), also known as Bornholm disease: stabbing pain in the chest or upper abdomen.
- Hemorrhagic conjunctivitis (heh-muh-RAH-jik kon-jung-tih-VY-tis): sudden and severe eye pain with red and watery eyes, eye swelling, and sometimes blurred vision. Rarely, enteroviruses can cause myositis*, meningitis*, or encephalitis*. Myocarditis* or pericarditis* can also occur. In some cases, these infections can be serious or even lead to death.

How Do Doctors Diagnose and Treat Enteroviruses?

Usually a doctor diagnoses an enterovirus infection by getting a history of the patient's symptoms and performing a physical exam, paying particular attention to any rash or blisters. Sometimes doctors use cotton swabs to take a fluid sample from the back of the mouth or throat, which is tested to find out if an enterovirus is present. Samples of feces also might be tested. Like other viral infections, enteroviral infections do not respond to antibiotics, which treat only bacterial infections. Some antiviral medications can be used to treat some severe cases of enterovirus infection. Usually, treatment is aimed at relieving discomfort. Doctors recommend that people with these viruses get plenty of rest, drink cool fluids, and take over-the-counter, non-aspirin pain relievers such as acetaminophen* to ease fever, headache, muscle aches, and painful mouth blisters. Doctors may prescribe a medicated cream or gel to numb sores inside the mouth or on the gums or tongue. Rarely, hospitalization is necessary for infants and children who experience complications.

- * **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.
- * **palate** (PAL-it) is the structure at the roof of the mouth. Damage or poor functioning of the palate can affect swallowing, the voice, and breathing.
- * **myositis** (my-oh-SY-tis) is an inflammation of the muscles.
- * **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.
- * **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.
- * **myocarditis** (my-oh-kar-DYE-tis) is an inflammation of the muscular walls of the heart.
- * **pericarditis** (per-ih-kar-DYE-tis) is an inflammation of the sac surrounding the heart.
- * **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

DID YOU KNOW?

Coxsackievirus got its name from the town of Coxsackie, New York, the site of the first recognized outbreak of the virus infection in 1948.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

How Long Do Enterovirus Symptoms Last and What Are the Complications?

Enteroviruses can cause illness that lasts from three days to two weeks, depending on the type of infection. Fevers usually last a few days, whereas rash and blisters take longer to disappear. Dehydration* can become a problem, especially in infants and young children, because mouth sores can make eating and drinking painful. In such cases, intravenous* fluids may be required. It is recommended that people with enterovirus infections seek medical attention if they start to experience pain in the chest or abdomen, a sore throat that does not improve, difficulty in breathing, severe headaches, neck stiffness, or vomiting.

How Are Enterovirus Infections Prevented?

There is no vaccine to prevent enterovirus infections. As with most contagious infections, washing hands with soap and water after going to the bathroom, changing diapers, shaking hands with other people, and touching surfaces, especially those in public places, may help prevent the spread of infection. It is a good idea to cover the mouth and nose when coughing and sneezing and to avoid contact with other people who are coughing and sneezing. It is recommended that toys shared by infants and toddlers, especially in day-care settings, be cleaned daily with a disinfectant because enteroviruses and other viruses can survive on them for days. Doctors usually advise that an infected child be kept out of day care or school for a few days to avoid spreading the virus to others.

▶ See also **Conjunctivitis • Encephalitis • Hepatitis • Meningitis • Myocarditis/Pericarditis • Poliomyelitis**

Resources

Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

Cretinism See *Thyroid Disease*.

Creutzfeldt-Jakob Disease

Creutzfeldt-Jakob (KROYTZ-felt YAH-kub) disease is a fatal disorder of the brain.

What Is Creutzfeldt-Jakob Disease?

Described first in 1920 by German neurologist* Hans Gerhard Creutzfeldt (1885–1964) and Alfons Maria Jakob (1884–1931), Creutzfeldt-Jakob disease (CJD) is a very rare, slowly progressing and fatal disease of the brain. It is a form of transmissible* spongiform encephalopathy (SPUN-ji-form en-sef-a-LOP-a-thee), which means it causes the brain to become a sponge-like mass as it deteriorates. CJD damages the tissues of the brain, causing a rapid decline in mental function and muscle coordination, eventually leading to death. While most people who contract the disease die within several months, some people decline more slowly and may survive between one and two years after they are diagnosed. Creutzfeldt-Jakob disease usually affects people over 50 years of age, but a variant of the disease strikes younger people.

Because Creutzfeldt-Jakob disease affects the brain, its primary symptom is dementia* (dih-MEN-sha). Some signs of dementia are disorientation, neglect of personal hygiene and grooming, and irritability. Other symptoms are fatigue, insomnia*, and muscle twitching or sudden contractions. With no known cure as of 2009, medical treatment focused on palliative* care (intended to give comfort) designed to make people with CJD as comfortable as possible.

A tiny transmissible protein called a prion triggers CJD. The protease resistant protein (PRP) is found throughout the body in healthy people and in animals. However, it has two basic configurations, one diseased and one healthy. Its diseased configuration is believed to be the infection's agent. Essentially, the diseased protein is a misfolded protein, and it is thought that the misfolded protein is able to convert healthy protein molecules (simply by coming into contact with them) into the abnormal configuration. CJD is divided into three categories:

- Familial CJD, which accounts for up to about 10 percent of cases. In these instances, there exists a family history of the disease, and it has been theorized that in affected persons a mutation* has occurred in the gene that codes for PRP, suggesting that certain genes* shared by family members make them more susceptible to CJD.
- Sporadic CJD, in which afflicted people have no known risk factors for the disease and which make up about 85 percent of occurrences.
- Acquired or iatrogenic CJD, in which the defective protein is transmitted to an uninfected person due to exposure to infected brain or spinal tissue and which is the rarest form. Less than 5 percent of all cases result from exposure to infected brain or spinal tissue, occurring usually during a medical procedure.

CJD belongs to a family of diseases known as transmissible spongiform (SPUN-jih-form) encephalopathies (en-seh-fuh-LAH-puh-theez) (TSEs). Spongiform refers to the post-mortem appearance of brain tissue affected by the disease: The damaged tissue is riddled with holes, much like a

* **neurologist** (new-RHAL-eh-jist) a physician who specializes in diagnosing and treating diseases of the nervous system.

* **transmissible** (trans-MIH-sih-bul) means able to be transferred or spread.

* **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

* **insomnia** abnormal inability to get adequate sleep.

* **palliative** (PAL-ee-at-iv) means to ease or relieve without curing.

* **mutation** (myoo-TAY-shun) is a change in an organism's gene or genes.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

- * **kuru** (KUR-ew) is a progressive, fatal brain disease characterized by tremors and loss of muscle coordination that is caused by eating contaminated brain tissue from other humans who had the disease.
- * **scrapie** (SKRAY-pee) is a fatal brain disorder of sheep that is characterized by itching of the skin and difficulty walking.
- * **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.
- * **cornea** (KOR-nee-uh) is the transparent circular layer of cells over the central colored part of the eyeball (the iris) through which light enters the eye.
- * **dura mater** (DUR-uh MAY-ter) is the outermost of three membranes covering the brain and spinal cord.
- * **grafts** are tissue or organ transplants.
- * **pituitary** (pih-TOO-ih-tare-e) is a small oval-shaped gland at the base of the skull that produces several hormones—substances that affect various body functions, including growth.
- * **growth hormone** is a chemical substance produced by the pituitary gland that regulates growth and other body functions.
- * **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.

sponge. Other diseases in the CJD family are kuru*; bovine spongiform encephalopathy (BSE), which infects cattle and is known as mad cow disease; and scrapie*, which affects sheep, goats, and other animals. CJD generally affects people over the age of 50. However, in 1996 scientists identified a new form of CJD, called variant CJD or new variant CJD (vCJD), which typically affects people under the age of 30 and causes different symptoms. As of 2009, cases of vCJD had been limited mostly to the United Kingdom and France, and all the people in whom vCJD developed were exposed to areas where BSE had been found.

How Common Is Creutzfeldt-Jakob Disease?

CJD is rare. It occurs in one person per one million people worldwide. In the United States, about 200 cases are diagnosed annually. The age of onset for classical CJD is between 50 and 75 years, with the average age of onset about 60 years of age. About 90 percent of cases end in death within one year after symptoms begin, while the remaining 10 percent of people with CJD survive for one to two years.

Is Creutzfeldt-Jakob Disease Contagious?

Although CJD is transmissible, it does not appear to spread through usual types of direct person-to-person contact. CJD can be transmitted through contact with infected brain or central nervous system* tissue or fluid, contact that arises usually only during a medical procedure. For example, the disease has been reported to have occurred after cornea* transplants and dura mater* grafts*, following injection of human pituitary*-derived growth hormone*, and after contact with medical instruments that were used during brain surgery or other surgery on a person with the disease. Cerebrospinal fluid* can be responsible for the spread of CJD, but there is no evidence of transmission of the disease through other body fluids, including saliva, blood, or urine. Variant CJD has occurred only where cases of BSE also have been found, leading researchers to theorize that eating beef from cattle with BSE could spread the agent and lead to CJD in humans. Although this explanation was widely accepted, it had not been proved as of 2009.

What Are the Signs and Symptoms of Creutzfeldt-Jakob Disease?

The most characteristic symptom of CJD is quickly worsening dementia, including memory loss and impaired thinking. Patients often have problems with vision and muscle coordination. The inability to sleep, unusual sensations, and depression are also common. Many patients experience muscle jerking known as myoclonus (my-AH-kloh-nus), which consists of brief, rapid muscle contractions. If the disease was contracted from infected human tissue (such as from a transplanted cornea), symptoms may not appear for decades after exposure to the contaminated tissue. Variant CJD at first causes psychiatric (sy-kee-AH-trik) symptoms, such as depression, anxiety (ang-ZY-uh-tee), or personality changes; dementia and myoclonus typically occur later than in classic CJD.

How Is Creutzfeldt-Jakob Disease Diagnosed?

CJD can be diagnosed by a brain biopsy (BI-op-see), which requires removing a small piece of brain tissue during surgery to examine for signs of the disease, or at an autopsy*. Other, less invasive tests may point to a diagnosis of CJD or help to exclude other diagnoses, such as meningitis or encephalitis. During a physical examination, the doctor checks for muscle twitching and spasms. An eye exam may show areas of blindness that the patient may not have noticed, and a spinal tap* and blood tests may identify certain proteins associated with CJD. An electroencephalogram

MAD COW DISEASE AND THE HUMAN CONNECTION

In 1986, the brain disease called bovine spongiform encephalopathy (BSE) was discovered in cows. Termed “mad cow disease” because the infected cows stumbled and lost muscular coordination, the disease had been transmitted to the cows from feed made from ground sheep bones and parts. The sheep disease scrapie had been passed on to the cattle. (Scrapie is another form of spongiform encephalopathy found in sheep that causes them to lose coordination and exhibit behavior described as scraping up against the fences of their pastures.)

It was thought that the infectious agent of mad cow disease could not be passed on to people, but the British Ministry of Health discovered a variant form of CJD in people younger than the average age for CJD cases. BSE was subsequently linked to variant CJD. The practice of feeding cows sheep parts may have caused an epidemic* of BSE among cows in the United Kingdom, so in 1988 this feeding practice was banned. Countries all over Europe and other parts of the world began to ban the import of beef from Britain, and millions of cattle in Britain were killed in order to avoid spreading the disease. Many people turned to vegetarian diets, and many restaurants stopped serving beef. The number of new BSE cases dropped sharply, and then the ban on beef coming from the United Kingdom in the United States was lifted.

To further prevent the transmission of mad cow disease to humans, surveillance programs were put into effect to test cows for the disease before they are allowed to enter the food chain. The number of cows tested varies by country, as does the type of cow tested. Some countries test only cows that have been classified as “downer cows,” or cows that cannot walk, for BSE. Other countries test a selection of seemingly healthy cows as well as downer cows and test a greater number of cows than are tested in the United States. The U.S. government tests only a sample of cows from the population to screen for BSE. In 2007, the Department of Agriculture’s Food Safety and Inspection Service (FSIS) announced a permanent prohibition on the slaughter of downer cattle for food processing. The U.S. government only allows the animals with healthy appearance to be used as food, and it maintains meat removal practices that keep brain and spinal cord matter from getting into processed meat.



Variant Creutzfeldt-Jakob disease has occurred only where cases of bovine spongiform encephalopathy also have been found, leading researchers to theorize that eating beef from cattle with BSE could spread the agent. In France and England whole herds of cattle have been put to death in an effort to prevent the spread of disease. *AP Images.*

* **autopsy** (AW-top-see) is an examination of a body after death to look for the cause of death or the effects of a disease.

* **spinal tap** also called a lumbar puncture, is a medical procedure in which a needle is used to withdraw a sample of the fluid surrounding the spinal cord and brain. The fluid is then tested, usually to detect signs of infection, such as meningitis, or other diseases.

* **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.

Genetically Engineered Bacteria to the Rescue

Growth hormone once was obtained from the pituitary glands of cadavers (corpses), and patients who needed injections of growth hormone were at risk of getting CJD. Later growth hormone was produced in laboratories by inserting the genes controlling the production of growth hormone into bacteria, thus avoiding the need to extract the hormone from human tissue and eliminating the risk of transmitting CJD.

* **microorganism** is a tiny organism that can be seen only by using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

ARE PRIONS INFECTIOUS?

Like bacteria, viruses, and parasites, prions, which are abnormal versions of widely occurring protein particles, have been linked to certain transmissible diseases. Yet prions are different from other infectious agents. Whereas microorganisms* contain genetic material, prions do not, which means that prions are not alive. According to the prion theory, the protein (PRP) at first cannot cause or transmit disease. Instead, it undergoes a change that causes it to fold into a different shape, its “infectious” form. When one of these abnormal proteins enters a brain cell in the course of CJD, it binds to normal proteins, causing them to change shape. This sets off a chain reaction that leads to cell death and the release of more prions that will, in turn, enter and affect more cells. As cells die, holes form in brain tissue, giving it the characteristic sponge-like appearance. Prions can be acquired during a medical procedure or from some other exposure to brain tissue or fluids containing brain tissue. In the inherited form of CJD, it is believed that a gene mutation causes some normal protein to change into prions under certain conditions.

(EEG) test records electrical activity in the brain and may show a pattern of brain waves seen in many patients with CJD, although the typical EEG findings are not present in vCJD. Some people with CJD have negative test results, making a diagnosis difficult without a brain biopsy.

What Is the Treatment and Course of Creutzfeldt-Jakob Disease?

Because CJD cannot be cured, the goal of treatment is to make the patient as comfortable as possible. Medications can help control aggressive behavior, lessen pain, and ease muscle jerks. Dementia can progress to loss of speech, the inability to take care of oneself, blindness, and even coma*. As patients become bedridden, they are vulnerable to infections, such as pneumonia, and most eventually need to be hospitalized. Many patients die within a year after symptoms appear.

How Can Creutzfeldt-Jakob Disease Be Prevented?

No measures known as of 2009 could prevent the onset of CJD in a person whose brain tissue contains the prion. Because the ways by which the disease can be transmitted were still not fully understood, blood banks forbid people with confirmed or suspected CJD or those who may be at high risk, such as people with a family history of the disease, to donate blood, and doctors advise that they not be organ or tissue donors. Family members of a person with CJD may wish to have genetic counseling to learn more about any family risk. Special handling of surgical instruments can limit the chance of transmission during certain medical procedures, particularly those involving the brain.

▶ See also **Prion Diseases**

Resources

Books and Articles

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- Ferreiro, Carmen. *Mad Cow Disease (Bovine Spongiform Encephalopathy)*. Philadelphia, PA: Chelsea House, 2005.

Organizations

- Creutzfeldt-Jakob Disease Foundation.** P.O. Box 5312, Akron, OH, 44334. Toll free: 800-659-1991. Web site: <http://cjd.foundation.org>.
- University of California, San Francisco Memory and Aging Center.** 400 Parnassus Avenue, San Francisco, CA, 94143. Telephone: 415-476-6880. Web site: <http://www.ucsfhealth.org>.

Crohn's Disease

Crohn's disease is an inflammation of the alimentary canal. Inflammation from the disease can occur anywhere along the canal from the mouth the anus although it usually starts in the lower part of the small intestine, called the ileum, or in the colon. Its signs and symptoms vary widely among afflicted individuals.

What is Crohn's Disease?

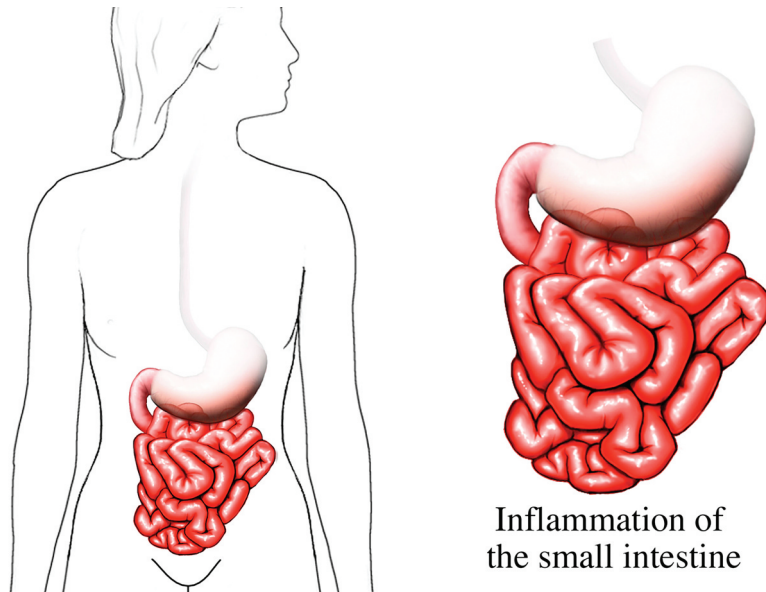
Crohn's disease is an inflammation of the alimentary canal for which the cause was unknown as of 2009 but the characteristics were well defined. The alimentary canal includes the mouth, esophagus, stomach, intestines, colon, and rectum. Inflammation from the disease can occur anywhere along the canal from the mouth the anus. It usually starts in the lower part of the small intestine, called the ileum, or in the colon.

The disease was named after American gastroenterologist Burrill Bernard Crohn (1884–1983), who described its symptoms in 1932 after observing various symptoms in patients all with an inflamed terminal ileum (the portion of the small intestine most distant from the digestive tract).

Classified as a type of inflammatory bowel disease (IBD), Crohn's disease can often be present simultaneously at various locations within the digestive tract. In fact, among its most characteristic features is the

Inflammation of the small intestine is a symptom of Crohn's Disease.

© Nucleus Medical Art, Inc./Alamy.



* **ulcers** are open sores on the skin or the lining of a hollow body organ, such as the stomach or intestine. They may or may not be painful.

presence of inflamed regions of intestine separated by apparently normal regions called skip areas. Another characteristic feature is that the inflammation goes through all layers of the intestinal wall from the innermost mucosal layer through the outermost serosal layer. The intense transmural nature of the inflammation explains the frequent stricture formation in the presence of holes, called fistulae, which pierced the intestinal wall. Because the inflammation can be at multiple sites, its signs and symptoms vary widely among afflicted individuals.

What Are the Signs and Symptoms of Crohn's Disease?

The visible signs and symptoms of Crohn's disease vary widely among individuals, and they may appear abruptly or take a long time to show up. However, overall, the primary signs and symptoms are:

- **Abdominal pain.** The bowel is likely to swell when inflammation occurs in its walls. Eventually, scar tissue may form, which can cause short areas of narrowing, called strictures, which obstruct the flow of intestinal contents and stretch the intestinal wall upstream to the stricture. This dilating, or stretching, of the intestine causes pain. Small ulcers (in minor cases) and large ulcers* (in more serious cases) that often penetrate into, or through, the tissues of the wall. These problems likely lead to reduced flow of digestive materials, which can lead to some discomfort at first with intensifying pain and cramping later on.
- **Bloody stool.** As food passes through the digestive tract, it can cause the inflamed, and sometimes ulcerated, tissues to bleed. The stool rarely appears as reddish in color as it often does in ulcerative colitis, another inflammatory bowel disease.

- **Diarrhea.** Inflammation of the digestive tract causes its tissues to secrete a saltwater-like solution. (Crohn's disease does not generally produce a secretory type of diarrhea. The diarrhea generally results from a combination of malabsorption and maldigestion along with intestinal motility disorder characterized by areas of partial structure and with brushes of intestinal content.) This buildup of liquids in the colon can produce loose stools—somewhat less firm than normal in minor cases, but much more liquid in severe cases. In these major cases, the patient can have multiple bowel movements each day.
- **Fistula or abscess.** Inflammation of the digestive tract can become so severe that the tract expands into other bodily organs. Such activity produces a fistula, or a physical connection between the other organs and the digestive tract. In other cases, an abscess* can be produced; that is, a pus-filled swollen sore.
- **Mouth ulcer.** Besides ulcers in the digestive tract, small sores, which look and feel like canker sores, may appear in the mouth.
- **Weight loss.** A reduced appetite and, consequently, weight loss usually result as inflammation in the digestive tract reduces a person's ability to digest and absorb nutrients throughout the body. Nausea and vomiting also contributes to weight loss.

When severe cases of Crohn's disease occur, other signs and symptoms can include arthritis, eye inflammation, fatigue, fever, inflammation of a bile duct* or the liver, and skin rashes. The signs and symptoms associated with the disease become more numerous and severe as the inflammation travels into more regions of the digestive tract. Crohn's disease is usually not a fatal condition. However, if left untreated, it can become a serious problem that can endanger the life of the patient.

How Is Crohn's Disease Diagnosed?

Especially when abdominal pain, bloody stool, bowel habit changes, diarrhea, and unexplained fever are present, a medical professional should be consulted. The professional, possibly a gastroenterologist (a person specializing in diseases of the digestive system), will likely use some of the following tests to identify the problem:

- **Upper gastrointestinal (GI) series:** Crohn's disease most frequently involves the upper GI tract, and upper GI series is generally done before a barium enema in suspected cases.
- **Barium enema:** Barium, a chalky solution that improves x-ray images. A barium enema is introduced into the lower gastrointestinal tract through a tube inserted into the anus before the observation of the large intestine.
- **Blood tests:** To analyze the blood for signs of inflammation and the presence of antibodies
- **Colonoscopy:** To observe the physical characteristics of the interior of the colon

* **abscess** (AB-ses) is a localized or walled off accumulation of pus caused by infection that can occur anywhere in the body.

* **bile duct** is a passageway that carries bile, a substance that aids the digestion of fat, from the liver to the gallbladder (a small pouch-like organ where the bile is temporarily stored) and from the gallbladder to the small intestine.

* **computerized tomography**

(kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **endoscopy** (en-DOS-ko-pee) is a type of diagnostic test in which a lighted tube-like instrument is inserted into a part of the body.

* **autoimmune diseases** (aw-toh-ih-MYOON) are diseases in which the body's immune system attacks some of the body's own normal tissues and cells.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **remission** is an easing of a disease or its symptoms for a prolonged period.

- Small bowel x-ray: To take pictures of the small bowel
- Computerized tomography* (CT) scans: To provide extra details that x-rays cannot convey
- Flexible sigmoidoscopy: To examine the sigmoid, which is the last segment of the colon
- Capsule endoscopy*: If all other tests result in a negative diagnosis, to have a video recording of the digestive tract by placing a minuscule camera inside a capsule, which is swallowed by the patient so it can record the entire length of the digestive tract

What Are the Causes of Crohn's Disease?

The exact physical cause of Crohn's disease was not known as of 2009. However, medical professionals think that genetic factors have something to do with causing the disease, as is the case with most autoimmune diseases*. About 20 percent of all patients have family members with the disease. Mutations (changes) in specific genes are believed to be the basis of this genetic problem.

Crohn's disease may also be caused by a problem with the person's immune system*. Bacteria or viruses may invade the human body and when the immune system tries to counter the germs, the digestive tract becomes inflamed. In another scenario, an abnormally functioning immune system may attack bacteria normally found in the intestines. Such action also causes the digestive tract to become inflamed. These theories were considered possible explanations as of 2009.

Some medical professions think that Crohn's disease is not caused by long-term anxiety and stress or any particular diet and eating habits. However, both emotional stress and diet are likely to complicate the condition.

How Is Crohn's Disease Treated?

A cure for Crohn's disease was not known as of 2009. Its treatment options aim to control the progression of the disease and the severity of the symptoms. If the disease goes into remission*, then such treatments help to minimize the chance that patients will relapse. When treatments are successful, most patients with Crohn's disease return to their normal daily lives.

Anti-inflammatory drugs are commonly the first step to treat Crohn's disease. Corticosteroids, mesalamine (Asacol, Rowasa), and sulfasalazine (Azulfidine) are among the anti-inflammatory drugs used.

Immune system suppressor drugs are used in some cases. Commonly used immune system suppressors are adalimumab (Humira), azathioprine (Imuran), infliximab (Remicade), and mercaptopurine (Purinetholand).

Antibiotic drugs are used to control abscesses and fistulas and to reduce intestinal bacteria—both problems that cause more severe symptoms among patients with Crohn's disease. Two frequently used antibiotics are ciprofloxacin (Cipro) and metronidazole (Flagyl).

WHAT CAN BE DONE IF TRADITIONAL TREATMENTS DO NOT WORK?

The National Center for Complementary and Alternative Medicine (NCCAM) was established by the National Institutes of Health (NIH) to provide resources and information for the non-traditional treatment of diseases such as Crohn's disease. Medical studies have shown that one out of two persons with Crohn's disease tries complementary or alternative therapies and medicines. However, medical science had not determined as of 2009 if these non-traditional treatments work. For the most part, the Food and Drug Administration does not regulate herbal and nutritional supplements used in such treatments. In addition, most Crohn's disease patients do not report non-traditional medicines to their family doctor, so their effectiveness has not been well documented. The web site of the NCCAM is <http://nccam.nih.gov>.

Other medicines used include anti-diarrheals, laxatives, pain relievers, along with supplements, including calcium, iron, vitamin B-12, and vitamin D. A special diet may also be prescribed to reduce the severity of symptoms.

As a last resort to relieve symptoms, surgery may be performed to remove one or more inflamed or severely damaged sections of the digestive tract. Surgery may also be recommended to eliminate fistulas or remove scar tissue. A surgical procedure is often used to widen a narrowed section of intestine. Many patients with Crohn's disease eventually have some type of surgery, and since the relief from surgery is temporary, many individuals have more than one surgery as their disease progresses.

Who Gets Crohn's Disease?

About 500,000 people in North America are afflicted with Crohn's disease. Men and women are equally at risk for getting the symptoms associated with the disease. People of all ages can develop the condition. However, teenagers and young adults in their 20s and 30s are most likely to get it, followed by people in their 50s to 70s.

Any ethnic group can acquire Crohn's disease. However, Caucasians have the highest risk. In fact, people of Jewish and European descent are four to five times more likely to get the disease than any other ethnic groups.

A person's immediate family is another important consideration when evaluating risk. If a person within an immediate family has Crohn's disease, then the other family members are at least thirty times more likely to get it than anybody else outside that family.

In addition, a person who uses tobacco is more likely to develop Crohn's disease than a non-smoker. The use of tobacco products during treatment also makes the disease much more difficult to treat successfully.

- * **trachea** (TRAY-kee-uh) is the windpipe—the firm, tubular structure that carries air from the throat to the lungs.
- * **larynx** (LAIR-inks) is the voice box (which contains the vocal cords) and is located between the base of the tongue and the top of the windpipe.
- * **stridor** (STRY-dor) is a high-pitched, squeaking noise that occurs while breathing in, present usually only if there is narrowing or blockage of the upper airway.

The physical environment in which people live is thought to be a contributing factor for developing Crohn's disease. Studies have found that people living in industrialized countries, especially those inside heavily polluted cities, are at higher risk for the disease than people living in non-industrialized countries and cities with clean air.

▶ See also **Colitis • Inflammatory Bowel Disease**

Resources

Books and Articles

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Steinhart, Allan Hillary. *Crohn's and Colitis: Understanding and Managing IBD*. Toronto, Canada: R. Rose, 2006.

Organization

National Association for Colitis and Crohn's Disease. 800 South Northwest Highway, Suite 200, Barrington, IL, 60010. Toll free: 800-662-5874. Web site: <http://www.nacc.org.uk/content/home.asp>.

Cross Eyes/Crossed Eyes See *Strabismus*.

Croup

Croup (KROOP) is the name for a group of conditions, typically occurring in childhood, in which the trachea (windpipe) and larynx (voice box) become inflamed, and the upper airway narrows. As a result, croup can sometimes make breathing difficult. The characteristic symptom is a barking cough, which may be accompanied by a grunting or wheezing noise when the child inhales. Although the breathing difficulties frequently cause considerable alarm among parents, most children recover from croup without any complications.

What Is Croup?

Croup is an inflammation of the throat, and specifically the trachea* and the larynx*. The upper airway narrows, which may cause breathing difficulties. Typically occurring in childhood, the condition is characterized by a barking cough that often becomes especially evident when a child is crying. In more severe cases of croup, a high-pitched or squeaking noise called stridor* can be heard when the child takes a breath. The symptoms

can appear suddenly or develop over a few days. Common cold symptoms, such as a runny nose, usually precede the onset of the barking cough. An allergy or a bacterial infection can produce symptoms of croup, but the majority of cases, 75 percent or more, are caused by a virus, usually parainfluenza* virus. Influenza viruses, adenovirus*, respiratory syncytial virus*, and measles virus also can cause croup.

Who Gets Croup?

Croup tends to develop in infants and toddlers, because the windpipe is still small enough to be impeded by swelling. As a child grows older, the risk of croup drops. Adult cases of croup, although very rare, do occur. Croup is most common during the winter months and in the early spring. In the same way that an adult with a cold might have laryngitis*, a child with a cold might get croup. In fact, many of the viruses that cause croup in children can lead to laryngitis in adults. Some children are more prone to croup, for example, those who are born prematurely or who have narrowed upper airways. These children may get symptoms of croup every time they have a respiratory illness. Although the viruses that cause croup can pass easily between children through respiratory secretions, most children who come into contact with those viruses will not get croup.

What Are the Symptoms and Complications of Croup?

Croup is typically divided into two types: a spasmodic form and a viral form. Spasmodic croup results from an allergy or a mild respiratory infection and usually comes on suddenly. Viral croup arises from a viral infection and usually develops slowly over several days. A low fever is common in children with viral croup, but not among those with spasmodic croup. In both cases, children typically have a cough that resembles the sound of a barking seal. Crying can make the breathing symptoms worse. The symptoms also tend to worsen at night when children are tired, and a child with croup will often have trouble sleeping or even resting. In severe cases, when the airway becomes more swollen and narrowed, a child might experience difficulty breathing, which may include fast breathing and/or stridor. If oxygen intake drops too low, the lips, tongue, and skin around the mouth can start to appear bluish. In general, croup symptoms peak two to three days after they start, and the illness generally lasts less than a week. Children usually make a full recovery without complications, but in a small number of cases, they may experience an ear infection or pneumonia.

How Is Croup Diagnosed and Treated?

A barking cough is a telltale sign of croup. Other clues to the diagnosis are stridor, low fever (in cases of viral croup), common cold symptoms, previous bouts of croup, or a history of intubation* or other upper-airway problems. The degree of obstruction of the airways is the doctor's most important consideration in diagnosing and

* **parainfluenza** (pair-uh-in-floo-EN-zuh) is a family of viruses that cause respiratory infections.

* **adenovirus** (ah-deh-no-VY-rus) is a type of virus that can produce a variety of symptoms, including upper respiratory disease, when it infects humans.

* **respiratory syncytial virus** (RES-puh-ruh-toe sin-SIH-she-ul), or RSV, is a virus that infects the respiratory tract and typically causes minor symptoms in adults but can lead to more serious respiratory illnesses in children.

* **laryngitis** (lair-in-JY-tis) is an inflammation of the vocal cords that causes hoarseness or a temporary loss of voice.

* **intubation** (in-too-BAY-shun) is the insertion of a tube into the windpipe to allow air and gases to flow into and out of the lungs in a person who needs help breathing.

* **epiglottitis** (eh-pih-GLAH-tis) is a soft flap of tissue that covers the opening of the trachea (windpipe) when a person swallows to prevent food or fluid from entering the airway and lungs.

* **epinephrine** (eh-pih-NEH-frin) is a chemical substance produced by the body that can also be given as a medication to constrict, or narrow, small blood vessels, stimulate the heart, and cause other effects, such as helping to open narrowed airways in conditions like asthma and croup.

* **corticosteroid** (KOR-ti-ko-STER-oid) is one of several medications that are prescribed to reduce inflammation and sometimes to suppress the body's immune response.

treating croup. If the bronchi (breathing tubes), the lungs, or the epiglottis* become infected, a child may be unable to breathe or swallow adequately, and that is a true medical emergency. If the symptoms are severe, or if the child does not respond quickly to treatment, medical professionals may recommend a neck x-ray to check for specific causes of the breathing difficulty.

For most cases of croup, however, parents can treat their children at home. A common home treatment for mild cases of croup is moist air from a steam-filled bathroom or a cool-mist humidifier. The mist moistens the child's airway, helps open the air passage, and relieves coughing. Parents may also find that taking the child outdoors for a few minutes, even in the winter, can ease a coughing attack quickly, because the cool air can shrink the swollen tissues lining the airway. As with most illnesses, drinking fluids and getting plenty of rest help the body heal. Cigarette smoke near a child with croup or any other respiratory illness can make symptoms worse. Doctors advise prompt medical treatment for serious croup infections. Treatment may include inhaled medications, including epinephrine*, to minimize swelling in the upper airways. Doctors often will administer corticosteroid* medicines to ease airway swelling for a few days while the child recovers from the virus infection that causes croup. Although many hospitals place a child in a room with humidity levels of 100 percent, a study in a 2006 issue of the *Journal of the American Medical Association* showed no advantage in the high humidity compared with humidity levels of 40 percent.

As of the early 2000s, croup was not preventable, but frequently washing hands and avoiding contact with people who have respiratory infections was known to lessen the chance of spreading the viruses that cause croup.

▶ See also **Common Cold • Epiglottitis • Influenza • Laryngitis • Pertussis (Whooping Cough) • Pneumonia**

Resources

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://familydoctor.org/online/famdocen/home/children/parents/common/ent/220.html>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dvrd/revb/respiratory/hpivfeat.htm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/MEDLINEPLUS/ency/article/000959.htm>.

Cryptosporidiosis See *Cyclosporiasis and Cryptosporidiosis*.

Cushing's Syndrome

Cushing's syndrome is a condition that occurs when the body is exposed to high levels of the hormone cortisol. Symptoms may include muscle weakness, weight gain, a round face (often referred to as a moon face), the growth of fat pads in specific places (along the collar bone and at the back of the neck), extra body fat, the growth of facial and body hair, and emotional problems.*

What Is Cushing's Syndrome?

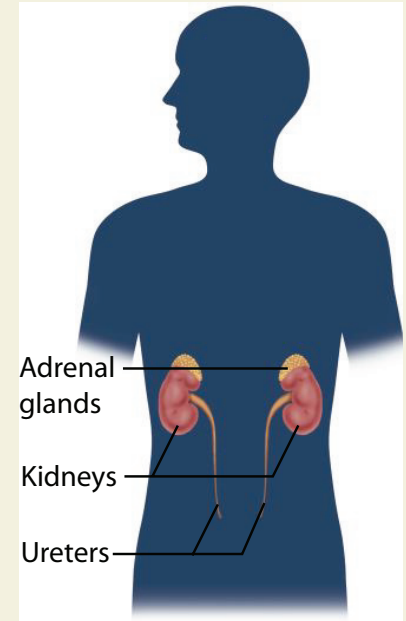
Cushing's syndrome occurs when the body is exposed to high levels of the hormone cortisol for long periods. Cortisol is often called the “stress hormone” because its level in the body rises in response to stress. In the healthy individual cortisol helps to manage stress and to repair its ill effects. Cortisol helps regulate blood pressure and the metabolism, which is the sum total of all of the chemical reactions occurring in cells (including the conversion of food into energy and waste products). Cortisol also plays a role in immune system responses to stress. As with most hormones, the amount of cortisol in the body must be closely controlled, as either too much or too little cortisol has negative effects on the body.

In a healthy person, cortisol production is regulated by the interactions of three parts of the endocrine* system:

1. A part of the brain called the hypothalamus* (hy-po-THAL-uh-mus) secretes the corticotropin-releasing hormone (CRH).
2. CRH signals, the pituitary* gland located at the base of the brain and just below the hypothalamus to release adrenocorticotropic hormone (ACTH).
3. ACTH circulates in the bloodstream and stimulates the adrenal glands, paired organs located just above the kidneys in the abdominal cavity, to make cortisol and release it into the bloodstream. Cortisol then acts on various cells that help to regulate blood pressure and the use of fats, proteins, and carbohydrates in the body, particularly during times of stress. If something goes wrong with any of these glands or with the signaling system, the body may produce too much cortisol.

How Does Cushing's Syndrome Develop?

Use of glucocorticoid-based medications The most common cause of Cushing's syndrome is long-term treatment (daily doses for weeks or months) with drugs that are chemically related to cortisol



▲ The adrenal glands are a pair of organs located just above the kidneys in the abdominal cavity. In some people with Cushing's syndrome, the adrenal glands produce too much of the hormone cortisol. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **endocrine** (EN-do-krin) refers to a group of glands, such as the thyroid, adrenal, and pituitary glands, and the hormones they produce. The endocrine glands secrete their hormones into the bloodstream, and the hormones travel to the cells that have receptors for them. Certain hormones have effects on mood and sometimes cause emotional swings.

How Did Cushing's Syndrome Get Its Name?

Harvey Williams Cushing (1869–1939) was a leading American brain surgeon. Drawing on his observations of the pituitary gland, he made the connection between pituitary tumors and a collection of signs and symptoms that were shared by patients who had these tumors. He published his findings in 1932 and later the signs and symptoms he described became known as Cushing's syndrome.

* **hypothalamus** (hy-po-THAL-uh-mus) is a brain structure located deep within the brain that regulates automatic body functions such as heart rate, blood pressure, temperature, respiration, and the release of hormones.

* **pituitary** (pih-TOO-ih-tare-e) is a small oval-shaped gland at the base of the skull that produces several hormones—substances that affect various body functions, including growth.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **asthma** (AZ-mah) is a condition in which the airways of the lungs repeatedly become narrowed and inflamed, causing breathing difficulty.

* **rheumatoid arthritis** (ROO-mah-toyd ar-THRY-tis) is a chronic disease characterized by painful swelling, stiffness, and deformity of the joints.

* **lupus** (LOO-pus) is a chronic, or long-lasting, disease that causes inflammation of connective tissue, the material that holds together the various structures of the body.

and can be converted into cortisol by the body. These drugs as a group are referred to as steroids, glucocorticoid-based drugs, or cortisone-like drugs. Prednisone is a common example. Glucocorticoid-based drugs are used to treat chronic inflammation* in disorders such as asthma*, rheumatoid arthritis*, lupus*, and other less common inflammatory diseases.

Tumors Some pituitary tumors can produce increased amounts of ACTH, which in turn causes the adrenal glands to produce excess cortisol. This form of the syndrome is known as Cushing's disease. Most of the ACTH-secreting tumors of the pituitary are not cancerous, and most affected people have only a single tumor. The tumors are five times more likely to occur in women than in men. Cushing's disease accounts for about 70 percent of all cases of Cushing's syndrome not caused by glucocorticoid-based therapies.

Tumors that arise elsewhere in the body, such as in the lungs, can also produce ACTH. Most ACTH-producing tumors located outside the pituitary gland are cancerous (malignant). In rare cases, tumors of the adrenal tissue itself cause excess cortisol production. Although most cases of Cushing's syndrome are not inherited, the tendency to develop tumors can be inherited.

What Are the Signs and Symptoms of Cushing's Syndrome?

The signs and symptoms of Cushing's syndrome are the same whether the syndrome is caused by drug therapy or tumor secretion. These include the following:

- Rounded face
- Increased fat in the region of the neck and upper body obesity
- Thin arms and legs
- Thin and fragile skin that bruises easily
- Purplish stretch marks* associated with fragile skin (the purplish color due to hemorrhages in the skin)
- Slow wound healing
- Slow recovery from surgery
- Weakened bones (osteoporosis)
- Fatigue and weak muscles
- Problems with sugar metabolism, which may lead to diabetes
- Menstrual irregularities
- Growth of excess facial and body hair
- High blood pressure
- Irritability and depression
- Increased susceptibility to bacterial infections

How Is Cushing's Syndrome Diagnosed and Treated?

Diagnosis A doctor who sees a patient with symptoms suggestive of Cushing's syndrome will ask questions about the person's medical history and medications being taken and perform a physical examination. Three specific laboratory tests that involve analysis of cortisol levels in the blood and urine are commonly used to measure cortisol levels. If cortisol levels are high, other tests are done to find out why. For example, imaging techniques for looking inside the body (such as CT scans* and MRIs*) can be used to look for tumors.

Treatment The treatment of tumors varies, depending on the tumor's location and whether it is cancerous. Noncancerous pituitary tumors are often successfully removed surgically. Cancerous tumors or pituitary tumors that cannot be operated on may be treated with radiation therapy or chemotherapy*, depending on the location of the tumor and the patient's general health. Additionally, Cushing's syndrome sometimes is treated with drugs that inhibit cortisol production.

If Cushing's syndrome occurs as a by-product of drug therapy, doctors will try to alter the drug dosage by reducing it, adjusting the patient's medication schedule so that there is less frequent dosing, or changing the medication to minimize the side effects of the drugs. Cortisol-inhibiting drugs may also be given.

Modifications of drug regimens (in the case of illness caused by drug therapies) and surgical removal of tumors can lead to a full recovery, although sometimes the tumors recur. When pituitary tumors are removed, the patient's level of ACTH may drop below normal. In such a case the patient must take doses of supplemental cortisol, until ACTH production returns to normal.

▶ See also **Metabolic Disease • Obesity • Osteoporosis**

Resources

Organizations

Cushing's Support and Research Foundation. 65 East India Row, Suite 22B, Boston, MA 02110. Telephone: 617-723-3824. Web site: <http://www.csrff.net>.

National Endocrine and Metabolic Diseases Information Service. 6 Information Way, Bethesda, MD, 20892-3569. Toll free: 888-828-0904. Web site: <http://www.endocrine.niddk.nih.gov/pubs/cushings/cushings.htm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/cushingsyndrome.html>.

* **stretch marks** are stripes or lines on the skin (such as on the hips, abdomen, and breasts) from excessive stretching and rupture of elastic fibers, especially due to pregnancy or obesity.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **MRI** short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **parasites** (PAIR-uh-sites) are organisms such as protozoa (one-celled animals), worms, or insects that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. Parasites live at the expense of the host and may cause illness.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

Cyclosporiasis and Cryptosporidiosis

Cyclosporiasis (sy-klo-spor-I-a-sis) and cryptosporidiosis (krip-to-spo-ri-die-O-sis) are infections in the intestines that result from eating or drinking food or water contaminated by the parasites Cyclospora cayetanensis and Cryptosporidium parvum. These infections can result in diarrhea, stomach cramps, and nausea.

The Milwaukee Story

Thousands of people in Milwaukee, Wisconsin, started to get sick in early 1993 during the time that the Frozen Four, the college ice hockey finals were being played there. They had stomach pains, nausea, fever, and diarrhea, as if perhaps they had influenza. But authorities soon discovered that dangerous one-celled parasites* were in the city's water supply. When people drank the contaminated water, cryptosporidiosis developed.

In the end, more than 400,000 people came down with symptoms of cryptosporidiosis. More than 100 people died, including many who had other diseases such as AIDS*. The parasite had entered the water system from human waste in Lake Michigan, a water source for the city. Filters on the city's water plant had not removed the parasite. That problem was remedied.

How Do People Get Cyclosporiasis and Cryptosporidiosis?

Cryptosporidiosis and cyclosporiasis, a closely related illness, are common infections that result from contaminated water and food. They (and similar illnesses) affect millions of people worldwide and are especially dangerous to children, the elderly, and people with diseases that weaken the immune system, such as AIDS. The infections are common in developing nations, but they also are found increasingly in developed nations that import food, such as the United States. For example, a 1996 outbreak of cyclosporiasis in Houston, Texas, was linked with raspberries imported from Guatemala.

Cyclosporiasis and cryptosporidiosis result when humans eat food or drink water containing the cyst form of microscopic parasites from infected human or animal waste. The *Cyclospora cayetanensis* and *Cryptosporidium parvum* parasites can also enter the human body when people touch objects that have come in contact with infected fecal matter and then place fingers in their mouths. Fresh fruits and vegetables can become contaminated if they are irrigated with water that contains the parasites.

Additionally, as the ease and frequency of global travel have increased and as importation of food sources has increased, these infections gained the ability to spread from one part of the world to another in very short periods of time.

What Happens When People Get Cyclosporiasis and Cryptosporidiosis?

Symptoms Although caused by different parasites, cyclosporiasis and cryptosporidiosis may cause similar symptoms: watery diarrhea, stomach pain, nausea, fever, and vomiting. Weight loss, due to the diarrhea, and loss of appetite are also common. The first symptoms of cyclosporiasis often appear a week after the parasite enters the body, but the first symptoms of cryptosporidiosis may appear as soon as two days after infection or as long as ten days after. The illnesses can last for a few days to two weeks. Infections from cyclosporiasis sometimes last more than a month and return one or more times.

Diagnosis It can be hard to diagnose cyclosporiasis and cryptosporidiosis, because many illnesses can cause similar symptoms. If doctors suspect these infections, they may order tests to examine patients' stool for signs of the parasites.

Treatment The danger of intestinal infections such as cyclosporiasis and cryptosporidiosis is dehydration* from the loss of water through diarrhea. Doctors remind patients to drink plenty of fluids, such as water and sports drinks. Cyclosporiasis can also be treated with antibiotics*. Cryptosporidiosis, however, has no specific drug cure. Usually people completely recover from either illness in a week or two. People with AIDS and other diseases that weaken the immune system need extra medical attention, because they are at higher risk of more severe and more prolonged infections.

How Are These Infections Prevented?

Intestinal infections such as cyclosporiasis and cryptosporidiosis are among the most common illnesses in the world. Several preventive measures can lower the chances of getting these or similar intestinal illnesses:

- Washing hands frequently and thoroughly with hot water, especially after going to the bathroom, changing diapers, playing with animals or cleaning up after them, and gardening, because the soil can be contaminated by animal or human waste. It also is important to clean hands before eating.
- Washing fresh fruits and vegetables thoroughly before eating. Even fruit that can be peeled should be washed.
- Avoiding drinking unfiltered water from lakes, rivers, and other sources. Even a sparkling spring might be contaminated and should not be used for drinking water. It is also important to avoid swallowing water in lakes and rivers as well as in swimming pools and spas, because chlorine might not be enough to kill the parasites.

Water quality varies, even in industrialized nations such as the United States. Tap water led to the 1993 outbreak of cryptosporidiosis

Did You Know

Intestinal infections such as cyclosporiasis and cryptosporidiosis are among the most common illnesses in the world. Between 1.6 and 2.5 million people worldwide (mostly in low-income and developing countries) died from illnesses that cause severe diarrhea in 2000, a drop in diarrhea-associated deaths compared to statistics from 1982 through 2000. In 2006, about 137 cases of cyclosporiasis and 6,071 cases of cryptosporidiosis were reported to the U.S. Center for Disease Control and Prevention.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

in Milwaukee. Some people choose to drink only bottled water or use special filters for drinking water and ice. When overseas, especially when in developing nations, travelers should not drink tap water or use ice made from tap water. It also is recommended that fruits and vegetables be avoided by individuals who when they travel outside the United States, unless they can be cooked or peeled.

▶ See also **Parasitic Diseases: Overview**

Resources

Books and Articles

Corsi, Steven R., and J. F. Walker. *Sources and Variability of Cryptosporidium in the Milwaukee River Watershed*. Alexandria, VA: Water Environment Research Foundation, 2003.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/parasites/cyclospora/default.htm>; <http://www.cdc.gov/crypto>.

Department of Health and Mental Hygiene, Community Health Administration. 201 West Preston Street, 3rd Floor, Baltimore, MD, 21201. Telephone: 410-767-5300. Web site: <http://www.cha.state.md.us/edcp/factsheets/cyclospor.html>; <http://edcp.org/factsheets/crypto.html>.

Department of Health Services. 1 West Wilson Street, Madison, WI, 53703. Telephone: 608-266-1865. Web site: <http://dhs.wisconsin.gov/communicable/factsheets/Cyclosporiasis.htm>; <http://dhs.wisconsin.gov/communicable/FactSheets/Cryptosporidiosis.htm>.

Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 888-INFO-FDA. Web site: <http://vm.cfsan.fda.gov/~mow/intro.html>.

Cyst

A cyst is a small, balloon-like swelling anywhere in the body. A cyst may contain air, fluid, or solid content contained within a sac. Usually, cysts are harmless, but they may be removed surgically if they cause discomfort or distress.

Where Are Cysts Found in the Body?

Cysts may develop in many areas on the inside or outside of the body. They may be found in the mouth around a developing tooth, in the skin around a hair follicle or sweat gland, in other glands, in the spinal cord, in the liver, in bone tissue, in ovaries*, and in other parts of the body.

Cysts are cavities that are lined with epithelium. Epithelium is a common tissue in the body, which is part of the skin and also serves as a covering for organs and as a lining for vessels and other cavities throughout the body. Cysts form most often when fluid in a gland* becomes blocked in the ducts or tubes leading out of the gland. Sometimes cysts develop because the glands are overactive and produce more fluid than the tissues can absorb. Another cause of cyst formation is the presence of parasites in vital organs, such as the liver or brain.

What Are the Different Types of Cysts?

Cysts are classified mainly by their location in the body. Some of the most common are:

- Alveolodental (al-vee-o-lo-DEN-tal) cysts, which form around a developing tooth
- Baker's cysts, which form around the knee joint
- Chocolate cysts, which form in the ovary (named for their dark brown fluid)
- Corpus luteum (KOR-pus LOO-tee-um) cysts (plural form is corpora lutea), which are yellow bodies that form in the ovary when an egg is released during the normal reproductive cycle
- Ependymal (e-PEN-di-mal) cysts, which form in the central canal of the spinal cord
- Ganglion (GANG-lee-on) cysts, which usually develop around the tendons or joints
- Lacteal (LAK-tee-al) or milk cysts, which form in the breast
- Sebaceous (se-BAY-shus) cysts, which form under the skin from plugged oil glands
- Solitary bone cysts, which form in long bones of children and adults
- Wens, which are sebaceous cysts that form on the scalp.

Cysts are also associated with polycystic kidney disease and bilateral cystic mastitis. In the first, numerous fluid-filled cysts form in the kidneys, a condition that can sometimes lead to kidney failure. The second is a much more common disease. In cystic mastitis (also known as Von Schimmelbusch's disease), cysts form in the breast and may be tender especially just before a woman has her menstrual period, but they are not dangerous to her health. Sometimes they can, however, be a health hazard because they may make it more difficult for the woman or her doctor to check the breasts for other unusual growths.

* **ovaries** (O-vuh-reez) are the sexual glands from which ova, or eggs, are released in women.

* **gland** is an organ that produces substances such as hormones and chemicals that regulate body functions.

“Bible Bumps”

Ganglion cysts of the wrist used to be called “Bible bumps.” The home remedy for ganglion cysts once was to rupture them by hitting them with a big book. Many people had only the *Farmers’ Almanac* and the Bible in the home, and because the Bible was the bigger book, it was used to break the cyst.

* **abscess** (AB-ses) is a localized or walled off accumulation of pus caused by infection that can occur anywhere in the body.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

How Are Cysts Treated?

Most cysts do not need treatment. Those that may require treatment are cysts that have become painful, have formed on visible parts of the body such as the hand or around the ears, or have become infected. An infected cyst may contain pus, in which case it is technically known as an abscess*. A doctor can remove a cyst by drawing out the fluid with a needle and syringe (aspiration) or by surgically removing it. Surgery is more effective. When the fluid is removed with a needle, the cyst has a tendency to return. Sometimes cysts disappear without any treatment.

▶ See also **Abscesses • Fibrocystic Breast Disorder • Ovarian Cysts • Tumor**

Resources

Organization

New Zealand Dermatological Society. c/o Tristram Clinic, 6 Knox Street, Hamilton, New Zealand. Web site: <http://dermnetnz.org/lesions/cysts.html>.

Cystic Fibrosis

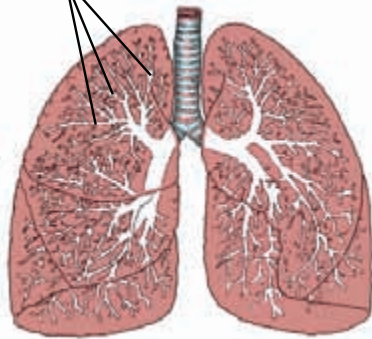
Cystic fibrosis is an inherited condition in which glands produce excessively sticky mucus. The sticky material clogs the lungs, liver, pancreas, and intestines and makes it difficult to breathe and to digest food properly.

Rachel’s Story

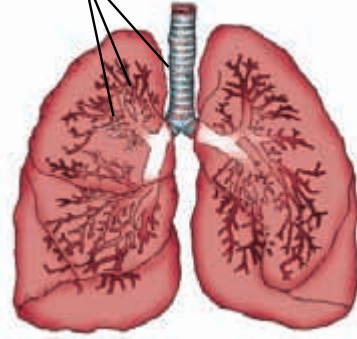
Rachel’s parents were worried. They believed they provided all the proper care Rachel needed, just as they had for their older daughter when she was a baby, but Rachel failed to gain as much weight as other children her age, even though she seemed to have the appetite of a normal infant. Rachel also seemed to have more colds than other children had and a lot more colds than her older sister ever had. She coughed often and breathed with a wheezing sound. Then, around the time of her second birthday, Rachel developed pneumonia*.

Rachel’s failure to gain weight and her frequent respiratory infections led her doctor to suspect that Rachel had cystic fibrosis (SIS-tik fy-BRO-sis), which is usually known by its initials, CF. Tests confirmed the diagnosis.

CF is a hereditary disease that affects about 30,000 children and adults in the United States. It is one of the most common hereditary conditions. Especially affecting people of European ancestry, CF occurs in one of every 3,000 live births. Nearly 1,000 new cases of CF are diagnosed each year in the United States, usually by the time children reach their third birthday.

Unobstructed
bronchial tubes

Healthy lungs

Bronchial tubes
are blocked by mucus

Lungs with cystic fibrosis

What Is Cystic Fibrosis?

Cystic fibrosis is a chronic, hereditary disease that affects many of the body's organ systems. In CF, some of the thin, easy-flowing mucus* in the body's respiratory and digestive systems becomes thicker. Glands* produce mucus to do various tasks, such as lubricate the lungs, trap dust and bacteria that is inhaled through the nose, and protect the lining of the intestines from the acidic fluids that help digest food.

The glands in people with CF, however, produce sticky mucus that clogs the passageways in the lungs, which makes breathing difficult and leads to infections. The sticky mucus also blocks the easy flow of digestive acids and enzymes from the pancreas* and liver* to the intestines. Without adequate amounts of these digestive fluids in the intestines, people with CF cannot break down their food into the substances the body needs for nourishment.

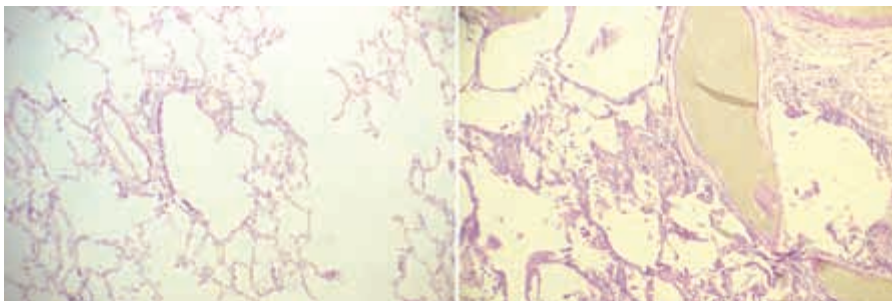
What Causes Cystic Fibrosis?

CF is caused by a mutation in a gene* on chromosome 7. Chromosome 7 is one of 23 pairs of chromosomes that are part of each person's genetic makeup. The CF gene causes the production of a protein that lacks an

Cystic fibrosis is a chronic disease in which the glands produce excessively sticky mucus that can clog the bronchial tubes in the lungs, making it difficult to breathe. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



- * **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.
- * **glands** are organs that produce substances such as hormones and chemicals that regulate body functions.
- * **pancreas** (PAN-kree-us) is a gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.



Lung infections are common in cystic fibrosis. Seen under a light microscope are tissue samples from a healthy lung (left) and from a lung affected by cystic fibrosis (right). *Custom Medical Stock Photo, Inc. Reproduced by permission.*

Turning on the CF Gene

In 1989, scientists discovered the location of the CF gene. If they could replace the defective gene with a normal gene, then they would be able to cure the cells that produce the defective CF protein, in which case the mucus in the respiratory and digestive systems would be thin and easy flowing as opposed to thick and sticky.

In 1990, two teams of researchers were able to correct CF cells in lab dishes by adding normal copies of the gene. In the spring of 1993 a person with CF got the first experimental dose. In October 1993, scientists determined that gene treatment had repaired a damaged gene in a human patient. Numerous studies followed. Some have had very encouraging results, but no cure had been found as of the early 2000s.

Gene therapy is a complicated experimental process, and a particular hurdle has been finding a way to deliver the gene to the parts of the body where it can do its work. Perhaps, gene therapy will never be able fix all of the defective genes, but it might cause enough of them to work properly to improve the quality of life for people with CF.

important building block, or amino acids*. The missing amino acid is called phenylalanine (fen-il-AL-a-neen). Without that amino acid, the protein hinders the ability of mucus to obtain the proper amounts of water and salt from the body, and the mucus is unable to maintain its thin and easy-flowing texture. As a result, the mucus becomes dense and sticky and clogs the respiratory and digestive systems.

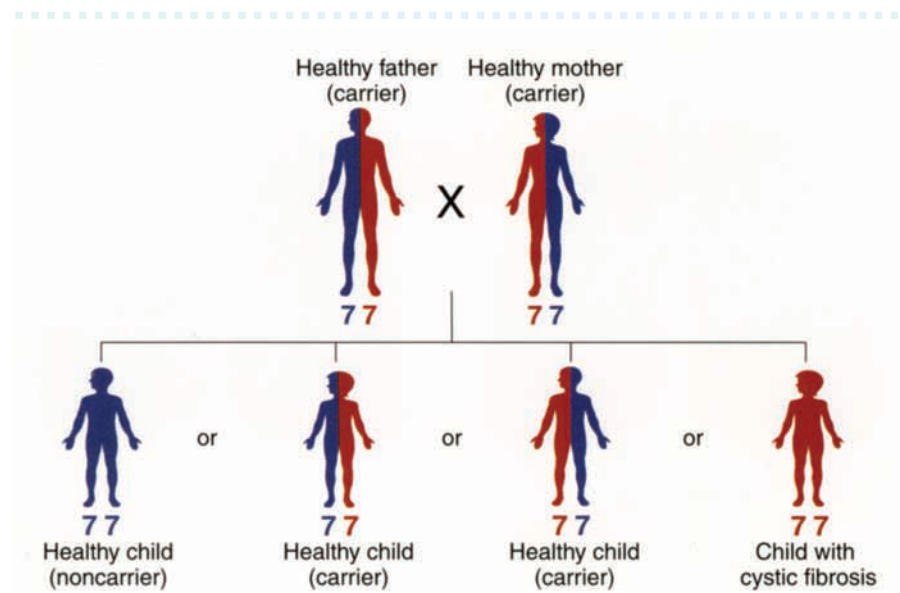
The obstructions in the lungs make breathing difficult and can increase the risk of infections. The problems in the digestive system prevent the body from getting all the nutrients it needs from food. It also means people with CF often have thicker, foul-smelling bowel movements, because fat in food cannot be broken down by digestive fluids and absorbed.

A person may carry the CF gene on one of the two copies of chromosome 7 and not have any signs of CF. This person is called a carrier*. Parents can pass the CF gene to many generations of offspring. If a person inherits the CF gene on both copies of chromosome 7, then that person develops CF. When parents are both carriers, such as Rachel's parents, their children have a one in four chance of having CF. Estimates are that 10 million Americans, or about one out of 30, carry the CF gene.

How Do Doctors Know Someone Has Cystic Fibrosis?

Descriptions of children with symptoms of cystic fibrosis appear as far back as the 1600s, but not until 1938 was CF recognized as a separate disease. Even in the early 2000s, the symptoms of CF can sometimes be confused with pneumonia or asthma.

Symptoms Cystic fibrosis affects each person differently. Many people with CF do not appear to be severely ill. In general, people with CF have some or all of the following symptoms:



Cystic fibrosis is a chronic disease caused by a mutation in a gene located on chromosome 7. If both parents carry the CF gene, there is a 50 percent chance that their child may carry the gene too, and a 25 percent chance that their child may have CF. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

- Salty-tasting skin and sweat
- Persistent cough or wheezing
- Many respiratory infections
- Bulky, smelly stools or bowel movements
- Nasal polyps (small growths in the nose)
- Enlargement of the fingertips and toes (clubbing)

Also, people with CF may eat large amounts of food but still be hungry, because mucus blocks the ability of digestive enzymes* and acids to break down food and absorb nutrients. So these individuals do not properly digest their food. Large portions of the poorly digested food pass out of the body during bowel movements. Some individuals may lose weight.

Later, the pancreas may clog and fail to secrete the enzymes essential to normal digestion. The liver becomes clogged, which may lead to cirrhosis (si-RO-sis), a condition in which the liver becomes hardened and fails. Diabetes also develops frequently in people with CF as they get older.

Diagnosis Doctors may begin to suspect CF soon after a baby is born when the infant becomes ill with repeated respiratory infections, fails to gain weight despite a healthy appetite, and shows other symptoms of CF. In addition, about 10 percent of infants with CF have intestinal blockage due to thick mucus that is apparent at birth. Many of the symptoms of CF are common in people who do not have the disease, but tests are available to confirm that a person has CF.

A sweat test is a preferred method for diagnosing cystic fibrosis because it is relatively easy to perform and is accurate. The test determines the salt content of perspiration. Although sweat can seem salty in people who do not have CF, the level of salt in the perspiration of people with CF is higher. Besides the sweat test, medical professionals may use a more complicated test to look for the CF gene on both copies of chromosome 7.

A Morning Ritual for Rachel

After her doctor determined that Rachel had cystic fibrosis, her parents worried she would not be able to engage in the same activities her older sister or other children enjoy. As she grew, however, Rachel went to school, participated in sports, and performed many other everyday activities.

Most people with CF get treatment that involves helping them breathe more easily and digest food better, which makes day-to-day activities less difficult. Although their symptoms can range from mild to severe, many people with CF get treatments similar to those that Rachel receives. One of those treatments is chest physical therapy. Each morning, her parents vigorously thump her back and chest to help loosen the thick mucus in her lungs so she can cough it out. They learned the technique, called daily percussion therapy, from a physical therapist after

* **amino acids** (a-MEE-no acids) are the chief building blocks of proteins. In humans, certain amino acids are required to sustain life.

* **carrier** is a person who has in his body a bacterium or virus or gene for a disease that he can transmit to other people without getting sick himself.

* **enzymes** (EN-zimes) are proteins that help speed up a chemical reaction in a cell or organism.



Devon Conley, 17, uses a saltwater nebulizer to treat cystic fibrosis at Saint Joseph Regional Medical Center in South Bend, Indiana, January 24, 2006. *AP Images.*

Boomer Fights Back

When two-year-old Gunnar Esiason was diagnosed with cystic fibrosis in 1993, his father, Norman Julius “Boomer” Esiason, decided to fight back. Boomer, who played quarterback for the National Football League’s Cincinnati Bengals, New York Jets, and Arizona Cardinals and later became a television sports reporter, had been a fierce competitor for many years. Now, his greatest battle became the fight against CF.

The NFL star started the Boomer Esiason Foundation with the main goal of finding a cure for CF. The foundation supports basic research and clinical trials for new CF treatments.

Rachel was diagnosed with CF. Depending on the patient’s condition, such therapy can sometimes take up to an hour. Sometimes, thumping is not enough, and the mucus must be extracted by suction.

Coughing is one of the main ways that people with CF can clear the mucus from their lungs, so Rachel coughs often at school. Because her teachers and the other students know Rachel has CF, they do not make a big deal about her coughing. Rachel keeps her own box of tissues on her desk, so she can cough the mucus into tissue and toss it into a nearby wastebasket.

Rachel also participates in physical education classes. Exercise is another way that people with CF loosen the mucus in their lungs. Sometimes Rachel gets tired more quickly than the other children, because she cannot breathe as easily, but she joins in many of the exercises and games on most days.

At lunch and other times that she eats a meal or snacks, Rachel takes pills. The pills contain enzymes to help her digest food. Without them, the mucus in her digestive system prevents her from getting the nutrients she needs from food. Even with the enzyme pills, Rachel and others with CF often need to take vitamin supplements and eat a diet rich in nutrients to assure they get the proper nourishment.

Rachel and others with CF also take antibiotics to prevent or treat lung infections. Sometimes, the antibiotics are taken as pills or inhaled into the lungs using a device called a nebulizer. People with CF also sometimes take prescription medications that thin the mucus and help reduce lung inflammation, which makes breathing easier and helps reduce the number of lung infections.

DNase, which is short for recombinant human dextroxyribonuclease, is one medication often used to treat CF. It does its job as a follow-up to the body’s normal response to invading bacteria, a problem that people with CF are constantly battling. The body fights bacterial infections with an army of white blood cells that destroy the bacteria. The blood cells die after they do their job. In people with CF, these dead white blood cells and bacteria serve to make the mucus thicker, basically turning its consistency from a fluid gel into a semi-solid custard. DNase helps break down these dead white blood cells and bacteria, which allows the mucus to thin out again.

Living with Cystic Fibrosis

Once CF almost always caused death in childhood, but treatments in the last decades of the twentieth century allowed many people with CF to live into adulthood. As for children with CF, the symptoms for an adult can range from mild to severe, but eventually the recurring infections in the lungs begin to damage the lungs’ ability to function. This complication is fatal for many people with CF. In the 1990s and early 2000s, however, lung transplantation has been performed on some patients who developed severe lung disease. The Cystic Fibrosis Foundation reports that

about 120 to 150 people annually receive lung transplants in the United States. Of them, up to 90 percent are alive a year later, and 50 percent are alive after five years.

According to the Cystic Fibrosis Foundation, the average life expectancy of people with CF was about 36.5 years in 2008, an increase from 32 years as of 2000. With treatment, people with CF are able to perform many activities that other people do.

▶ See also **Asthma • Cirrhosis of the Liver • Genetic Diseases • Pneumonia**

Resources

Books and Articles

Byrnes, Isabel Stenzel, and Anabel Stenzel. *The Power of Two: A Twin Triumph over Cystic Fibrosis*. Columbia: University of Missouri Press, 2007.

Orenstein, David M. *Cystic Fibrosis: A Guide for Patient and Family*, 3rd ed. Philadelphia, PA: Lippincott Williams & Wilkins, 2004.

Thomson, Anne, and Ann Harris. *Cystic Fibrosis: The Facts*, 2nd ed. New York: Oxford University Press, 2008.

Organizations

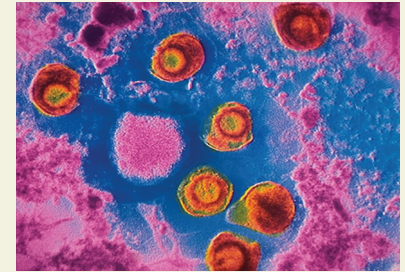
Boomer Esiason Foundation. 52 Vanderbilt Avenue, 15th Floor, New York, NY, 10017. Telephone: 646-292-7930. Web site: <http://www.esiason.org>.

Cystic Fibrosis Foundation. 6931 Arlington Road, Bethesda, MD, 20814. Web site: <http://www.cff.org>.

Cystitis See *Urinary Tract Infections*.

Cytomegalovirus (CMV) Infection

Cytomegalovirus (sye-tuh-MEH-guh-lo-vy-rus), or CMV infection, is very common and usually causes no symptoms. It poses little risk for healthy people, but it can lead to serious illness in people with weak immune systems.



Once inside the human body, the cytomegalovirus can invade many organs and systems including the salivary glands, brain, lungs, kidneys, and liver. *PHOTOTAKE Inc./Alamy.*

- * **herpes** (HER-pee-z) is a viral infection that can produce painful, recurring skin blisters around the mouth or the genitals, and sometimes symptoms of infection elsewhere in the body.
- * **mononucleosis** (mah-no-nu-klee-O-sis) is an infectious illness caused by a virus with symptoms that typically include fever, sore throat, swollen glands, and tiredness.
- * **bone marrow** is the soft tissue inside bones where blood cells are made.
- * **semen** (SEE-men) is the sperm-containing whitish fluid produced by the male reproductive tract.
- * **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.
- * **microcephaly** (my-kro-SEH-fah-lee) is the condition of having an abnormally small head, which typically results from having an underdeveloped or malformed brain.
- * **retinitis** (reh-tin-EYE-tis) is an inflammation of the retina, the nerve-rich membrane at the back of the eye on which visual images form.

What Is CMV?

CMV is part of the herpesvirus (her-pee-z-VY-rus) family, which also includes the viruses that cause herpes*, chicken pox, and mononucleosis*. As with other members of the herpesvirus family, once CMV enters a person's body, it remains there for the person's whole life. CMV infection can cause flu-like symptoms when a person is first infected, but many people have no symptoms at all. The virus usually becomes dormant after it enters the body, meaning that it remains hidden and does not cause symptoms of illness. The virus can emerge at a later time, however, and produce illness in people with weakened immune systems, such as people who have cancer or AIDS or those who have received organ or bone marrow* transplants. CMV is a risk for pregnant women because of the danger that it can be transmitted to their babies. The disease is the leading cause of mental retardation and hearing defects in newborns in the United States as a result of congenital (kon-JEH-nih-tul) infection, that is, infection that is present at birth.

How Is CMV Spread?

CMV is contagious and can spread through bodily fluids, including blood, saliva, semen*, breast milk, tears, and urine*. The virus can be transmitted by sexual contact, by close person-to-person contact, or from mother to baby during pregnancy, birth, or breast-feeding. It often spreads among children in day care or preschool or among family members. In the United States, as many as three of every five adults have been infected with CMV by the time they reach age 40. CMV infects people all over the world and is even more widespread in developing countries and among those with poor living conditions.

What Are the Symptoms of CMV?

Most people who have been infected with CMV never show symptoms. In some people, the virus causes mild symptoms that mimic the flu or infectious mononucleosis, such as fever, chills, body aches, headache, swollen lymph nodes*, sore throat, and fatigue. Newborns who contract CMV infection in the womb may be born with jaundice*, microcephaly*, signs of brain damage, and a serious inflammation of the eyes known as retinitis*. Others seem healthy when they are born but later have growth problems and signs of hearing loss or mental retardation.

How Are CMV Infections Diagnosed and Treated?

Most cases of CMV infection are never diagnosed because they produce few or no symptoms. When doctors do suspect CMV, they often base the diagnosis on symptoms, physical examination, and blood tests for antibodies* to the virus. They will also rule out other diseases that cause similar symptoms, such as infectious mononucleosis caused by the Epstein-Barr virus*. Sometimes blood tests show evidence of past infection with CMV but do not indicate active infection. A test known as the polymerase

(pah-LIM-er-ace) chain reaction, or PCR, can test specifically for active CMV infection by finding traces of DNA* from the virus in body fluids. People with healthy immune systems who contract CMV infection usually do not require medical treatment. When people with weakened immune systems develop CMV infection, doctors often prescribe medication made to fight viruses. These antiviral medicines may need to be given by injection, and patients sometimes have to take them for months or even years. Symptoms of initial CMV infection usually last two to three weeks in healthy people. After that, the virus remains in the body for life. Flare-ups of illness from CMV in healthy people are rare and typically occur when the immune system has been stressed by fighting another illness.

What Are the Complications of CMV Infection?

CMV infection can cause more severe illness in people with weakened immune systems, such as pneumonia* and retinitis. If it is untreated, retinitis can lead to blindness. CMV also can cause severe inflammation of the esophagus and colon, leading to difficulty in swallowing, long-lasting diarrhea, and weight loss. It also can affect the brain or nerves. Infants born with CMV infection may have jaundice, poor growth, problems with vision and hearing, and other disabilities, including slow development and mental retardation.

How Is CMV Infection Prevented?

The best way to help prevent the spread of CMV is to wash the hands regularly, especially after changing diapers or touching bodily fluids. Doctors advise women who are pregnant and people who work in child care to be particularly careful. Patients scheduled to have organ or bone marrow transplants typically receive medication before the operation to prevent CMV disease from developing, as the transplant process weakens their immune systems.

▶ See also **AIDS and HIV Infection • Blindness • Congenital Infections • Hepatitis • Immune Deficiencies • Jaundice • Mononucleosis, Infectious • Pneumonia • Pregnancy • Viral Infections**

Resources

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov>.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **Epstein-Barr virus** (EP-stine-BAHR VI-rus) is a common virus that causes infectious mononucleosis.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

D

Dandruff See *Hair and Hair Loss; Skin Conditions.*

Deafness and Hearing Loss

Deafness is complete loss of hearing, whereas hearing loss may be partial or complete. Deafness may be present from birth, as a result of many possible causes, or it may begin later in life as a result of age-related changes in the ear, disease, injury, or excessive exposure to noise.

Loud Music and Hearing Loss

Kathy Peck was a guitarist in the 1970s and 1980s in a rock band known as the Contractions. The band played a mix of punk and new wave music in San Francisco and toured across the United States. The band gained some critical and popular success, playing shows with such groups as Duran Duran. In the mid-1980s, Peck realized she was losing some of her hearing. All those years of playing loud music and attending concerts had damaged her ears, as had happened to musician Pete Townshend of the Who. When Kathy Peck and a physician named F. Gordon attended an especially loud concert in 1988, they decided to make a difference. They started H.E.A.R. (Hearing Education and Awareness for Rockers), a group that aims to prevent hearing loss among musicians and their fans. H.E.A.R. promotes wearing earplugs to reduce loud music to a level that does not damage the ear.

Rock music is not the only cause of noise-related ear damage. Excessive exposure to power tools and other forms of machinery is one of the most common causes of deafness and hearing loss in the United States. Overall, more than 28 million Americans have some form of hearing loss.

What Is Hearing?

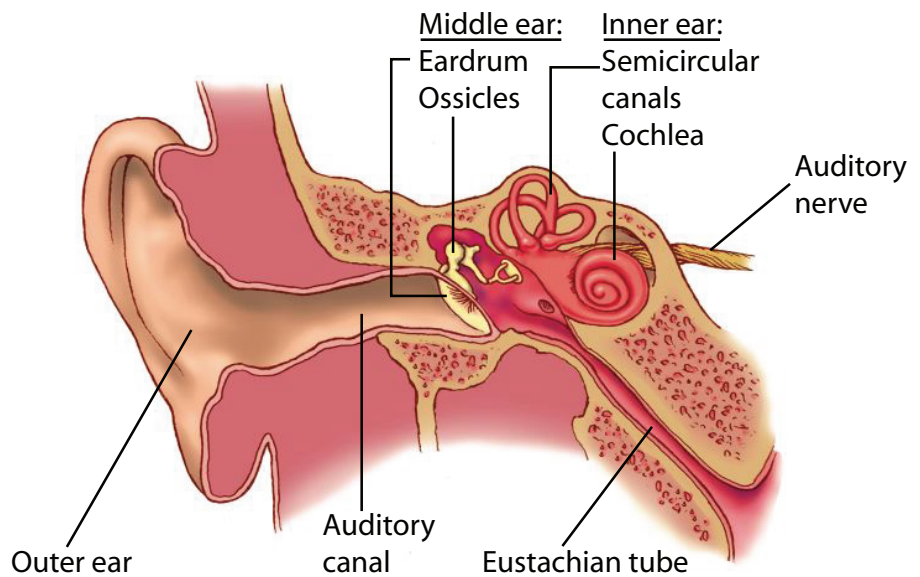
Hearing is the ability to perceive sounds. It depends on the ability of sound waves to travel through the various parts of the ear. As sound waves travel through the ear, they are converted into electrochemical impulses or messages that are sent along more than 30,000 nerve connections to the brain. The brain then interprets these messages as words and other sounds.

Anatomy of the Ear

The ear is comprised of the following parts:

- **Pinna** (PIN-na) is the medical term for the outer ear: the part of the ear that protrudes from the head and is used to hold up eyeglasses and to wear earrings.
- **Tympanic membrane** (eardrum) is the thin, flexible layer of semi-transparent tissue that forms the dividing wall between the outer ear and the middle ear.
- **Ossicles** (OSS-i-kulz) are the three smallest, most delicate bones in the body: the malleus (MAL-ee-uss) looks like a hammer; the incus (ING-kuss) looks like an anvil; and the stapes (STAY-pee-z) looks like a stirrup.
- **Cochlea** (KOKE-lee-a) is the organ of hearing that resembles the shell of a snail.
- **Cilia** (SILL-ee-a) are the delicate hairs in the inner ear.

Anatomy of the ear. As sound waves travel through the ear, they are converted into electrochemical messages that are sent along more than 30,000 nerve connections to the brain. The brain then interprets these messages as words and other sounds. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



* **earwax** also known as cerumen (se-ROO-men), is the wax-like substance in the ear that traps dust and other particles to prevent them from damaging the inner ear.

How sounds are heard Sounds actually are waves of energy that move through the air. Sometimes it is even possible to feel them, as when a hand is placed for a few moments next to a loudspeaker.

The pinna is the fleshy, visible part of the outer ear that captures the sound waves. It directs sound waves down a short tunnel, called the ear canal. The canal ends at the eardrum, which vibrates when sound waves reach it.

The vibrating eardrum causes the ossicles that are connected to it to begin vibrating as well. The ossicles are three tiny bones in the air-filled middle ear. As the bones move, the sound waves are transferred through another thin layer of tissue into the inner ear.

The most complex action in the ear occurs in the inner ear, deep within the skull. The sound waves first enter the cochlea, which contains liquid and is lined with cilia (tiny strands of hair). The liquid in the cochlea begins to vibrate and causes the microscopic hairs to move, too. The movement of the hairs stimulates nerves that are connected to the brain, which interprets the signal as a particular word or sound.

How some people cannot hear sounds People with deafness can hear no sounds at all. Others have partial hearing loss, which means they may have trouble hearing certain sounds unless someone is speaking close to them. Hearing loss can be unilateral (affecting only one ear) or bilateral (involving both ears). Some people slowly start to lose their ability to hear, and the problem gets worse as time passes. Hearing loss may be temporary, such as when earwax* builds up. If the wax is removed properly by a health professional, hearing is restored. But some forms of total or partial hearing loss are permanent.

What Causes Hearing Loss?

There are basically three types of hearing loss: conductive, sensorineural (sen-sor-i-NOOR-al), and a mixed form that combines conductive and sensorineural hearing loss.

Conductive hearing loss Conductive hearing loss happens when sound waves are not transferred (conducted) completely from the outer and middle ear to the inner ear. If sound is imagined as waves of water, then conductive hearing loss occurs when something is creating a “dam” that blocks the sound waves. This dam can result from the buildup of earwax in the ear, water in the ear canal that comes from swimming, or an infection that causes part of the ear to malfunction. Other causes include:

- **Damaged eardrums:** Sometimes the eardrum gets a tear or hole in it, which causes it to lose some or all of its ability to vibrate properly. Such damage may occur if a cotton swab or other object is placed too far inside the ear; if an explosion or gunshot or other extremely loud sound occurs too close to the ear; or as a result of an ear infection, a head injury, or a sudden or extreme change in air pressure.
- **Abnormal bone growth:** The ossicles are the tiny bones in the middle ear that work together in a very small space to conduct sound from the ear drum to the inner ear. If they grow too much or too little or are damaged, they cannot do their jobs well. This problem may be present from birth or it may occur as children grow.

Sensorineural hearing loss Sensorineural hearing loss occurs when there is a problem with some part of the inner ear or with the nerves that send messages from the inner ear to the brain. This type of hearing loss is more common than conductive hearing loss and more difficult to treat. Some estimates suggest that about 90 percent of hearing loss results from sensorineural problems. The most common cause of sensorineural hearing loss is change in the inner ear as people age. Not all older people experience sensorineural hearing loss, but many do. Common forms include:

- **Presbycusis** (press-bi-KOO-sis), the most common form, starts gradually for many people when they are in their 40s or 50s. More than 50 percent of people age 75 and older have some form of presbycusis.
- **Damage to the cilia** (SILL-ee-a), the delicate hairs in the inner ear. Loud noises can damage the cilia, as can poor blood supply to the inner ear resulting from high blood pressure, heart disease, smoking, or poor nutrition. Infections, tumors, and some medications also may damage the cilia and nearby parts of the inner ear or nerves to the brain.

Watching the Volume Control

Loud music can be enjoyable, but it can damage the hair in the inner ear and lead to permanent hearing loss. It can be a special problem for those who listen to music through earphones.

Even listening to two hours of loud music can damage the ear. Doctors advise those who listen to music to keep the volume at a level where other sounds and conversation still can be heard. If other people can hear the music from earphones, then it is too loud to be safe. At concerts, ear plugs can lower damaging sound levels.

The same advice about protecting the ears applies to those who work regularly with loud machines, including power tools, lawn mowers, chain saws, and leaf blowers. It also applies to many recreational or leisure activities such as snowmobiling.

* **vertigo** (VER-ti-go) is the feeling that either the environment or one's own body is revolving or spinning, even though they are not.

LUDWIG VAN BEETHOVEN'S HEARING LOSS

Composer Ludwig van Beethoven (1770–1827) created some of the most important symphonies even though he spent most of his life struggling with hearing loss and deafness. He began to experience mild episodes of hearing loss when he was about 28 years old. His hearing progressively worsened until he was left completely deaf at the age of 44.

Nonetheless Beethoven continued to compose great works. Contemporaries reported that he placed his ear to the piano while he played in order to sense the vibrations of the different notes. Medical historians are uncertain as to how Beethoven became deaf, although they believe nerve damage and otosclerosis (o-to-skler-O-sis), which damages the bones in the ears, are the likeliest causes.

- Genetic disorders may cause deafness from birth by interfering with the proper development of the inner ear or nerves to the brain.
- Injuries to the ear or head, such as a skull fracture, may cause sensorineural hearing loss.
- Ménière's (men-YERZ) disease affects more than 3 million people in the United States, many of them between the ages of 30 and 60. It can cause sensorineural hearing loss, vertigo* and dizziness, and a ringing in the ears called tinnitus (ti-NY-tis).

Mixed hearing loss Mixed hearing loss involves any combination of conductive hearing loss and sensorineural hearing loss. For example, loud noise can damage the ear drum, which causes conductive hearing loss. But loud noise also can damage the hairs in the inner ear, which is sensorineural hearing loss. If both occur, people are said to have mixed hearing loss.

When Sounds Begin to Fade

Hearing loss or deafness that is present from birth usually is first discovered by parents. They might begin to notice that loud sounds do not startle the baby or cause the baby to turn toward them. By school age, all children should have had their hearing tested, either by the family doctor or in school.

Hearing loss at later ages often is not recognized at first. People may find they can hear almost as well by increasing the volume on the television set or by moving closer to someone who is speaking, but they may not realize they are adapting this way. Other signs of hearing loss include needing people to repeat what they have said; complaining

that other people are mumbling; misunderstanding what people have said; and not hearing the phone, doorbell, or voices calling from other rooms. Often, the voices of women and children cause earlier problems, because the hair cells that recognize their higher-pitched voices are the first to fail.

Diagnosis Doctors use several tests to diagnose hearing loss. One requires patients to listen with earphones for a variety of tones and signal when they are heard and when they disappear. A related test involves a special device that is placed behind the ear and transmits tones directly to the inner ear through a portion of the skull called the mastoid. If these tones are recognized better than those from the earphone test, the hearing problem is in the middle ear. Another test involves understanding various words as they are spoken through earphones.

How Is Hearing Loss Treated?

Treatment for earwax buildup or infections can reverse some forms of hearing loss. Surgery to repair damaged ear drums or the bones of the middle ear is also possible.

Hearing aids The most common device used to amplify sound is the hearing aid. Aids come in various forms that fit in or behind the ear and can help make sounds louder and clearer. They cannot completely restore lost hearing, but they can make it easier for many people to hear sounds. Audiologists are trained specialists who help select, fit, and monitor the use of hearing aids for both children and adults.

Cochlear implants A cochlear (KOKE-lee-ar) implant is a complex device that replaces the work of the delicate hair cells (cilia) of the inner ear. A receiver worn behind the ear captures sound waves and transmits them to a receiver that is surgically placed inside the skull. This receiver then stimulates the nerves that the brain uses to interpret sounds. The surgery can be expensive, and it does not work for everyone, but for some it can be an effective way to partially restore hearing.

Living with Deafness and Hearing Loss

People with deafness and hearing loss usually learn to read lips and to use sign language for conversation. Other ways to improve activities of daily living include:

- Closed caption televisions that display words as people speak
- Lights that flash when the phone or doorbell rings
- Enhanced telephone services and telephones
- Dogs trained to alert their human companions to sounds, such as the phone ringing, a baby crying, or the person's name being called

Many people with deafness and hearing loss take pride in the many ways that deafness education and deaf culture enrich the lives of people who can hear.

▶ See also **Agging • Dietary Deficiencies • Heart Disease • Infection • Otitis (Ear Infections) • Rubella (German Measles) • Tinnitus • Tumor • Vertigo**

Resources

Books and Articles

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Dicker, Katie. *Explaining Deafness*. London: Franklin Watts, 2009.

Luterman, David. *Children with Hearing Loss: A Family Guide*. Sedona, AZ: Auricle Ink, 2006.

Myers, David. *A Quiet World: Living with Hearing Loss*. New Haven, CT: Yale University Press, 2000.

Organizations

American Society for Deaf Children. P.O. Box 1510, Olney, MD, 20830-1510. Toll free: 800-942-ASDC. Web site: <http://www.deafchildren.org>.

American Speech-Language-Hearing Association. 2200 Research Boulevard, Rockville, MD, 20850-3289. Toll free: 800-638-8255. Web site: <http://www.asha.org>.

H.E.A.R. (Hearing Education and Awareness for Rockers). P.O. Box 460847, San Francisco, CA, 94146. Telephone: 415-773-9590. Web site: <http://www.hearnet.com>.

National Institute on Deafness and Other Communication Disorders, National Institutes of Health. 31 Center Drive, MSC 2320, Bethesda, MD, 20892-2320. Telephone: 301-496-7243 (voice); 301-402-0252 (TTY). Web site: <http://www.nih.gov>.

Death and Dying

Death and dying present the most difficult of human experiences. Situations caused by or surrounding the dying process and death evoke intense and complicated feelings. Moreover, adults and children process death and express grief differently.

Life's Two Great Mysteries

Everyone shares two experiences: birth and death. Someone dies about every 20 seconds. Most people know someone who has died. But people tend to resist thinking about death or talking about it. People tend to avoid acknowledging that everyone dies. Worldwide and through the centuries, people have considered birth and death as the two great mysteries. They have witnessed death and dying and viewed it with fear.

How Do People Understand Death?

The grief people feel in the face of death tends to be affected by the facts pertaining to the event of death they witness. The age of the person and the cause of death affect the way the death is understood by the living. The most easily accepted, perhaps, are deaths of people in old age, when the body has worn out and the elderly individuals are ready to die. Death at the end of a long life is understandable and fitting. But when the young die or when death comes accidentally and without warning in the prime of life, death is unacceptable, and grief can be more intense. Illness, injuries, natural catastrophes, and violence can all cause early death.

Sometimes death results from terminal disease. Individuals of all ages with these diseases have to face their own deaths and their families and friends must witness the dying process of their loved one. Psychologists* and physicians who have worked with people in this situation assert the importance of honesty and love. People with terminal illness and those who love them need to understand the effects of the terminal illness and find ways to express their feelings about it. It helps to talk about it, enjoy time together, and help with caregiving.

What Is Grief?

Grief is the wide range of feelings that accompany a death, such as shock, anger, sadness, and confusion. Knowing ahead of time that someone is going to die does not necessarily soften the impact of the person's death. It still may be difficult to believe that the death has occurred and hard to imagine life without the person who has died. When the death is sudden and unexpected, the shock of the news makes the reality all the more difficult to accept. Such shock can take time to fade. Most people need comfort and support while they grieve, from their relatives and friends, perhaps from members of the clergy, from therapists, or members of a support group.

* **psychologists** (sy-KOL-o-jists) are mental health professionals who treat mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth. Psychologists also study the brain, behavior, emotions, and learning.

STAGES OF GRIEF, TWO VIEWS

Elisabeth Kübler-Ross, in her 1969 book *On Death and Dying*, identified five emotional stages that people move through as they face their own dying process and death:

1. Denial: This is not happening.
2. Anger: Why is this happening to me?
3. Bargaining: I will make a deal in order to escape dying.
4. Depression: I do not care any more.
5. Acceptance: I am ready to die.

Roberta Temes, in her 1977 work *Living with an Empty Chair: A Guide through Grief*, identified three behavioral stages people move through as they cope with the loss of a loved one:

1. Numbness, which includes mechanical functioning and social isolation
2. Disorganization with painful feelings of loss
3. Reorganization with a return to a more normal social life

How Do Children Cope with the Death of a Parent or Sibling?

When a parent or sibling dies, everyone in the family suffers. Very young children may not fully understand what has happened and that the death is permanent. Children feel many of the same feelings that adults do when someone dies: shock, sadness, or confusion. But children seem to process those feelings differently. They may wonder what effects the death will have on their lives. While they may not be able to express grief as adults do, they may find themselves wondering about the changes this loss may have on them and on their future. They may have fears about their widowed parent remarrying or their having to move from their family home.

Sometimes it is hard for young people to understand their own feelings and reactions to death. Young people may also have trouble understanding the grief of adults around them. Grief can cause people to lose interest in activities that they normally enjoy, and it may cause people to avoid situations that used to involve the person who died. People express grief in different ways and at different tempos. Family members may find it impossible to talk about what they are experiencing. Sometimes children get ignored as adults become preoccupied with their own feelings. Finding someone to talk with (a family member, friend, or trusted adult) may help young people understand their feelings and the feelings of those around them.

How Do Adults Cope with the Death of a Child?

The death of a child disrupts the natural order in which members of the older generation die before members of the younger one do. Adults assume that they will be outlived by their children. Parents assume their children will outlive them. The death of an offspring is sometimes said to be the hardest loss. Regardless of the facts concerning such a death, parents often feel guilt for having failed to keep their child safe. Sometimes, after losing a child, parents become overly protective of their surviving children. Some parents want to move or change their lives to avoid being reminded of the child who died. Different adults choose different paths in the process of coming to terms with their grief and continuing to live their lives.

How Do Rituals Help People Cope with Death?

Funerals, memorial services, and burials are generally held a short time after a death and sometimes on the anniversary of a death. These ceremonies bring out painful feelings and are often difficult to attend. But they offer a way for people to express their feelings, take comfort with others who are grieving, and pay tribute to a person's life. Funerals or other rituals—such as planting a memorial garden, writing memories or a tribute, enjoying the person's interests—help people stay connected to the person even after the death.

What Happens after Death?

People have different beliefs about what happens after death. Some religions assert that the souls of dead people go to heaven. Some religions assert that the soul takes on another form and lives on earth again, a belief called reincarnation. Some people believe that the body as matter decomposes, and this matter becomes part of the life cycle in plant growth, which is consumed by living organisms. Many people with religious faith or without it take comfort in the cycle of life and death observable in nature and the seasons. Many people are comforted by their memories of those who have died.

MUMMIES OF ANCIENT EGYPT

In ancient Egypt, elaborate methods were used to preserve the body of royalty after death. These methods were used because the Egyptians believed they assured the dead person a good life in the afterworld.

The first step was embalming, which involved removal of major body organs, drying the body, and wrapping it in linens and spices. The higher the individual's status in society, the more elaborate the ritual. The coffin was painted with a portrait of the person and filled with valuables, such as gems and prized possessions of the deceased, to be used in the afterlife. Cats, which were thought to be sacred, were sometimes mummified and buried with their owners.



▲ Mummy of an Egyptian priestess dating from about 1000 B.C.E. showing the outer decoration of the coffin and wrapped body inside. *British Museum, London, UK/Bridgeman Art Library.*

* **neurotransmitters** (nuro-trans-MIH-terz) are chemical substances that transmit nerve impulses, or messages, throughout the brain and nervous system and are involved in the control of thought, movement, and other body functions.

Resources

Books and Articles

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- Gootman, Marilyn. *When a Friend Dies: A Book for Teens About Grieving and Healing*, rev. and updated ed. Minneapolis: Free Spirit, 2005.
- Horsley, Heidi, and Gloria Horsley. *Teen Grief Relief*. Highland City, FL: Rainbow Books, 2007.
- Kübler-Ross, Elisabeth. *On Death and Dying*. New York: Macmillan, 1969.
- Temes, Roberta. *Living with an Empty Chair: A Guide through Grief*. Amherst, MA: Mandala, 1977.

Organizations

- American Academy of Child and Adolescent Psychiatry.** 3615 Wisconsin Avenue NW, Washington, DC, 20016-3007. Telephone: 202-966-7300. Web site: http://www.aacap.org/cs/root/facts_for_families/children_and_grief.
- Compassionate Friends.** P.O. Box 3696, Oak Brook, IL, 60522. Toll free: 877-969-0010. Web site: <http://www.compassionatefriends.org>.

Decompression Sickness *See Bends.*

Decubitus Ulcers *See Bedsores (Pressure Sores).*

Delinquency *See Conduct Disorder.*

Delirium

Delirium is a sudden onset of widespread generalized confusion. It is a serious condition that can lead to death if not treated urgently. The cause is presumed to be interference in the neurotransmitters in the brain. The neurotransmitters act as messengers throughout the nervous system. When a situation prevents the neurotransmitters from sending out the vital instructions from the brain to the rest of the body, there is no way to make*

sense of the information coming from the senses. Therefore, general confusion sets in. In this condition, an individual cannot even recognize or accurately perceive familiar objects and situations.

* **psychoactive** (sy-ko-AK-tiv) affecting a person's mood, behavior, perceptions, or consciousness.

Joey's Story

Joey was hurrying down the hall of his high school, heading to Algebra class. He noticed a man standing in the hall watching the students go past. The man seemed very interesting. His face looked like someone from Joey's history book, but his clothes were modern. Joey was so fascinated with the man that he went up to him and asked, "Who are you?"

"Where are you supposed to be going?" The man asked sternly.

Joey felt that the man did not want to be bothered, but as he turned away from the man, he realized that he did not know where he was going. "I guess I'm going to lunch," Joey muttered.

"Lunch was hours ago," the man exclaimed.

"What am I doing in school? How did I get here?" Joey asked.

"Joey, are you all right? Tell me that you know me. I am Principal Fletcher," the man said. "Joey, come on. Tell me that you are joking." Principal Fletcher thought Joey was acting like students he had seen who used psychoactive* drugs, but Joey was not the type. What kind of drug could he be on? Then Principal Fletcher remembered signing Joey into school late this morning because Joey had been to the doctor's office. If the doctor had prescribed a new drug, Joey could be suffering from delirium.

What Is Delirium?

Delirium is a symptom of some disease or medical disorder. Its onset is sudden with severely impaired thinking. The person with delirium has trouble with simple reasoning and speaking. Delirium characteristically involves rapid and frequent change between mental states. The individual may start off agitated and then become extremely calm only to go right back to being agitated. The doctors who most often have to deal with delirium work with emergency room and cancer patients.

Medical conditions that bring on delirium include extreme pain and trauma. Many cases are caused by the patient misusing a drug or the patient's doctor prescribing the wrong drug. Delirium is considered a medical emergency. It can lead to long term mental and physical difficulties or even death. Proper and rapid treatment of underlying condition is essential.

How Common Is Delirium?

Delirium can affect people of all ages. However, it is most common among elderly people. There are more cases of delirium in males than in females. Delirium is the problem in about 20 percent of all people admitted to the hospital, but the proportion of patients admitted to Intensive Care

- * **psychological** (SI-ko-LOJ-i-kal) refers to mental processes, including thoughts, feelings, and emotions.
- * **serotonin** (ser-o-TO-nin) is a neurotransmitter, a substance that helps transmit information from one nerve cell to another in the brain. It is associated with feelings of well-being.
- * **dopamine** (DOE-puh-meem) is a neurotransmitter in the brain that is involved in the brain structures that control motor activity (movement).
- * **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

Units is estimated at 40 percent. Moreover, delirium goes unreported in as many as two-thirds of all patients. Most of these unreported cases are for patients whose main delirium symptom is abnormal calmness.

Where Causes Delirium?

There are many causes of delirium, but the psychological* explanation for the symptoms is dysfunction in critical areas of the brain and the interference of essential neurotransmitters. The two main areas of the brain that influence the onset of delirium symptoms are the prefrontal cortex (responsible for decision making) and the parietal areas (responsible for perception). The main neurotransmitters that are disrupted leading to delirium are acetylcholine, serotonin*, and dopamine*. Acetylcholine is important for learning and memory. Serotonin affects moods and arousal. Dopamine contributes to attention and emotion.

How Is Delirium Diagnosed and Treated?

The key symptom of delirium is sudden acute confusion. Detailed signs of delirium can be deduced by reviewing the brain functions that are disturbed at the time of the onset. Because the prefrontal cortex is not working correctly, the person will not be able to make even the smallest decisions. Hallucinations are common because the individual's perception has ceased operating. With acetylcholine dispersed or blocked, even the most common and essential thoughts and memories are unavailable. The inaction of serotonin brings on wide mood swings as well as sleep disorders. Emotion is inappropriate and attention is weak due to the problems with the dopamine levels in the brain. The person affected may be inappropriately agitated or inappropriately unaroused.

Diagnosis As with most medical conditions, delirium is diagnosed through an admissions interview regarding the existence of essential symptoms. With other medical problems, the doctor can interview the patient directly, but with delirium the patient is confused and has problems communicating. Any answers given by the patient in such a state of mind cannot be trusted. Preferably a family member or someone who knows the patient can be interviewed regarding the patient's medical situation. Of course, this is not always possible. The family member might not know enough about the patient's condition or the patient may have been brought to the hospital by a stranger. In such a situation, without a medical history, the doctor might not be able to determine if the patient has long-term dementia* or acute, sudden delirium.

Another problem with diagnosis stems from the fact that delirium may arise from a condition for which the patient is already hospitalized. Many unreported cases of delirium occur among patients already hospitalized. Nurses tend not to report with necessary urgency any confusion they observe in a patient. Also, delirium usually is recognized by inappropriate agitation, it can also occur with inappropriate tranquility, which can be missed as a sign of delirium.

The diagnosis of delirium cannot be achieved without a detailed history of the person and the current onset of delirious symptoms. Nurses, who have more interaction with the hospitalized patient than doctors do, need to know what to look for and how to report their observations. Furthermore, critically ill patients should be monitored regularly for delirium.

Treatment Treatment for delirium is focused on addressing the underlying cause. Doctors concentrate on finding the cause of the delirious episode. After the underlying cause is identified and treated, efforts are made to relieve the delirium.

Drugs are not the first choice in treating delirium. However, some drugs can help if the patient is hurting himself or others or is not responding well to non-medicinal treatments. An antipsychotic drug may be prescribed. Antipsychotic drugs* are mainly used for their calming effects. The use of drugs for delirium can have adverse or even paradoxical effects which lead the patient to be even more agitated and delusional.

Non-medicinal treatments include making the patient's environment as familiar and calming as possible. The patient's family should bring some personal objects from home to make the hospital room familiar. The hospital staff interacting with the patient should be limited in number so that the patient does not get confused with too many new faces. Also, whenever possible the patient should have a private room. The patient should regularly be informed about his condition and provided with mentally challenging activities.

Complications Delirium is often confused with dementia. The two disorders share symptoms but one of the key components of delirium is the struggle to understand one's surroundings that is not necessarily present in dementia. Dementia is characterized by memory impairment that interferes with processing information. Sufferers of both delirium and dementia have a hard time understanding what is being told to them. However, delirium involves a general confusion, while dementia involves a confusion specific to the processing of new information and memory tasks. Delirium is a symptom of a serious underlying disorder. Dementia is a disorder with a collection of symptoms, one of which may be delirium. Delirium is expected to be short-term and reversible, whereas dementia involves a slow steady decline in mental functioning.

Can Delirium Be Prevented?

Delirium has a sudden onset; therefore, by definition, it cannot be prevented. However, applying what is known about delirium can offer some preventive measures in some cases. For instance, research has identified some of the characteristics of people at risk and also some of the conditions that lead to higher occurrence of delirium. Doctors should be particularly aware when dealing with someone at risk to respond quickly when such a person has a condition that threatens delirium. Certain prescribed drugs may induce delirium. A doctor should be especially

* **antipsychotic drugs** are medications that counteract or reduce the symptoms of a severe mental disorder such as schizophrenia.

cautious in prescribing these drugs to an elderly person or someone with a preexisting psychological disorder. Of course, the recreational use of psychoactive drugs is a preventable risk factor, but the warnings are often ignored by users. If more information is made available to the public, people can be more aware in taking care of themselves and others.

Resources

Books and Articles

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Organization

Vanderbilt University Medical Center, Delirium and Cognitive Impairment Study Group, Center for Health Services Research.
1215 Twenty-first Avenue S., 6th Floor Medical Center East, Suite 6000, Nashville, TN, 37232-8300. Telephone: 615-936-1010.
Web site: <http://www.icudelirium.org/delirium>.

Delusions, Delusional Disorders, and Paranoia

Delusions (dee-LOO-zhunz) are one or more false beliefs that a person holds despite either lack of evidence that the belief is true or clear evidence that the belief is not true.

What Is a Delusion?

Imagine being completely convinced that someone is following you, to the point where you even call the police several times. Or imagine believing that your friend is spreading horrible rumors behind your back, even though there is no reason to think she is. Or imagine thinking that you are about to release a new hit record or that there is something physically wrong with you when your doctor has found otherwise.

These thoughts may sound ridiculous, but they help to illustrate what it means to be “delusional.” It is normal for people to have occasional thoughts that, for example, a boss, teacher, or friend is “out to get them.” Delusions are different, however. A person with delusions holds on to unfounded beliefs for a long time (more than a month) and is certain that they are true in spite of evidence to the contrary.

Delusions often are classified into the following subtypes:

- **Erotomaniac** (air-ROT-oh-MAN-ik). People with erotomaniac delusions falsely believe that someone is in love with them and make repeated attempts to establish contact through phone calls or letters or by stalking.
- **Grandiose** (gran-dee-OSE). People with grandiose delusions falsely believe that they have a great talent or have made an important discovery. These so-called delusions of grandeur involve wild exaggerations of the person's own importance, wealth, power, or talents.
- **Persecution**. People with delusions of persecution may falsely believe that someone is plotting against them, spying on them, lying about them, or harassing them. They may repeatedly call the police or try to get justice through appeals to the court system and other government agencies.
- **Jealousy**. People with this type of delusion incorrectly believe that a spouse or significant other is cheating on them, despite a lack of supporting evidence. People with jealous delusions sometimes resort to violence.
- **Somatic** (so-MAT-tik). This type of delusion relates to a bodily function. For example, people with somatic delusions may falsely believe that they have a physical deformity, an unusual odor, or some kind of germ in their bodies. As a result, they may make repeated trips to doctors, even after the doctors tell them they are fine.

* **hallucinations** (ha-LOO-sin-AY-shuns) occur when a person sees or hears things that are not really there. Hallucinations can result from nervous system abnormalities, mental disorders, or the use of certain drugs.

What Is the Difference between Delusional Disorder and Schizophrenia?

Delusions often are a symptom of serious psychotic (sy-KOT-ik) disorders, the most common being schizophrenia (skitz-oh-FREN-ee-uh). Besides delusions, other symptoms of schizophrenia include hallucinations*, disorganized thoughts and speech, and bizarre and inappropriate behavior. Schizophrenia typically first affects people in late adolescence or early adulthood.

If a person has delusions but none of the other symptoms of schizophrenia, the doctor may diagnose a delusional disorder. In delusional disorder, the delusions are not bizarre as they often are in schizophrenia. A delusion is bizarre if it is clearly impossible and not derived from ordinary experiences, such as believing a stranger has replaced your internal organs with someone else's organs without leaving any scar. Delusions that involve situations that could actually occur in real life, such as being followed or poisoned or having a serious illness, are not considered bizarre. Unlike schizophrenia, delusional disorder usually begins when people are in middle age (ages 35 to 55) or later adult life. Also, it generally does not lead to severe problems with everyday functioning and thinking. Many people with delusional disorder can keep their jobs, and, on the whole, their personalities do not change. However, once delusions occur, the false beliefs

often prove to be a long-term problem. Some people with delusions can become dangerous or violent, threatening harm to themselves or others.

How Is Delusional Disorder Treated?

Treatment for delusions usually involves regular meetings with a doctor who specializes in treating mental disorders. People with delusions tend to resist treatment at first and deny that there is any problem. The doctor needs to establish a cooperative relationship with the person, listening to his or her thoughts, easing any fears, and suggesting ways of coping. Some medications, particularly those used to treat depression and psychotic disorders, may help as well. Hospitalization may be necessary if the person shows signs of dangerous behavior or suicidal tendencies as a reaction to the delusional beliefs.

John's Experience

One day John came across a group of his friends huddled together on the soccer field. As he approached, they were all talking, laughing, and enjoying themselves. When he reached the group, however, his friends suddenly became quiet. John could not help feeling that his friends had been talking about him and that was why they had all stopped talking when he approached. He found himself thinking about it the rest of the day. He even began to suspect that his friends had been plotting against him.

The next morning, John saw the same group of guys huddled around his locker. This time when he approached, they shouted “surprise” and presented him with a new CD for his birthday. With embarrassment he realized that they had probably been discussing his birthday surprise the day before on the soccer field. He wondered what had caused him to doubt himself and his friends. Was it paranoia or a simple misunderstanding?

What Is Paranoia?

Paranoia is not a particular disorder so much as a way of experiencing (or incorrectly experiencing) reality. For example, John experienced paranoia when he wrongly believed that his friends were out to get him. A person whose phone was once tapped and was thereafter cautious about stating confidential information over the telephone might be considered reasonably concerned rather than paranoid. In contrast, a person who unrealistically feared that his or her phone was tapped even though it never had been before and who continued to think the phone was tapped even when presented with compelling evidence that it was not true, would be considered paranoid. The key issue is not the behavior itself so much as its basis in reality.

Common characteristics of people who tend to be paranoid include the following:

- Poor self-image
- Social isolation
- Expectation that others are trying to take advantage of them
- Inability to relax

- Inability to work with others
- Deep mistrust of others
- Inability to let go of insults or to forgive others
- Poor sense of humor

Like many personality traits, paranoia is something that can occur in different degrees of severity. In its milder forms, paranoia may be what a person feels only occasionally or only in certain situations. John, for example, experienced paranoia one day, but he did not usually feel this way. In its more severe forms, however, paranoia can seriously limit an individual's activities. People with significant levels of paranoia may consistently misinterpret reality and experience delusions.

Even people with severe paranoia may function normally much of the time if, for instance, they have a paranoid delusion that affects only a part of their life. For example, an individual might become obsessed with the idea that a particular chain of restaurants is conspiring to poison unsuspecting customers. He or she might stop eating in those restaurants and even go so far as to call the health authorities to investigate. Despite this delusion, the individual still may function normally in other respects.

What Causes Paranoia?

Medical and scientific experts do not fully understand the cause or causes of paranoia. Many healthy people experience paranoid feelings at some point in their lives, just as John did, and certain situations may increase the likelihood that someone will experience paranoid feelings. For example, evidence suggests that immigrants are more prone to suspiciousness and paranoia as a result of the language and other cultural barriers they face. People in the majority culture may misunderstand the immigrants' suspiciousness and react with hostility, which creates even more mistrust and misunderstanding.

Paranoia can accompany a number of illnesses. It is associated with certain neurological conditions such as temporal lobe epilepsy* and some forms of dementia* associated with aging, such as Alzheimer's (ALTS-hy-merz) disease*. People who repeatedly use drugs such as cocaine* or amphetamines* can also experience paranoia. In addition, paranoia is associated with mental disorders such as schizophrenia (skit-so-FREE-nee-a) and paranoid personality disorder.

Paranoid schizophrenia Schizophrenia is a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors that distort their view of reality. Doctors have come to understand that schizophrenia likely is the result of brain differences or chemical imbalances within the brain. However, schizophrenia is a complex and disabling disorder, and scientists and medical professionals do not fully understand it. Schizophrenia is also a disorder that can assume many different forms, or subtypes. Paranoid schizophrenia is

* **temporal lobe epilepsy** (EP-i-lep-see), also called complex partial epilepsy, is a form of epilepsy that affects the part of the brain that is located underneath the sides of the head, near the ears. Epilepsy is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.

* **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

* **Alzheimer's (ALTS-hy-merz) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.

* **cocaine** (ko-KAYN) is a stimulant, a drug that produces a temporary feeling of alertness, energy, and euphoria.

* **amphetamines** (am-FET-a-meenz) are stimulants, drugs that produce a temporary feeling of alertness, energy, and euphoria.

one of the subtypes. (The others are catatonic, disorganized, undifferentiated, and residual.)

Paranoid schizophrenia is characterized by the presence of one or more prominent delusions or auditory hallucinations—hearing threatening voices that are not there—in a person who seems to have otherwise relatively normal thinking ability and emotions. The delusions are usually organized around a consistent theme relating either to the idea that the person is being persecuted (he is being targeted) or that he or she has special powers; the hallucinations, when they are present, are typically related to the delusional theme. People with paranoid schizophrenia often act anxious, aloof, angry, and argumentative, and they may also exhibit either a stiff, formal attitude or be quite intense in their interactions with others.

None of the other major characteristics associated with schizophrenia, such as disorganized speech, inappropriate behavior, or inappropriate emotional reactions, is present in people with paranoid schizophrenia, and the age at which this disorder begins tends to be later than it is for the other forms of schizophrenia. People with paranoid schizophrenia are more likely to succeed in holding a job and at living independently when compared to people with other subtypes of schizophrenia.

Paranoid personality disorder Paranoid personality disorder is one of several different types of personality disorders (others include narcissistic, dependent, avoidant, and antisocial). All of the personality disorders cause individuals to behave inappropriately in many different situations. These disorders typically lead to problems in social, school, and work settings, and cause the affected person significant internal distress. The personality patterns that later develop into personality disorders usually begin during childhood or adolescence. The persistent nature of these conditions makes them particularly difficult to treat.

The key characteristic of paranoid personality disorder is a pattern of deep distrust of others. Unlike people who have paranoid schizophrenia and whose ideas may be totally bizarre or out of touch with reality, people with a paranoid personality disorder are not completely out of touch with reality, but they are out of step with it. Their belief that other people are untrustworthy colors all aspects of their lives, and as a result, they have difficulty forming close relationships.

Some common characteristics of people with paranoid personality disorder are as follows:

- Suspecting, without justification, that others are trying to harm or trick them
- Doubting the loyalty of friends
- Avoiding talking about themselves for fear that the information will be used against them
- Interpreting casual remarks or events as threats or insults
- Carrying grudges and seeking revenge

- Overreacting with anger to minor slights
- Being overly jealous and suspicious about others (e.g., girlfriend, boyfriend, or spouse) without justification

One complication about paranoid personality disorder is that it is often self-fulfilling. A paranoid person's suspicious and combative nature may provoke hostile responses from others. These responses, in turn, confirm the paranoid person's fears that others are hostile and not to be trusted. The paranoid person, then, does not see his or her own role in creating the situation, but instead erroneously concludes that his or her suspicions are justified.

Some possible signs of paranoid personality disorder may appear in childhood or adolescence. These include difficulties making friends and relating to others, the tendency to be a loner in social situations, and poor performance in school. Paranoid personality disorder is more common in males than in females. Overall, it affects between 0.5 percent and 2.5 percent of the population. Frequently, an individual who has schizophrenia also has relatives with paranoid personality disorder, and this link suggests that the two conditions may have a genetic* component.

▶ See also **Hallucination • Psychosis • Schizophrenia**

Resources

Books and Articles

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Munro, Alistair. *Delusional Disorder: Paranoia and Related Illnesses*. Cambridge, UK: Cambridge University Press, 2006.

Organizations

National Alliance on Mental Illness. Colonial Place Three, 2107 Wilson Boulevard, Suite 300, Arlington, VA, 22201-3042. Telephone: 703-524-7600. Web site: <http://www.nami.org>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov>.

Psychology Today. 115 East 23rd Street, 9th Floor, New York, NY, 10010. Web site: <http://www.psychologytoday.com>.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

Dementia

Dementia (dee-MEN-shuh) is a decline in mental ability that usually progresses slowly, causing problems with thinking, memory, and judgment. It is most often seen in the elderly and is caused by deterioration in parts of the brain. A person with dementia eventually has difficulty with the activities of everyday living, such as balancing a checkbook, reading, and working.

Why Doesn't Grandpa Recognize Me?

As Jacob sat in the hospital waiting room, he reminisced about this same day last year; Grandpa had taken him to the Baltimore Orioles' home opener to celebrate his eleventh birthday. Since then, his grandfather had experienced a few small strokes, or blockages in the blood vessels that supply oxygen and nutrients to his brain. The resulting loss of oxygen caused damage to parts of Grandpa's brain, and now he could barely talk or make any decisions for himself. Grandpa was 70 years old, but he almost seemed like a little kid.

During today's visit, Grandpa did not seem to know that it was Jacob's twelfth birthday. In fact, Grandpa did not even seem to know who Jacob was. Seeing his grandfather in this state made Jacob very sad and a little bit angry. He did not understand why his grandfather did not recognize him. Grandpa's doctor saw Jacob sitting in the waiting room and knew he was upset. She sat beside him and explained that Grandpa did not recognize people because he had a condition called dementia, which was a result of the brain damage caused by the strokes. (This kind of dementia is called multiple infarct dementia or vascular dementia.) She said that only time would tell if Grandpa's condition would improve, but in the meantime Jacob should keep visiting him, talking to him, and including him in special occasions. She told Jacob that even though Grandpa might act differently in many ways, there was still a part of the old Grandpa inside and that Jacob's presence could still bring enjoyment to him.

What Are the Common Forms of Dementia?

Dementia is a term that refers to several different physiological brain diseases, all of which affect the way brain neuron cells function, and the symptoms of which can overlap. In the healthy brain, neuron cells produce electrical and chemical impulses or signals, and the process of relaying these signals helps people think. In a person suffering from some form of dementia, this neuron relay process does not work correctly and thinking processes are impaired. Dementia has four common forms:

- Alzheimer's disease: Degeneration of healthy brain tissue occurs as clumps of plaques and knots called tangles form in cell neurons. Several genes have been identified that are associated with Alzheimer's disease, and many researchers theorize that the predisposition for this disease may be inherited. This disease is progressive and fatal.

- **Vascular dementia:** With gradual or sudden onset of symptoms, arteries that normally deliver blood to the brain become narrow or are obstructed altogether. When the blood flow to the brain is cut off, a person may experience a stroke. The resulting brain damage may cause symptoms of dementia. Sometimes underlying causes, such as high blood pressure, can be treated, in which case the progression of the disease can be slowed or eliminated. Sometimes brain damage is irreversible, but not necessarily fatal.
- **Lewy body dementia:** Clumps of protein in the brain, called Lewy bodies, cause this form of dementia, and are also found in the brains of people with Alzheimer's disease and Parkinson's disease*. People with Lewy body dementia may be treated effectively with some medicines used to treat Alzheimer's and Parkinson's. However, brain impairment can be serious and is permanent.
- **Frontotemporal dementia:** In this condition, cells located in the frontal area of the brain are specifically affected, and people with this disease develop socially inappropriate behavior. With onset as early as age 40, this disease is inherited.

In addition, people who have Huntington's disease, Parkinson's disease, and Creutzfeldt-Jakob disease may develop dementia in the later stages of their disease.

What Are the Symptoms of Dementia and Who Is Affected?

People who develop dementia typically experience changes in personality, frequent confusion, and reduced energy. Thinking, reasoning, memory, and judgment are often affected, and a person with dementia might also have trouble with language and motor (movement) skills.

Dementia is mostly a disease of the elderly. It is estimated to affect more than 15 percent of people (about 1 in 7) over age 65 but as many as 40 percent of people (2 out of 5) over age 80. It is one of the most common reasons for nursing home admissions in the United States. In the early 2000s, more than 5 million people in the United States were estimated to be living with Alzheimer's disease, which is a common form of dementia. When dementia affects young people, it is usually the result of an injury or some other condition that causes brain damage.

What Causes Dementia?

Dementia can result from any physical damage that interferes with the normal functioning of the brain. This damage may be permanent or temporary, and it can have a variety of causes that are usually classified into three categories:

- **Structural:** a problem with the structure of the brain that affects its ability to function.

* **Parkinson's disease** is a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.

* **metabolic** (meh-tuh-BALL-ik) pertains to the process in the body (metabolism) that converts food into energy and waste products.

* **high blood pressure** also called hypertension, is a condition in which the pressure of the blood in the arteries is above normal.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **degenerative** (dee-JEN-er-uh-tiv) means progressively worsening or becoming more impaired.

* **Acquired Immunodeficiency Syndrome** or AIDS, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

Infectious (in-FEK-shus): a bacterium or virus causes an infection that interferes with brain function.

metabolic* or toxic: a problem with the substances in the blood that are needed to nourish the brain.

Structural causes of dementia The most common form of dementia is Alzheimer's (ALZ-hy-mers) disease, a condition in which abnormal structures (called plaques and tangles) accumulate in the brain's neuron cells and increasingly interfere with nerve cell function. Alzheimer's disease leads to a gradual loss of mental abilities, including memory, judgment, and abstract thinking, as well as to changes in personality. This disease usually affects people over age 65.

Successive strokes are the second most common cause of dementia. Strokes, which are caused by blockages in arteries that feed the brain, gradually destroy brain tissue. People who develop this condition often have a history of high blood pressure* and/or diabetes*.

Other structural causes of dementia include:

- A brain tumor, which is a mass of abnormal cells growing in the brain. As the tumor grows, it presses on certain areas of the brain and causes personality change and problems with thinking, movement, and other functions. Severe or repeated milder head injuries can lead to dementia, also.
- Parkinson's disease is a slowly progressing, degenerative* disorder of the nervous system that leads to shaking, difficulties with movement, and muscle stiffness. About 15 to 20 percent of people who have it also develop dementia.
- Huntington's disease is a rare inherited disease in which people in midlife begin having occasional jerks or spasms that are caused by a gradual loss of brain cells. People with Huntington's disease eventually develop uncontrolled movements and mental deterioration.

Dementia caused by infectious diseases People who have Acquired Immunodeficiency Syndrome* (AIDS) sometimes experience dementia because the virus that causes AIDS can infect the brain. Another dementia-causing condition is Creutzfeldt-Jakob Disease (CJD), a very rare, rapidly progressing disease that affects the brain. Researchers are not sure what causes CJD, although in some cases it appears to have been passed from human to human by contaminated surgical instruments. One form of the disease has been found in humans who have eaten beef from a cow that has mad cow disease. Yet another cause of dementia is viral encephalitis (en-sef-uh-LIGHT-us), an inflammation of the brain that can be caused by certain viruses, particularly those transmitted to humans by the bite of a mosquito.

Metabolic and toxic causes of dementia Having too much or too little of certain substances in the body can damage the brain enough to cause dementia. The excessive or insufficient substances affect the metabolism. For example, anoxia (too little oxygen reaching the brain),

vitamin B12 deficiency, and hypoglycemia (hy-po-gly-SEE-mee-uh; a lower than normal amount of sugar in the bloodstream) are conditions that can lead to dementia if left untreated. Toxic reactions can occur in people who take in excessive amounts of alcohol or some other drugs, and these toxic amounts can cause dementia. People with severe alcoholism can develop Wernicke-Korsakoff syndrome, which occurs when a person's body has too little of the vitamin called thiamine. Thiamine plays a key role in helping the brain process sugar for energy; over time, a thiamine deficiency can cause mental confusion and memory loss. People who are malnourished or do not get enough of certain other nutrients from their diet have also been known to develop Wernicke-Korsakoff syndrome.

How Is Dementia Diagnosed and Is It Treatable?

The process of diagnosing dementia usually begins when the person and/or family members begin to notice that the person is experiencing increasing forgetfulness, lapses in memory, or problems with

GET TO KNOW THE SCIENTISTS

Many dementia-causing conditions are named after the physicians or scientists who discovered them:

Alois Alzheimer (1864–1915) was the German physician who published an article on a “new disease of the cortex” (the outermost or “reasoning” portion of the brain) in 1907. The disease is now called Alzheimer's disease.

James Parkinson (1755–1824) was the English physician who published “Essay on the Shaking Palsy” in 1817, one of the first articles on the disease later named for him.

George Huntington (1850–1916) was an American doctor from Ohio whose 1872 paper on hereditary chorea (kor-EE-uh; a condition of uncontrolled, rapid movements) made him famous because of its accurate and complete descriptions of this disease. The condition later became known as Huntington's chorea or Huntington's disease.

Hans Gerhard Creutzfeldt (1885–1964) and Alfons Jakob (1884–1931) were German physicians who, in the 1920s, first described the brain disease later known by their last names hyphenated.

Carl Wernicke (1848–1905) was a German physician whose 1881 *Textbook of Brain Disorders* first described a nervous system condition caused by insufficient amounts of a vitamin known as thiamine.

Sergei Korsakov (1853–1900) was a Russian psychiatrist who studied and described the connections among alcoholism, nerve inflammation, and mental symptoms.

everyday tasks. The doctor may give the patient a mental status test by asking questions that require memory of everyday events or by asking the patient to perform simple tasks such as counting backwards. The doctor will also try to determine whether there is some underlying cause of the person's symptoms. Blood tests and scans of the brain can help the doctor see whether there is an imbalance of certain substances in the body or a structural problem in the brain. The doctor will also ask for a complete description of the person's symptoms, his or her family medical history, current medications, and about the presence of any other medical conditions (such as high blood pressure or diabetes).

In most cases, dementia cannot be cured; rather, it is likely to worsen over time, especially when a progressive disease such as Alzheimer's disease or Parkinson's disease is the cause. However, in some cases the worsening of dementia can be slowed and sometimes the symptoms can actually improve if the underlying cause can be addressed. For example, controlling blood pressure and quitting smoking can slow or stop progressive dementia associated with blockages in blood vessels within the brain. Stopping excessive alcohol intake or correcting a vitamin deficiency can also help, if either of these is causing the problem.

When a Loved One Has Dementia

Dementia is especially hard on family members and loved ones who remember the person as he or she once was. The loss of memory, increased helplessness, and personality changes can be especially difficult to witness and accept. However, family and friends can play an important role in helping the person deal with dementia. Familiar faces, regular exercise, and having a cheerful, familiar environment have all been shown to help people with dementia. Caregivers can also help the person establish a routine, take part in low-stress activities, and get good nutrition and regular exercise. Large calendars and clocks can help the person keep track of the day and time. Reminders from family, friends, or other caregivers about what is going on, who they are, and where the person is can also be helpful.

▶ **See also** Alzheimer's Disease • Brain Chemistry (Neurochemistry) • Brain Injuries • Creutzfeldt-Jakob Disease • Huntington's Disease • Parkinson's Disease

Resources

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Hardman, Lizabeth. *Dementia*. Detroit, MI: Lucent Books, 2009.

Lillrank, Sonja M. *Psychological Disorders: Alzheimer's Disease and Other Dementias*. New York: Chelsea House, 2007.

Organizations

Alzheimer's Association. 225 North Michigan Avenue, 17th Floor, Chicago, IL, 60611-7633. Toll free: 800-272-3900. Web site: <http://www.alz.org>.

American Geriatrics Society. Empire State Building, 350 Fifth Avenue, Suite 801, New York, NY, 10118. Telephone: 212-308-1414. Web site: <http://www.americangeriatrics.org>; <http://www.healthinaging.org>.

Family Caregiver Alliance. 180 Montgomery Street, Suite 1100, San Francisco, CA, 94104. Toll free: 800-445-8106. Web site: <http://www.caregiver.org>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Web site: <http://www.ninds.nih.gov/disorders/huntington/huntington.htm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/dementia.html>.

Dengue Fever

Dengue (DENG-gay) fever is a serious illness commonly occurring in tropical and subtropical regions of the world. It is caused by a virus that passes from person to person through the bite of a mosquito, and it causes high fever and pain in the muscles, joints, and bones.

What Is Dengue Fever?

Dengue fever, which was originally known as breakbone fever, is characterized by a sudden high fever and severe pain in the muscles, joints, and bones. The disease is more likely to cause serious illness in children, and some cases are fatal. Dengue fever is caused by four different strains

Aedes Aegypti, the Dengue host transmitter. Image copyright Vinicius Tupinamba, 2008. Used under license from Shutterstock.com.



of flavivirus (each of the four is known as “dengue virus”), which are within the arbovirus family of viruses, spread by blood-sucking insects. The genus of mosquitoes known as *Aedes* is responsible for most dengue transmission. This genus of mosquito is distinct from the type that transmits malaria, which is most active at night. *Aedes* mosquitoes are day feeders, as they are most active during the day as opposed to night biters. Each of the four strains, or serotypes, can cause illness, and being infected by one type of dengue virus does not make a person immune to the other three. Infection with one strain of dengue virus increases the chances that an individual will develop more severe complications if infected with a second strain.

Who Gets Dengue Fever and How?

The World Health Organization (WHO) reported in 2008 that worldwide dengue fever was increasing sharply. Whereas before 1970 only 9 countries had reported epidemics, as of 2008, more than 100 countries had. Dengue fever is widespread in Southeast Asia, Africa, the Americas, Eastern Mediterranean, and western Pacific. WHO estimated that as of 2008, 2.5 billion people were at risk of infection with 50 million infections reported worldwide. The fever occurs most frequently in highly populated areas such as cities with poor control of stagnant water and mosquito populations. Dengue fever is one of the leading causes of death in children in many countries of Southeast Asia. Transmission may be increased under El Niño conditions. Although the number of places where dengue fever is found continues to grow in the early 2000s, the disease remained rare in the United States, with most cases appearing in travelers arriving from other countries.

The virus does not spread directly from person to person. The bite of a mosquito, usually the female *Aedes* mosquito, is required to transmit the disease. The insect takes in the virus with its meal of blood when it

WHAT'S IN A NAME?

The history of medicine is replete with fanciful names derived from the symptoms or causes of various medical conditions, such as “breakbone fever.” The following are examples:

- **Alice in Wonderland syndrome:** a neurologic condition in which a person has delusions or hallucinations
- **Cri-du-chat, or cat-cry, syndrome:** a genetic disease with many signs and symptoms, including mental retardation and a high-pitched, catlike mewing cry
- **Cauliflower ear:** thickening of the outer ear with distortion of the contours, also known as boxer’s ear
- **Happy puppet syndrome:** a genetic disorder marked by a jutting out of the jaw, seizures, and prolonged spasms of laughter
- **Jumping disease:** an exaggerated response to being startled, causing a person to jump, fling the arms around, and yell; sometimes called jumping Frenchmen of Maine disease after the French loggers it was first found to affect
- **Kissing disease:** infectious mononucleosis, an acute viral illness that can be spread through saliva
- **Mitten hand:** a birth defect involving the fusion of several fingers, with a single fingernail
- **Vagabond’s disease:** discoloration of the skin in people who are exposed to lice bites over a long period of time.

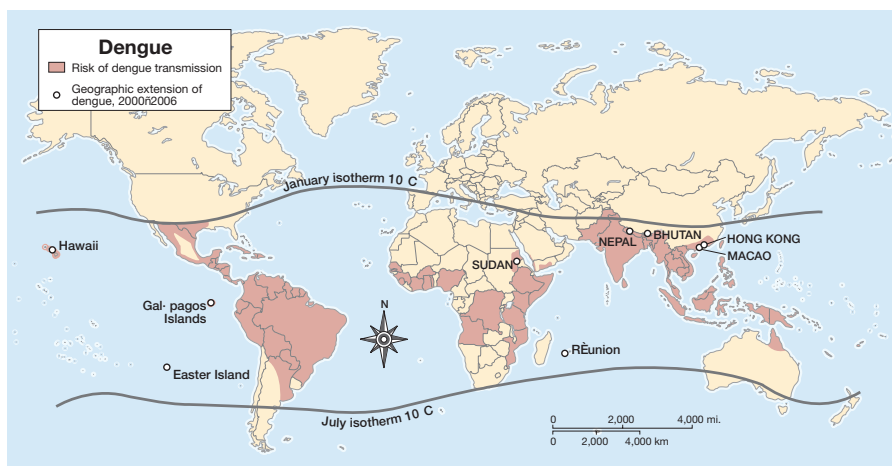
bites an infected person. Because the virus remains in the mosquito for the rest of its life, the mosquito can pass the infection to many people. In areas with large populations of mosquitoes, dengue fever epidemics can occur.

What Are the Symptoms of Dengue Fever?

A sudden high fever, sometimes reaching 104 or 105 degrees Fahrenheit, often is the first sign. The affected individual also usually has a flushed (reddish) face. Muscle, joint, or bone pain develop, especially in the knees and shoulders; nausea and vomiting occur with a severe headache and pain behind the eyes. There are also small hemorrhages, for example, bleeding gums, petechiae (pin-point red dots under the skin), or a nosebleed. Fever typically begins on the third day after infection and lasts five to seven days. In some children a pattern known as saddleback fever may occur in which the fever fades for a day and then returns. Once the fever goes away, the other signs and symptoms usually fade as well, with recovery usually complete by seven to ten days. Some symptoms may linger for a few weeks.

Dengue Fever

The areas of the world at risk of dengue transmission in 2006. Dengue fever has a close relationship to the regions where the *Aedes* mosquito lives. The disease is widespread close to the equator, in the tropical areas of Asia, Africa, South America, and Central America, the mosquito's preferred habitat. © World Health Organization (WHO). Reproduced by permission.



* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

What Are the Complications of Dengue Fever?

The most serious form of the disease is called dengue hemorrhagic fever, which usually occurs between the third and seventh day. Dengue hemorrhagic fever is characterized by high fever; serious hemorrhage (often with bleeding from the nose, mouth, and gums); pneumonia; and sometimes owing to blood vessel collapse, failure of the circulatory system (heart failure) or shock. People who develop dengue hemorrhagic fever usually require hospitalization, and in the hospital they receive fluids. It is possible to die from this form of the disease, although most people recover. Dengue hemorrhagic fever and dengue hemorrhagic shock are more likely to develop if an individual has previously been infected with another strain of dengue, and most people who experience this complication have had prior infection with one or more other strains. One theory to explain this phenomenon is that some of the immune responses formed by the body in defense against the first strain may predispose some of the body's cells for further viral entry and replication. Other complications from dengue fever may include brain damage from prolonged shock, inflammation of the heart tissue, and liver failure, but these are rare.

How Is Dengue Fever Diagnosed and Treated?

Doctors typically diagnose dengue fever from a patient's history of symptoms and risk factors, including whether that person has been in locations where dengue fever is found. The doctor looks for high fever, pain, and rash, known as the dengue triad. To help confirm the diagnosis, doctors may order blood tests or tests on spinal fluid to look for antibodies to the virus.

The disease usually clears up on its own. Supportive care such as fever reducers and pain killers may be used. Dengue fever often involves excessive loss of body fluids, through sweating, vomiting, or diarrhea, requiring the patient to drink plenty of fluids to avoid dehydration*. Over-the-counter medicine, such as acetaminophen*, can relieve pain and fever

while the disease runs its course. Patients suspected to be developing dengue hemorrhagic fever are closely monitored and have frequent blood work to check for signs of hemorrhagic conditions.

How Is Dengue Fever Prevented?

In the early 2000s, scientists were working on a vaccine for dengue fever, but one was not yet available. The only way to control the spread of the disease is to reduce mosquito populations. Using pesticides, stocking lakes and ponds with special fish that eat mosquito larvae, and covering or eliminating small pools of standing water in which the insects breed can help keep mosquito levels in check. People can protect themselves from bites by using insect repellent, wearing clothing that covers much of the body, and avoiding outdoor activity. Mosquito repellent containing DEET* is most effective.

▶ See also **Ebola Hemorrhagic Fever** • **Travel-related Infections** • **Viral Infections** • **Yellow Fever**

Resources

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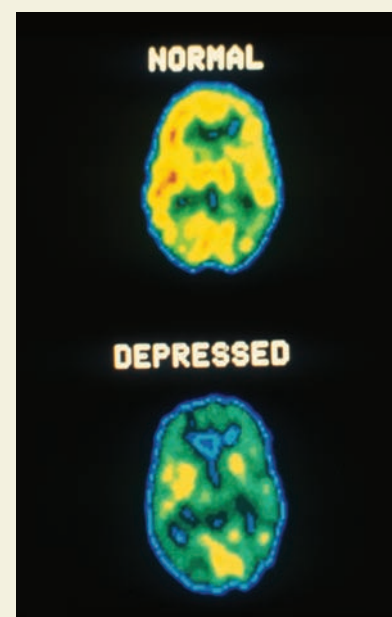
Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dvbid/dengue>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/topics/dengue/en>.

Depersonalization See *Dissociative Identity Disorder*.

Depressive Disorders

Major or clinical depression (dee-PRESH-un) is a mental disorder that causes people to feel long-lasting sadness and to lose interest in activities that normally give them pleasure. It is also referred to as unipolar depression because the people have only one type of feeling, that of sadness. People with depression have continuing negative and pessimistic thoughts and may experience changes in eating and sleeping patterns and in their ability to concentrate and make decisions.



▲ Computer-generated positron emission tomography (PET) scan (top) shows the brain of a healthy person in contrast to the brain of a person with untreated depression (bottom). Doctors and researchers use PET scans to study how the brain functions. *ASAP/Photo Researchers, NIH/Science Source, Photo Researchers, Inc.*

* **DEET** (abbreviation for N,N-Diethyl-meta-toluamide) is the active ingredient in many insect repellants.



▲ In his autobiographical book *Darkness Visible*, William Styron, seen here in a 2000 photo, explores the possible sources of his debilitating depression, his recovery, and the history of this illness which has affected many other artists and writers. Sean Gallup/Getty Images.

Jodie's Story

The sun is shining brightly, but 15-year-old Jodie feels darkness all around her. She used to sleep so soundly that her father said he needed a cannon blast to wake her. In recent weeks, however, she rises unexpectedly in the gray light before dawn. She lies awake, staring at lights caused by headlights of passing cars and crying as the shapes slowly cross her ceiling.

Why would Jodie cry over a thing like that? Lately, so many odd things bring tears to her eyes. She is tired constantly. She cannot concentrate. Sometimes when she tries to solve a simple math problem in class or decide what to have for lunch, it seems as if her brain will not work. Jodie used to love to go with her friends to get a soda after school. Now all she wants to do is get home to her room and be alone. Nothing is enjoyable, not her favorite books or television shows or even foods. Sometimes Jodie is annoyed at things and people, but she cannot explain why. For weeks, Jodie's friends have told her to snap out of it. She thinks to herself, "I want to, but what would the point be? I wish I knew what was wrong!"

What is Depression?

Jodie has major or unipolar depression, a disorder that affects more than 17 million people in the United States. Although people often say that they are depressed when they feel down, this is not the same thing as the mental disorder called depression. The condition often leads to constant negative thinking and sometimes substance abuse or self-harm. Extreme depression can lead to the sufferer attempting or committing suicide.

Everyone feels sad at times. Perhaps a relative has died or the home team has lost an important game. However, in a short time, that unhappy mood passes, and person is excited about a day at the beach or a good grade on a test. However, people with depression have long periods when nothing seems to make their mood better. It affects their whole body and mind: how they feel, think, and behave. The good news is that, if they get professional help, more than 80 percent of people with depression can feel better, often within a few weeks.

Award-winning author William Styron, who wrote the book *Sophie's Choice*, suffered from depression. In *Darkness Visible*, a book about his own depression, Styron calls the disorder a "veritable howling tempest in the brain." He compares depression to a storm that blows away all of a person's usual feelings and abilities to cope with life.

How Does Major Depression Differ from Other Forms?

Depression comes in many forms. The *Diagnostic and Statistical Manual of Mental Disorders IV* established guidelines for determining what kind of depression a person may have. According to the manual, major depression or clinical depression involves excessive sadness and/or loss of interest that lasts for at least two weeks. Episodes of feelings of sadness may be a single occurrence or recurrent as certain events happen over the lifespan.

In some cases, the down period lasts for many weeks or months. At times, a person with major depression may feel as if the disease has gone away on its own. Normal feelings return, like the ones the individuals used to experience. But like a tide that moves in and out at the beach, the suffering usually comes back if the person does not get treatment. About 8 percent of people experience this type of depression at some point in their lives.

Chronic depression, also known as dysthymia (dis-THI-mee-ah), is a form of depression that lasts for two years or more. People with chronic depression do not experience the severe down feelings of someone with major depression. Instead, they suffer from a nagging feeling of emptiness that never seems to go away. They often are said to have a negative view of life or to feel “down in the dumps.” About 15 to 20 percent of people who get a depressive disorder have chronic depression. Chronic depression and major depression are referred to as unipolar because the person experiences one type of feeling, that of sadness.

Bipolar disorder (sometimes called manic depression) is a very different type of depressive disorder. People with bipolar disorder have periods of almost unlimited energy, wild happiness, and hyperactivity that are followed by periods of depression. The mood extremes may be mild or severe, and the mood changes may occur slowly or quickly. Because this type of depression involves two different feelings, it is called bipolar depression, to distinguish it from unipolar depression. Only about 1 percent of people with a depressive disorder have bipolar disorder.

How Do People Know They Have a Unipolar Disorder?

Major depression and chronic depression involve a variety of symptoms. Some people experience only a few symptoms, while others feel most of them. Possible symptoms include the following:

- Ongoing feelings of sadness, hopelessness, or emptiness. In children, the mood can appear more as irritability than as sadness.
- Loss of interest in family, friends, favorite hobbies, and other activities that usually make the person happy.
- Crying easily or frequently.
- Change in sleeping habits. Some people have trouble sleeping. Others find themselves sleeping too much.
- Change in eating habits. Some people lose their appetite or lose weight without dieting. Others overeat or gain weight.
- Extreme fatigue or a feeling of slowness.
- Inability to concentrate or make decisions.
- Increased interest in death or thoughts of suicide.

These symptoms must last for at least two weeks and be present every day for most of the day before depression is diagnosed. If the person has recently experienced a major loss, the symptoms must last for two months

Did You Know?

- Clinical depression affects about 7 to 18 percent of the population before the age of 40 on at least one occasion in their lives.
- According to the Center for Mental Health Services, a U.S. government agency, as many as 1 in 33 children may have depression.
- For teenagers, the rate of depression may be as high as 1 in 12.
- About twice as many females as males report or receive treatment for clinical depression, although the gap is narrowing in recent history.
- According to the World Health Organization, by the year 2020 depression was anticipated to be the second leading cause of disability worldwide (after heart disease).
- The majority of people who commit suicide have a depressive disorder.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **identical twins** are twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.

* **neurotransmitters** (nu-ro-trans-MIH-terz) are chemical substances that transmit nerve impulses, or messages, throughout the brain and nervous system and are involved in the control of thought, movement, and other body functions.

or longer before it is considered depression, and then it might be called reactive depression, meaning the person is adjusting to (or reacting to) a serious loss. For people with major depression, the symptoms might occur once, or they might return over and over. For those with chronic depression, the symptoms linger for a long time.

What Causes Depression?

Experts are not exactly sure what causes depression. Depression is not the result of laziness, weakness, or a flaw in character. The person simply cannot drive out the feelings of emptiness and sadness. Many different factors about a person's biological makeup and life experience can trigger depression. A combination of factors often must exist together, both within a person's body and during day-to-day activities, for depression to occur. Unlike a cold, this illness cannot be caught from another person. Components that appear to be involved are genetics, physiology, mental thoughts, and environmental happenings.

Genetic predisposition Some studies show that depression can occur in several members of the same family. Certain genes* that are passed from parent to child might increase the chance of getting the disorder. The strongest evidence of heredity comes from twin studies. Researchers have found that identical twins*, who have the same genes, are twice as likely to both experience major depression as fraternal twins, who do not have identical genes. Twin studies show that about 50% of the possible cause of depression is genetic and the other 50% is related to other factors. Someone who has a parent or sibling with major depression has a two to three times greater risk of developing depression compared with the average person. Specific single genes do cause some diseases such as cystic fibrosis, but combinations of many genes probably predispose some people to depression.

Mental components Some researchers observe that certain people seem more vulnerable to depression because of how they think about themselves and their lives. For example, people with low self-esteem might be more likely to develop depression. They might think that they are ugly, stupid, or always saying the wrong things, even if family and friends tell them differently. Also, people who tend to be pessimistic can become overwhelmed by depressed feelings. Such people see the negative in many situations and have feelings of being helpless and of having no choices. Perfectionists, who often set unrealistic goals for themselves, are prone to depression.

Physiological components Some researchers who study depression and the brain have found links between depression and an imbalance in certain chemicals in the nervous system, known as neurotransmitters*. These chemicals let brain cells communicate with each other and, therefore, allow the brain to function normally. In people with depression, the nervous system may have either too much or too little of these chemicals,

especially, serotonin* and norepinephrine*. Some research has suggested a link between depression and the hippocampus, a horseshoe-shaped structure that is a center for both mood and memory. Several other physical conditions may relate to depression:

Some illnesses such as heart disease, hepatitis, hypothyroidism, and brain damage caused by Alzheimer's disease or a head trauma may cause depression.

Some medications, such as birth control pills and steroids, may contribute to depression.

Depression may be caused by certain dietary deficiencies, such as reduced levels of omega-3 fatty acids and lower magnesium levels.

Poor sleep quality may occur with major depression. Depression leads to alterations in the function of the hypothalamus and pituitary and causes excessive release of chemicals that cause poor sleep.

Seasonal affective disorder (SAD) is a type of depressive disorder that occurs among some people living in areas in which winter months are especially dark. The reduction in sunlight may lead the body to produce higher levels of melatonin, a major player in SAD.

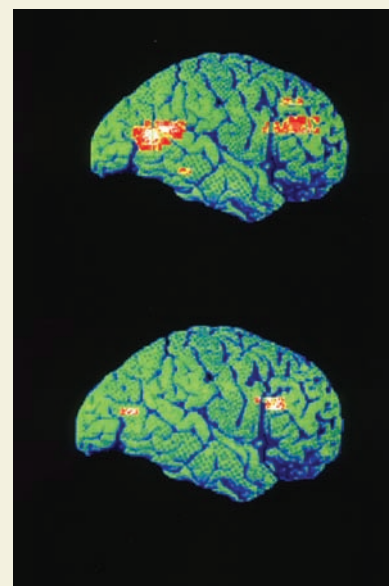
After childbirth some women may experience a disabling depression called postpartum depression. The incidence rate is 10 percent to 15 percent and usually sets in within three months of delivery and can last for about three months.

Environmental components Certain situations or events can cause depression or make it worse. The causes may arise from psychological factors, early experiences, or current circumstances. One of the toughest experiences for anyone is loss of a loved one, such as a grandparent who dies or a parent who moves away because of a divorce. It is natural to feel sadness on such occasions. For some people, however, the sadness does not go away; rather, it develops into depression. Other situations are linked with depression. Children and young adults can experience depression caused by school-related problems, difficulties with friends or family, or physical or sexual abuse. Adults may become depressed while dealing with the loss of a job, money problems, or separation or divorce.

Any one of these factors might lead to depression. Often, however, depression occurs for a combination of reasons. For example, it is normal for a teenager who loses a parent to feel sad. However, if the teenager already thinks that the world is a terrible place and nothing good ever happens, the stress of the loss might be worse for this teenager than for another. If the teenager also inherited a gene linked to depression, it might be difficult for the individual to bounce back from the loss without treatment.

How Are Depressive Disorders Diagnosed?

Depression is not always easy to diagnose. When a person cannot move one arm after a fall, the doctor can order an x-ray to check for a broken bone. However, the symptoms of depression may not be so obvious.



▲ Positron emission tomography (PET) records electrical activity inside the brain. With red and yellow showing brain activity, the brain of a depressed person at the top shows a decrease in activity compared to the brain of a person who has been treated for depression at the bottom. Treatment can improve metabolic activity and blood flow in the brain. *Photo Researchers, Inc.*

* **serotonin** (ser-o-TO-nin) is a neurotransmitter, a substance that helps transmit information from one nerve cell to another in the brain. It is associated with feelings of well-being.

* **norepinephrine** (NOR-e-pi-ne-frin) is a body chemical that can increase the arousal response, heart rate, and blood pressure.

* **psychiatrist** (sy-KY-uh-trist) is a medical doctor who has completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can diagnose mental illnesses, provide mental health counseling, and prescribe medications.

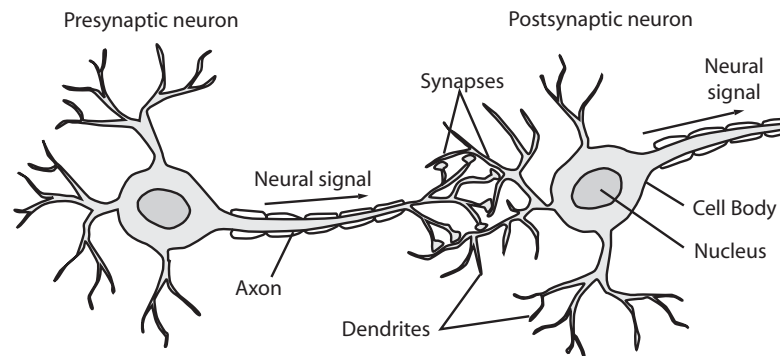
* **clinical psychologist** refers to a mental health professional who has earned a non-medical doctoral degree. Clinical psychologists can do psychological evaluation and provide mental health counseling and therapy.

DEPRESSION IN HISTORY

Ancient Egyptians and Greeks described 4,000 years ago a disorder that sounds like depression.

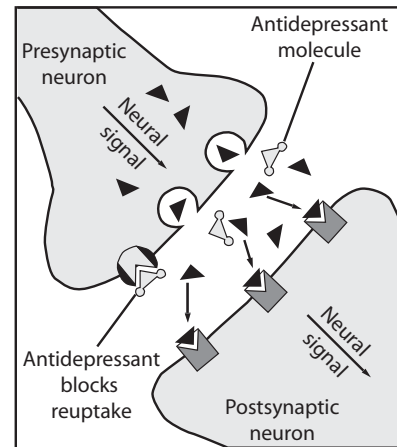
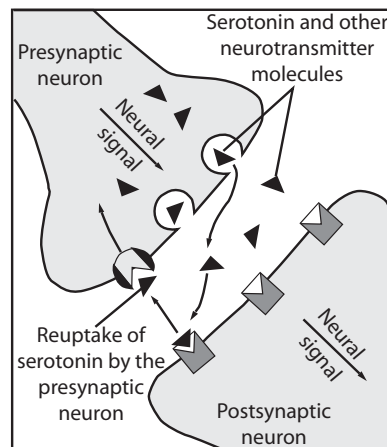
In past centuries, people tried treatments that seem cruel in the 21st century, such as removing parts of the brain or dropping depressed people into freezing water to shock them.

Often, people with depression do not realize that they have the disorder. They might sense that things are wrong, but often it is a family member, friend, coworker, family doctor, or teacher who notices the problem. That is when a professional who specializes in mental health, such as a psychiatrist* or clinical psychologist*, should be consulted. Such professionals are trained to observe how a person acts and talks. They look for symptoms of depression and decide what to do based on what they see and hear from the person and the person's family.



Nerve cells (neurons) use chemicals called neurotransmitters to send messages. The message (neural signal) travels in a specific direction from one cell to the next across a connecting synapse (SIN-aps), often transmitted from the axon terminal of one cell (the presynaptic neuron) across the synapse to the dendrites of the next (the postsynaptic neuron). Some antidepressant medications work by targeting levels of serotonin and other neurotransmitters in the synapses.

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



How Are Depressive Disorders Treated?

Almost all people who get depression can be helped. Statistics show that about 8 of every 10 people who get help find that their symptoms improve. Two primary kinds of treatment are used: psychotherapy and medication.

Psychotherapy Psychotherapy or counseling assists individuals in understanding and resolving habits or problems that may be contributing to or cause depression. Depressed people may benefit from talking with a psychiatrist, clinical psychologist, clinical social workers, or other mental health counselors. Mental health professionals can help depressed individuals learn how to cope better with stressful situations, such as moving to a new town or experiencing problems at home. Family members sometimes also take part in counseling.

Medication There are several antidepressant medications* that psychiatrists and other physicians can prescribe to affect the way that neurotransmitters work in the brain. These medications correct the imbalance that causes the symptoms of depression and allow a person to feel better. Examples of medications that are prescribed for depression are as follows:

- **Selective serotonin reuptake inhibitors (SSRIs)** are a family of antidepressants that are considered to be the standard treatment. Many scientists believe that one cause of depression is an inadequate amount of neurotransmitter serotonin. Proloft, Paxil, and Zoloft are SSRIs.
- **Serotonin-norepinephrine reuptake inhibitors (SNRIs)** are antidepressants that act on both norepinephrine and serotonin. Examples are Effexor and Cymbalta.
- **Tricyclic antidepressants (TCAs)** are older drugs for use in depression and include such medication as amitriptyline and desipramine.
- **Augmentor drugs** are used in combination with other drugs. Such drugs include a variety of tranquilizers and sedatives and tryptophan.

If one medication does not work in a matter of weeks or has side effects, another can be tried. Medications work best for individuals who are also getting counseling. However, medications and mental health counseling do not work for everyone. About 20 percent of people with the worst symptoms of depression do not respond well to these treatments, either used alone or in combination.

Some severe cases of depression require the person to spend time in a hospital for more intensive observation and treatment. In addition, psychiatrists sometimes treat such severe cases with electroconvulsive therapy*. This procedure involves passing a small amount of electricity through the brain after the person has been put to sleep with a drug. Although this is a controversial procedure, many who receive the treatment report feeling better.

* **antidepressant medications** are used for the treatment and prevention of depression.

* **electroconvulsive therapy** popularly known as shock therapy, involves sending small, carefully controlled pulses of electric current to the brain, which leads to brief seizures. It is a fast treatment for severe depression.

About two-thirds of the people with symptoms of depression do not seek or get the proper help. The disorder often makes it hard for them to recognize what is wrong. Some people try to mask depression by using alcohol or illicit drugs, but such self-medication usually just makes the depression worse. Other people might believe that their mood problem can be overcome without outside help, so they endure the symptoms without seeking help. Such people need to understand that depression is an illness, not a character flaw. Just as something can go wrong with the heart or lungs, people can have something go wrong in their brain.

For long periods of sadness or other symptoms of depression, people need to seek help. A young person should talk with parents, relatives, teachers, school counselors, or a close adult friend about these feelings, especially if they include thoughts of suicide. In most cases, people with depressive disorders can be helped with proper treatment.

▶ *See also* **Alcoholism • Bipolar Disorder • Seasonal Affective Disorder • Substance Abuse**

Resources

Books and Articles

Cobain, Bev. *When Nothing Matters Anymore: A Survival Guide for Depressed Teens*, Rev. and updated ed. Minneapolis, MN: Free Spirit, 2007.

Evans, Dwight L., and Linda Wasmer Andrews. *If Your Adolescent Has Depression or Bipolar Disorder: An Essential Resource for Parents*. New York: Oxford University Press, 2005.

Styron, William. *Darkness Visible: A Memoir of Madness*. New York: Random House, 1990.

Organizations

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.psych.org>.

Depression and Bipolar Support Alliance. 730 N. Franklin Street, Suite 501, Chicago, IL, 60610-7224. Toll free: 800-826-3632. Web site: <http://www.dbsalliance.org>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov>.

Dermatitis *See Skin Conditions.*

Developmental Disabilities See *Autism; Cerebral Palsy; Down Syndrome; Genetic Diseases; Intellectual Disability.*

Diabetes

Diabetes mellitus is a condition that results when the pancreas produces little or no insulin* or when the cells of the body cannot use the insulin produced effectively. When insulin is absent or ineffective, the cells of the body cannot absorb glucose (sugar) from blood to provide the body with energy.*

Melinda's Story

Melinda had just turned 12 and felt hungry all the time. Her stomach growled in class and her after-school snack no longer held her until dinner. No matter how many trips she made to the school water fountain, she was always thirsty. Even worse, she needed to go to the bathroom very frequently. One of her teachers, after signing Melinda's seventh bathroom pass for the day, suggested that Melinda ask her parents to take her to the doctor. She thought that Melinda might have diabetes, and she was right.

What Is Diabetes?

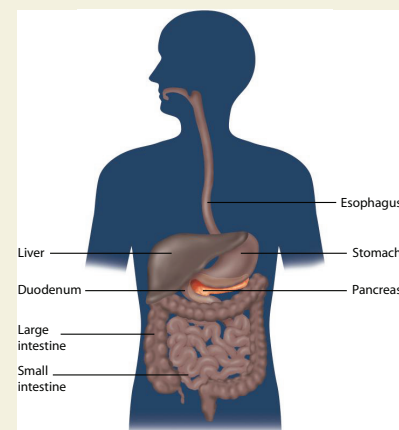
The term "diabetes" refers to a group of related diseases characterized by elevated levels of glucose (sugar) in the blood. It is caused by the failure of the pancreas to produce sufficient insulin or any insulin at all. It can also be caused by the failure of the body's cells to make proper use of the insulin that is produced.

The pancreas, the site of insulin production, is a large gland near the stomach. It contains groups of cells that function like tiny factories, producing different hormones* at exactly the right time and in the right amount. These groups (or "islands") of cells are called islet (EYE-let) cells.

One type of islet cells, the beta (BAY-ta) cells, are responsible for producing the hormone insulin. The human body needs insulin to function, because insulin helps the body turn food into energy.

When people eat, their bodies break down food and convert it into sugars and other fuels. The main fuel is a sugar called glucose (GLOO-kose). When it is in the blood, it is called "blood glucose" or sometimes "blood sugar." Glucose provides the energy people need to carry out almost every task, from pumping blood to walking to reading a book. But glucose cannot get too far on its own: Insulin must be there to allow it to pass into the body's cells.

Insulin works like a key, "unlocking" the door to cells. When insulin production stops or slows down in the beta cell factory, the body's cells cannot take in the glucose they need for energy. People with diabetes get



▲ The pancreas is one of the most important organs in the body. It has several functions as part of the endocrine (hormone-producing) system and the digestive system including the production of insulin. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **pancreas** (PAN-kree-us) is a gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.

* **insulin** is a kind of hormone, or chemical produced in the body, that is crucial in controlling the level of glucose (sugar) in the blood and in helping the body use glucose to produce energy. When the body cannot produce or use insulin properly, a person must take insulin or other medications.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

Greek Origin for Words: A Diabetes Dictionary

Many English words come from Greek, including many of the words used to describe diabetes, as well as the word “diabetes” itself:

Diabetes: Greek for “passing through,” because Greek doctors noticed how much liquid people with diabetes drank and how often they needed to urinate

Mellitus: Greek for “honey-like” or “sweet,” because it was noticed that the urine of people with diabetes tasted sweet, due to its high sugar content

Insulin: Greek for “island.” The groups of islet cells in the pancreas that are responsible for making insulin and other hormones look like tiny islands under a microscope.

Hypo: Greek for “below,” and thus “too little”

Hyper: Greek for “above,” and thus “too much”

Glyk: Greek for “sugar”

Emia: Greek for “blood”

The hormone insulin is the key that unlocks the cell’s glucose channel, allowing glucose (“blood sugar”) to enter the cell and refuel it. Without the insulin key, glucose is locked out of the cell and must remain in the bloodstream. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

glucose from their food, but no matter how much they eat, if the insulin “key” is absent or not working properly, their glucose fuel is “locked out” of the body’s cells.

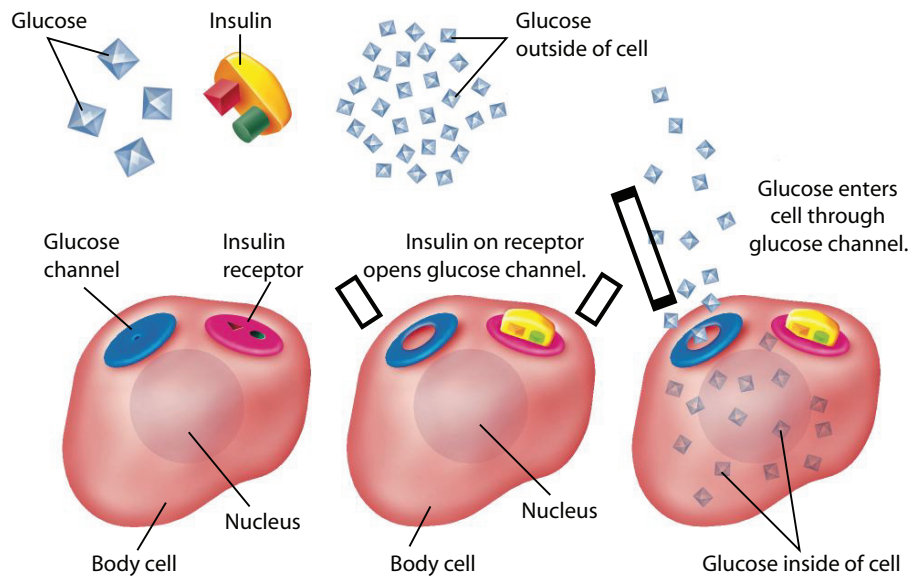
What Are the Different Types of Diabetes?

As of 2007, 23.6 million people (7.8% of the U.S. population) had diabetes. Experts estimated that 17.9 million people had been diagnosed with diabetes, whereas 5.7 million people remained undiagnosed. According to data provided by the National Diabetes Information Clearinghouse, 15,000 young people in the United States are newly diagnosed each year with Type 1 diabetes, and about 3,700 young people are newly diagnosed with Type 2 diabetes. Melinda has Type 1 diabetes. It is also called immune-mediated diabetes or insulin-dependent diabetes mellitus (IDDM).

Type 1 diabetes is usually diagnosed before a person turns 19 and is, therefore, also referred to as “juvenile” diabetes. People with Type 1 diabetes make little or no insulin of their own, so they depend on injections of insulin to stay healthy. They also need to make lifestyle changes, regarding when and what they eat.

About 186,300 people younger than 20 years have Type 1 or Type 2 diabetes, which represents 0.2 percent of all people in this age group in the United States. But these numbers do not include all youth who have Type 2 diabetes because some individuals are undiagnosed. However, among all people 20 years of age or older, 23.5 million, or 10.7 percent, have diabetes.

The other 16 percent of Americans with diabetes have what is called Type 2 diabetes. Two other names for Type 2 diabetes are “non-insulin-dependent” diabetes mellitus and “adult-onset” diabetes. Type 2 diabetes occurs when the cells of the body do not respond to insulin the way they



should. This type of diabetes typically, but not always, affects people who are over 40 years old. Extra body fat often contributes to this condition, and in many cases, weight loss can help remedy it. A person with Type 2 diabetes is not necessarily dependent on insulin injections the way a person with Type 1 diabetes is. Type 2 diabetes can be treated with pills in addition to a change in diet.

What Causes the Different Types of Diabetes?

Type 1 diabetes Type 1 diabetes is not contagious like a cold or chickenpox: People cannot catch it from one another. Nor do people get Type 1 diabetes suddenly. It usually takes months or years to develop. Despite what many people think, Type 1 diabetes is not caused by eating too many sweets.

Although causes for Type 1 diabetes were not fully understood as of 2009, some evidence suggested at least two reasons why one person develops it when another does not: genes and environmental triggers.

- **Genes***. People with Type 1 diabetes are born with certain genes for the illness, just as they are born with genes that determine eye color. Genes are inherited from biological parents. In some families, the genes for Type 1 diabetes are passed from parents to more than one child; a sibling of someone with Type 1 diabetes has about a 5 percent chance of also developing it.
- **Environmental triggers**. In some people, Type 1 diabetes is caused by an environmental trigger, such as a virus*. The trigger makes the person's immune system attack and destroy the beta cells, with the result that insulin can no longer be produced. However, for an environmental trigger to have this effect, people probably have to have a genetic predisposition to disease. Most people do not just suddenly develop diabetes because they get a viral infection such as the flu.

Type 2 diabetes People with Type 2 diabetes are not contagious. Two major factors seem to play a role in why people develop Type 2 diabetes: genes and obesity*.

- **Genes**. Just as certain genes determine that a person may be more likely to develop Type 1 diabetes, other genes play an important part in the development of Type 2 diabetes.
- **Obesity**. Many people who have Type 2 diabetes are obese. The extra weight may impair the body's ability to use insulin effectively.

How Do People Know If They Have Diabetes?

Symptoms When the body does not have adequate amounts of insulin, symptoms like Melinda's result. Frequent urination is common in a person with Type 1 diabetes. This symptom occurs because glucose cannot get into the body's cells, and it builds up in the blood instead. Normally,

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **virus** (VY-rus) is a tiny infectious agent that can cause infectious diseases. A virus can only reproduce within the cells it infects.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

the kidneys do not allow glucose to get into the urine. But in the case of diabetes, the high level of blood glucose spills into the urine, pulling extra water out of the body along with it.

Feeling thirsty is also common because the body needs to make up for all the liquid lost through urination. Feeling hungry and eating a lot are also common symptoms; the body is looking for a way to get the energy that it is missing. But even with all the extra eating, people with undiagnosed diabetes may lose weight, because their bodies start to use fat for energy instead of sugar. In the case of growing children and teenagers, the fact that they are not gaining weight at a time in their lives when they should be may be a sign of diabetes.

These symptoms are common to both Type 1 and Type 2 diabetes, although usually less severe in the latter. Type 2 diabetes may sometimes have other symptoms, such as repeated or hard-to-heal infections; blurred vision; and dry, itchy skin. But often these symptoms are quite mild, and sufficient attention is not paid to them.

Diagnosis When doctors suspect that a patient has diabetes, usually they first perform a urine test. A strip of paper that has been treated with a chemical to detect glucose is placed in a small sample of the patient's urine. If the immersed strip shows that glucose is present, the doctor will want to confirm the test by checking the patient's blood sugar with a blood test. If the doctor feels sure that there is too much glucose in the patient's blood, further evaluation and testing will be done. (Diabetes is defined by the American Diabetes Association (ADA) as a fasting blood sugar in excess of 126 mg per deciliter.) Treatment will be started if the diagnosis of diabetes is confirmed.

Because people with Type 2 diabetes continue to make insulin that is functioning to a certain extent, they may develop symptoms over a

TWO MILLENNIA OF MEDICINE

The ancient Greek physician Aretaeus (ar-e-TE-us) of Cappadocia (c. 81–c. 138 C.E.) described diabetes as a “melting down of the flesh and limbs into urine.” Throughout history, many people with the disease died at an early age by wasting away, although the disease was probably not as prevalent in ancient times as it is in modern times.

Treatments frequently involved dietary changes. Aretaeus recommended milks, cereals, and starches. In 1797, John Rollo recommended a meat diet high in proteins. These diets were not cures for diabetes, but they did allow people with diabetes to live longer than if they had remained on regular diets.

The first truly successful treatment for diabetes was finally made available in the 1920s when Frederick Banting, Charles Best, and John James Macleod first isolated insulin for use through therapeutic injections.

period of months or years without facing immediate danger. They may feel tired, worn out, or thirsty much of the time, without thinking that it could be diabetes. In many cases, Type 2 diabetes is actually discovered by accident, during a routine physical exam or screening blood or urine test.

How Is Type 1 Diabetes Treated?

A person who has been diagnosed with Type 1 diabetes needs to take several steps in order to function well. These include taking insulin, following a diabetic diet, exercising, monitoring blood glucose levels, and taking urine tests. All of these measures contribute toward achieving the major goal: keeping the amount of glucose in the blood as close to normal as possible, so the person with diabetes can stay healthy and feel good.

Insulin People with Type 1 diabetes must get the correct amount of insulin into their blood. If not, usually within a matter of days they develop the severe emergency condition diabetic ketoacidosis, which is fatal unless treated with insulin. Different sources of insulin have been used to treat diabetes. Pork insulin is extracted from the pancreata of pigs, and bovine insulin comes from the pancreata of cows. These animal insulins work well in humans but the structure of the insulin proteins differs slightly in their amino acid sequence, and they produce mild immunologic reactions. These animal insulins were used as treatment for diabetes for many decades and were still available in the early 2000s. As of 2009, synthetic human insulin, which has the same amino acid sequence as the native human insulin, was preferred.

Insulin comes in liquid form (dissolved in water) in a bottle and must be injected into the body. Unlike a lot of medications, insulin cannot be swallowed in pill form because the hormone insulin is a protein. Like other proteins, it would be digested and broken apart in the stomach, just like the protein contained in food.

Most people take insulin by using a needle to inject it into the layer of fat beneath the skin. The most common places where people inject insulin are in the arms, legs, stomach, and hips, all places where people have some fat. The injection does not hurt much, since the needle is very thin. Usually, a person needs to inject insulin this way two or more times a day, on a set schedule, coordinated with meals.

Some people with Type 1 diabetes use an insulin pump, which is about the same size as a beeper, with a small container filled with insulin. The insulin gets automatically pumped into the person's body through a small tube attached to a needle inserted into the skin. The insulin is pumped in at a slow rate all the time, with an extra "boost" pumped in before meals to prepare the body for the incoming sugar.

However people with Type 1 diabetes take insulin, one factor stays constant: They must take insulin every single day to allow the body's cells to take in and use glucose properly. They cannot take a break or decide to stop taking it, or they will become ill.

Sports Stars with Type 1 Diabetes

These outstanding athletes were all diagnosed with Type 1 diabetes at an early age:

Jackie Robinson. Robinson was the baseball player who broke the color barrier in 1947. In his 10-year career with the Brooklyn Dodgers, Robinson was a batting champion, the League Most Valuable Player (MVP), and a member of six championship teams. He was baseball's first Rookie of the Year. Robinson was elected to the Hall of Fame in 1962, his first year of eligibility.

Bobby Clarke. The tenacious leader of hockey's Philadelphia Flyers for 15 seasons, Clarke was first diagnosed with diabetes at the age of 15. Undeterred, he went on to win three Hart trophies as league MVP.

Wade Wilson. An National Football League (NFL) quarterback for more than 16 years. Beginning in 1981, Wilson led the Minnesota Vikings to three playoffs and the 1987 NFC championship game.

* **ketones** (KEE-tones) are the chemicals produced when the body breaks down fat for energy.

Food Proper nutrition is a very important part of staying healthy—for everyone—especially for a person with Type 1 diabetes. Because food affects how much glucose is in the blood, people with Type 1 diabetes must pay careful attention to the food they eat, how much they eat, and when they eat it. In particular, because carbohydrates are the body's main source of glucose, many people with diabetes estimate the amount of carbohydrates in each meal to determine if they are getting the right amount of sugar.

All that does not mean that the eating habits of someone with diabetes are so very different from other people. The food itself can be the same as that eaten by most people. But in most cases, their meal plans must be on some sort of schedule, include snacks, and limit sweets because of the large amount of sugar they contain.

Exercise Just like healthy eating, exercise is something that is important for everyone especially for people with Type 1 diabetes. In the 20th century some doctors thought people with Type 1 diabetes should not exercise, but that opinion changed. Exercise helps insulin work better to control the level of glucose in the blood. Exercise also helps keep people with diabetes at the right weight, and it helps maintain a healthy heart and blood vessels. In addition, exercise helps people feel good about themselves.

When people with Type 1 diabetes exercise, they use glucose at a faster-than-normal rate, so they must pay special attention to ensure that their blood glucose level does not drop too low. To assure the proper level, they may need less insulin, more food before exercise, or snacks during and after exercise.

Blood glucose and urine testing People who have Type 1 diabetes usually test their blood glucose three or more times per day. This process involves pricking the finger with a tiny, sharp device to get a drop of blood. The blood drop is put on a chemical strip and inserted into a testing meter that reads the amount of sugar in the blood. The person then records the blood glucose numbers in a diary. This monitoring helps to determine if the level of glucose in the blood is where it should be and guides adjustment in the treatment plan.

Urine testing is another helpful form of monitoring. It is especially important when a person with Type 1 diabetes is sick (with the flu, for example). Any kind of physical stress, such as an infection, tends to interfere with the absorption and proper use of glucose. When this interference occurs, the cells begin to break down fat for energy. A potentially harmful byproduct of this process is the production of ketones*. Urine testing is an effective means of determining if ketones are building up in the blood.

Hypoglycemia, Hyperglycemia, and Ketoacidosis

Sometimes, even with insulin, proper nutrition, and exercise, it can be difficult to control diabetes completely. Blood glucose levels can become either too high or too low in some cases, and blood levels of ketones can rise to toxic levels.

Hypoglycemia Hypoglycemia (hy-po-gly-SEE-mee-a) occurs when the level of glucose in the blood is too low, which can result when someone takes too much insulin, misses a meal or snack, or exercises too hard without taking special precautions. In its beginning stages, hypoglycemia can make someone weak, shaky, dizzy, and sweaty. A person with diabetes learns to be aware of these warning signs and almost always takes action immediately to treat them, by drinking some juice or taking glucose tablets. If left untreated, a person may become disoriented, sleepy, or have a hard time talking. Eventually, the person may become very confused and uncoordinated and, in extreme cases, go into a coma*. The treatment for an extreme case of hypoglycemia is to give the person sugar as soon as possible, by intravenous* injection if necessary.

Hyperglycemia Hyperglycemia (hy-per-gly-SEE-mee-a) occurs when too much glucose is in the blood, which happens if the person has taken too little insulin, has eaten too much high-sugar food, or is ill with an infection or stressed for other reasons. Symptoms include very frequent urination, extreme thirst, weakness, and tiredness.

Ketoacidosis Ketoacidosis (ke-to-a-si-DO-sis) occurs in uncontrolled diabetes when the blood becomes too acidic due to high levels of ketones. People in ketoacidosis may be nauseated or vomiting and breathing deeply. If they do not get treated, they will become dehydrated and go into a coma. Emergency treatment involves insulin and lots of intravenous fluids. Fortunately, ketoacidosis is almost always preventable in people whose diabetes had been diagnosed early and in those who had managed to take care of their diabetes properly.

How Is Type 2 Diabetes Treated?

People who have Type 2 diabetes are often able to manage their diabetes with dietary changes and a weight-control program, if needed, which consists of balancing a healthy combination of foods and exercise.

In some cases, people with Type 2 diabetes are given pills to help the body make more insulin or respond to insulin more normally. In some cases, a person with Type 2 diabetes needs to take insulin injections, like a person with Type 1 diabetes.

There are many similarities in the treatments for Type 1 and Type 2 diabetes, but the main difference is the role of insulin. If individuals with Type 2 diabetes forget to take their insulin, they will not go into ketoacidosis. And while a doctor might say it is all right for a person with Type 2 diabetes to stop taking insulin completely and just take pills, this would not be possible for a person with Type 1 diabetes.

Living with Type 1 or Type 2 Diabetes

Between taking insulin, following a meal plan, testing blood sugar levels, and the rest, living with Type 1 diabetes can sound like a big job—and it can be—especially in the beginning. Luckily, many people who have been

Diabetes Research

Clinical trials are research projects undertaken by scientists, pharmaceutical companies, and government researchers to determine whether medications and treatment plans are safe and effective.

To evaluate the effectiveness of careful self-management in reducing the long-term complications of diabetes, in 1983 the U.S. National Institute of Diabetes and Digestive and Kidney Diseases undertook a ten-year study, called the Diabetes Control and Complications Trial (DCCT).

People with diabetes took part in the DCCT and followed instructions for testing their blood glucose three or four times a day, taking more frequent insulin injections or using an insulin pump, and following a diabetic diet. The test results showed that the people who maintained near-normal blood glucose levels had fewer long-term complications, such as problems with their hearts, eyes, or kidneys. It proved that for a person with diabetes, paying close attention to small symptoms on a daily basis has a big payoff later on.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

The United States and the World

Globally, there were approximately 180 million adults with diabetes in 2008. By the year 2030, that number was expected to rise to 360 million. The World Health Organization (WHO) provides the following data:

- In 2005 an estimated 1.1 million people died from diabetes.
- Almost 80 percent of diabetes deaths occur in low and middle-income countries.
- Almost half of diabetes deaths occur in people under the age of 70 years; 55 percent of diabetes deaths are in women.
- WHO projected that deaths from diabetes would increase by more than 50 percent between 2006 and 2016 without urgent action. Most notably, diabetes deaths were projected to increase by more than 80 percent in upper-middle income countries between 2006 and 2015.
- WHO estimated that between 2006 and 2015, China would lose \$558 billion in national income due to heart disease, stroke, and diabetes alone.

* **retina** (RET-i-na) is the tissue that forms the inner surface of the back of the eyeballs; it receives the light that enters the eye and transmits it through the optic nerves to the brain to produce visual images.

ANIMAL RESEARCH AND DIABETES

In 1880 Oskar Minkowski (1858–1931) and Josef, Freiherr von Mering (1849–1931) were among early researchers to discover that removing the pancreas of dogs rendered them diabetic. Shortly thereafter Edward Sharpey-Schafer (1850–1935) discovered the active principle in the islets of Langerhans, and he named it “insuline.”

Canadian surgeon Frederick Banting (1891–1941) and physician Charles Best (1899–1978), using the laboratory of John James Macleod (1876–1935) at the University of Toronto, conducted research also on dogs that led to better understanding of the medical uses for insulin.

In 1923, Banting and Macleod were awarded the Nobel Prize for medicine and physiology for the discovery of insulin. Banting shared his half of the prize money with Best.

diagnosed with Type 1 diabetes have an entire diabetes treatment team to help them. This team usually includes a doctor, a diabetes nurse, a dietitian, a psychologist, and a social worker. Ideally, the entire team works to become partners with the patient and the patient’s family, so that they can maintain as normal a life as possible.

People with diabetes can do almost everything that people without diabetes can. They can:

- Go to school
- Play sports
- Spend time with friends
- Eat food at parties
- Do almost every kind of job
- Go to college
- Get married and have children

A person with diabetes may have to eat an extra snack before competing in a track meet or duck out of a party for a minute to take insulin or have only a small bit of ice cream when everyone else is going for the Super Sundae. But people who control their diabetes lead normal lives. And women with diabetes who want to have babies can usually do so, with the support of their diabetes treatment team.

How Can Diabetes Affect a Person’s Future?

Both Type 1 and Type 2 diabetes can have negative long-term effects on a person’s health. These effects tend to develop very slowly. Because a person with diabetes may not process fat properly, there tends to be damage to the blood vessels in the body, which increases the chances for high blood pressure, heart attacks, and strokes. Diabetes can also have long-term effects on the eyes, because tiny blood vessels in the retina* become

weakened. If these blood vessels burst, they can cause bleeding and scarring in the eye, or even blindness. The chance of nerve damage and of developing kidney disease is also increased in a person with diabetes. Finally, foot health can become an issue for people with diabetes. Because the condition can affect circulation to the feet, small cuts or wounds can turn into serious infections without proper care. When such infections occur, they may lead to death of cells and tissue. When this happens, the affected foot may be amputated (surgically removed) to prevent further spread of infection or tissue death.

People with diabetes can help prevent or lessen the effects of these long-term problems. Blood sugar control is a key factor. It is very important for people with diabetes to have regular physical checkups, when a doctor can monitor blood pressure and foot health, check fat levels in the blood, and look for problems with the kidneys. Annual trips to the eye doctor are crucial for people with diabetes. If the ophthalmologist* discovers problems with the blood vessels in the retina, vision problems often can be prevented or lessened with laser surgery.

While people with diabetes must depend on doctors and other medical professionals to help them, they can also do quite a bit to help themselves. Continued education about proper diabetes management is important for helping people with diabetes stay healthy.

Will There Ever Be a Cure?

Diabetes research is an active field in the early 2000s. Much of the scientific work is concerned with insulin: how to get it into the body or how to get the body to produce it on its own. Because insulin cannot be swallowed, researchers have investigated other ways to get it into the bloodstream without an injection, such as eye drops, nasal sprays, and inhalers. As of 2009, clinical trials of inhaled and oral spray forms of insulin were being conducted. Scientists have also experimented with pancreas transplantation, as well as transplantation of the islet cells that make insulin. Until there is a cure for diabetes, however, people must live with it and control it by using the information and equipment available to them.

▶ See also **Genetic Diseases • Hypoglycemia • Kidney Disease • Obesity**

Resources

Books and Articles

American Diabetes Association. *American Diabetes Association Complete Guide to Diabetes*, 4th ed. New York: Bantam, 2006.

Becker, Gretchen, and Allison B. Goldfine. *The First Year: Type 2 Diabetes, an Essential Guide for the Newly Diagnosed*, 2nd ed. New York: Da Capo Press, 2006.

Medic Alert Tags

People with diabetes often wear metal tags or bracelets imprinted or inscribed with important medical information. In the event of an accident or diabetic coma, the information on the tag can alert medical personnel about the patient's condition.

Some companies offer medical alert tags that have an identification number that is unique to the individual so that a doctor who does not know the person can retrieve the patient's medical history in the event of emergency.

* **ophthalmologist** (off-thal-MOLL-o-jist) is a medical doctor who specializes in treating diseases of the eye.

Metzger, Boyd. *American Medical Association Guide to Living with Diabetes: Preventing and Treating Type 2 Diabetes*. New York: Wiley, 2007.

Parker, Katrina. *Living with Diabetes*. New York: Facts On File, 2008.

Thomas, Pat. *Why Am I So Tired? A First Look at Childhood Diabetes*. Hauppauge, NY: Barron's, 2008.

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org>.

American College of Physicians. 190 N. Independence Mall West, Philadelphia, PA, 19106. Toll free: 800-523-1546. Web site: <http://www.acponline.org>.

American Diabetes Association. 1701 North Beauregard Street, Alexandria, VA, 22311. Toll free: 800-342-2383. Web site: <http://www.diabetes.org>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/Diabetes>.

Children with Diabetes. 8216 Princeton-Glendale Road, PMB 200, West Chester, OH, 45069-1675. Web site: <http://childrenwithdiabetes.com>.

Juvenile Diabetes Research Foundation International. 120 Wall Street, New York, NY 10005-4001. Toll free: 800-533-CURE (2873). Web site: <http://www.jdrf.org>.

Diagnostic Tests

Diagnostic tests are used to help medical professionals diagnose illnesses.

What Are Medical Diagnostic Tests?

Before doctors can treat someone with an illness, they have to identify or diagnose the illness. By talking with the patient (“taking the history”), examining the patient, and, when necessary, ordering laboratory tests and/or other kinds of medical tests (such as imaging tests), doctors are able to make a diagnosis. Laboratory tests are analyses of samples of blood, urine, or tissue. Imaging tests provide images of the body’s interior. Often, doctors are able to make a diagnosis without needing to order any medical tests. Thousands of possible medical tests exist, ranging from simple, inexpensive tests, such as the use of a sphygmomanometer (a blood pressure

gauge that includes an inflatable cuff, usually placed around the upper left arm) to measure blood pressure to much more complicated and expensive tests, such as magnetic resonance imaging (MRI), which produces cross-sectional images of the body. Through training and experience, doctors learn when to use medical tests, which ones to use, and how to interpret the results.

Medical tests often help to identify the cause of a person's illness. Sometimes a test reveals the presence of a specific microorganism* or other cause of illness, and the diagnosis is made relatively easily. For example, a person with a high fever, painful sore throat, and white patches or white coating on the throat and tonsils* may have strep throat, an infection by streptococcus bacteria that can lead to more serious illness. The doctor will perform a laboratory test known as a throat culture*, in which the doctor swabs the patient's throat and attempts to grow any microorganisms that have been collected in a laboratory dish. Thus the lab test may confirm the diagnosis of strep throat.

Sometimes a test result suggests only a general area of focus or a range of possible causes of an illness, and making the diagnosis requires medical insight as well as further medical testing. For example, an elderly person who feels short of breath is probably going to receive a chest x-ray. The x-ray may show an enlarged heart, which is a sign that the heart is overworked, but that result is not a diagnosis. To make a diagnosis, further medical tests are needed.

A lab test can also rule out a suspected cause of illness, thereby shortening the list of diagnoses that are considered. For example, a person with anemia* is likely to undergo iron tests, a group of tests that measure iron levels in blood and blood serum and the amounts of iron stored in the body. Tests that show adequate amounts of iron in serum would help to eliminate the diagnosis of anemia and help to guide the evaluation toward other possibilities.

How Did Laboratory Testing Develop?

The existence of microorganisms has been known since 1674 when Dutch scientist Antonie van Leeuwenhoek (1632–1723) first described “little animals” in a drop of rain water. But it was the German physician Robert Koch (1843–1910), the “father of modern bacteriology” (the study of bacteria), who proved that a specific microorganism was the cause of a specific disease. That disease was anthrax (AN-thraks), an infectious disease that occurs in humans and animals; the microorganism was the bacterium *Bacillus anthracis*. That bacterium had already been discovered, but Koch was able to prove that it caused the disease. Koch also observed that anthrax bacteria, under conditions unfavorable to its growth, would produce spores* that were able to resist adverse conditions and that when favorable conditions were restored would develop into new bacteria. In 1881 Louis Pasteur took it one step further and was able to develop an effective vaccine for sheep and cattle against anthrax.

* **microorganism** is a tiny organism that can be seen only by using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

* **tonsils** are paired clusters of lymphatic tissue in the throat that help protect the body from bacteria and viruses that enter through a person's nose or mouth.

* **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

* **spores** are a temporarily inactive form of a germ enclosed in a protective shell.

- * **fungi** (FUNG-eye) are microorganisms that can grow in or on the body, causing infections of internal organs or of the skin, hair, and nails.
- * **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. A virus can only reproduce within the cells it infects.
- * **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

Following his work with the anthrax bacterium, Koch set out to find a better way of growing and isolating microorganisms. Previously, he had used liquid media for growing it, but these were easily contaminated with other microorganisms, and he was obliged to use live animals as reservoirs for the bacteria he was studying. Encouraged by his observations of colonies of bacteria (groups visible to the naked eye) growing on slices of potato, he set out to develop a solid substance nutrient medium on which he would be able to grow bacteria. With the help of his assistant Julius Petri, who is credited for having developed the Petri dish, a shallow glass dish used by biologists to grow cells, Koch developed methods for isolating colonies of microorganisms. Koch also developed new methods of staining bacteria, which made them more visible and easier to identify.

The methods for culturing bacteria that Koch developed well over a century ago became the commonly accepted standard for use by labs in the 20th century. After Koch's work, culture methods improved. Laboratories in the 21st century also culture yeast, fungi*, and viruses*.

How microorganisms are cultured First, a sample of tissue or fluid is taken from the infected region of a person's body. When the throat is cultured, sterile cotton is used to swab the throat. The sample obtained is then plated (wiped onto plates). The plates contain growth media that enable microorganisms (usually bacteria) to grow. An agar plate is a sterile Petri dish that contains a growth medium (agar plus bacterial nutrients). Agar is a gelatinous substance derived from seaweed. Individual microorganisms placed on the plate will grow into individual colonies. The bacteria that are grown are then identified. Small samples of blood, urine, pus drawn from a site of infection, and sputum (material that is expelled from the respiratory tract, usually by coughing) are also used to grow bacteria in medical laboratories, for eventual identification.

Identifying bacteria When a large enough population of bacteria has grown on the plate in the form of a "lawn," laboratory technicians must perform two operations: identification of the bacteria and sensitivity testing (determining the sensitivity of bacterial populations to a range of antibiotics*). Identification of bacteria uses a range of techniques: examination of lawn characteristics with the naked eye, staining, observation of which nutrients or combinations of nutrients (in nutrient media) are needed for bacterial growth, and microscopic examination.

Staining and sensitivity Staining is the use of a dye to make cells or cell structures more visible and easier to study. Gram staining is the use of a particular dye (the Gram stain) to differentiate bacteria into two major groups: Gram-positive bacteria and Gram-negative bacteria. Bacteria absorb the dye and turn color according to the properties of their cell walls. Gram-positive bacteria have thick cell walls, retain more dye, and stain dark blue or purple. Gram-negative bacteria have relatively thin cell walls, retain the dye less well, and stain red or pink.

Sensitivity testing is accomplished by placing small amounts of specific antibiotic substances (sometimes small paper disks that have been saturated with the antibiotic) directly onto the bacterial lawn and then allowing the bacteria to incubate for 24 hours or more. The plate is then examined, to see whether bacterial growth has been inhibited (or not) by the antibiotic. A clear area or “halo” around the antibiotic disk indicates an absence of bacteria and strongly suggests that the antibiotic will be effective against that species of bacteria in the patient. Sensitivity testing is increasingly important in medicine because bacteria that were once sensitive to (killed by) a given antibiotic may have become resistant to it.

It usually takes 48 to 72 hours to get results for routine bacterial cultures. Other cultures may take much longer to produce results. Fungal and viral cultures can take weeks. Doctors may prescribe antibiotics while waiting for culture results and later stop the antibiotic therapy if the culture results are negative or if the sensitivity tests show that the growth of the microorganisms has not been inhibited by the antibiotic.

Types of Laboratory Tests

Urinalysis A urinalysis is an array of tests that are performed on urine*. It is one of the most common laboratory tests and is performed routinely during physical examination. A typical urinalysis includes visual inspection of the urine sample (a visual check of the urine’s color and clarity), urine dipstick chemical analysis, and microscopic examination of the urine. Dipsticks are strips of paper coated with chemical compounds that are dipped in urine and change color when they come into contact with substances that may be present in urine. Dipsticks are used to measure the urine’s pH (a measure of how acidic or basic the urine is) and the urine’s “specific gravity” (urine has solutes, or dissolved matter, and specific gravity is a measure of how concentrated the urine is). Dipsticks are used to test for the presence of several substances that are usually absent in urine: protein (its presence may be an indicator of kidney* disease); glucose (its presence may be an indicator of diabetes*); ketone bodies (substances produced by the body when it must use fatty acids and other fat molecules for energy; their presence in urine may also point to diabetes); and hemoglobin (the main constituent of red blood cells; its presence in urine may indicate urinary tract* infection, kidney disease, or the presence of a kidney stone). Dipsticks are a quick screen for urinary tract infections, diabetes, and a range of kidney diseases.

For microscopic analysis, the urine is centrifuged (rotated rapidly) in a test tube until sediment appears at the bottom of the test tube. The sediment is examined under a microscope for the presence of casts (aggregations of particulate matter), including red blood cell casts, white blood cell casts, and bacterial casts, all of which are indicative of disease.

Stool tests Stool tests are diagnostic tests in which fecal matter that has been collected from a patient is sent to a laboratory for chemical and

* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

* **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body’s pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **urinary tract** (YOOR-ih-nair-e TRAKT) is the system of organs and channels that makes urine and removes it from the body. It consists of the urethra, bladder, ureters, and kidneys.

- * **parasites** (PAIR-uh-sites) organisms such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.
- * **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.
- * **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.
- * **hemoglobin** (HE-muh-glo-bin) is the oxygen-carrying pigment of the red blood cells.
- * **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **gall bladder** is a small pear-shaped organ on the right side of the abdomen that stores bile, a liquid that helps the body digest fat.
- * **bile duct** is a passageway that carries bile, a substance that aids the digestion of fat, from the liver to the gallbladder (a small pouch-like organ where the bile is temporarily stored) and from the gallbladder to the small intestine.

microbiologic tests. The stool is tested for the presence of illness-causing bacteria, protozoa, and parasites* such as pinworms. The fat content of the stool sample is often measured, as a check for the malabsorption of fat. Stool samples are tested for the presence of blood, which is very often evidence of abnormal bleeding in the gastrointestinal* tract. The color of the stool may give evidence in support of specific diagnoses. For example, stools light in color could suggest hepatitis.

Blood tests The most common test is the complete blood count (CBC), which supplies information about the cells in a patient's blood. A CBC generally provides the following information: the number of red blood cells (per volume of blood); the number of white blood cells (per volume of blood); the number of platelets* (per volume of blood) and information about their sizes; the amount of hemoglobin* (per volume of blood); the red blood cell indices, which include the average size of red blood cells and the average amount of hemoglobin per individual red cell; and the white blood cell differential count, a determination of the number of each type of white blood cell (e.g., lymphocytes, monocytes, neutrophils) expressed as an absolute number (per volume of blood) and as a percentage. During a bacterial infection, the numbers of white cells are almost always elevated because these cells are the responders to infection.

A doctor may request blood coagulation tests to determine if a patient has bleeding or clotting problems. Prothrombin time (PT) and partial thromboplastin time (PTT) are tests that measure the blood's clotting ability. In either test, the test result is the time it takes a small sample of blood to clot after substances that promote clotting have been added to the sample.

The erythrocyte sedimentation rate (ESR) is the rate at which red blood cells settle in a test tube of blood under standardized conditions. The ESR becomes elevated as a result of virtually any kind of inflammation* in the body. When inflammation is present, there are changes in blood cells and in blood serum that cause the red cells to settle more slowly. ESR is a non-specific measure of inflammation.

Liver* function tests (LFTs) are an array of blood tests that indicate how well the liver, gall bladder*, and bile ducts* are working. They measure the circulating blood levels of liver enzymes* (the liver is a biochemical factory and employs a large number of enzymes to catalyze its biochemical reactions), clotting factor proteins, and chemical substances such as bilirubin (a pigment molecule, formed when red blood cells break down, which is the cause of jaundice).

The lipid profile is a group of blood tests that help to determine a patient's risk of coronary heart disease* and stroke*. The typical lipid profile includes measures of the circulating blood levels of total cholesterol*, low-density lipoproteins (LDLs, often called "bad cholesterol"), high-density lipoproteins (HDLs, often called "good cholesterol"), and triglycerides (a common dietary fat).

Lumbar puncture (spinal tap) A lumbar puncture, also known as a spinal tap, is a diagnostic procedure that is administered to collect a sample of cerebrospinal fluid (CSF), the clear fluid that surrounds the brain and spinal cord and protects them from physical impact. It is used most often to collect cerebrospinal fluid in cases of suspected meningitis*. Meningitis is an inflammation of the meninges, the thin membranes that envelop the brain and spinal cord. It is often extremely serious and even life-threatening and needs to be diagnosed and treated in its early stages. A neurologist* inserts a spinal needle between two adjacent vertebrae, the bony segments of the spinal column, in the lumbar or lower back area and then withdraws a small amount of cerebrospinal fluid from the spinal canal. The fluid is then tested for the presence of microorganisms.

Biopsy Samples of tissue that must undergo microscopic or chemical analysis are removed by biopsy. The tissue specimens may be obtained by needle biopsy or by minor surgical techniques. Some examples of biopsy specimens are tissue samples obtained from the liver, lung, breast, and bone marrow*. Bone marrow specimens are often needed to determine the cause of a person's unexplained anemia*. A pathologist, a doctor who studies cells and tissues under a microscope, examines tumor cells to determine if a tumor is malignant (cancerous, the cells of which are likely to spread) or benign (not cancerous and localized).

Antibody and antigen tests Many antibodies* can be detected (and their levels measured) in blood samples. Tests that can identify specific antibodies in blood serum are commonly used to diagnose many infectious diseases. These tests measure the body's response to an infectious disease. Antibodies are produced by specialized cells of the immune system* in the presence of antigens* found on the surface of the invading organism. It takes some time for the body to mount an effective antibody response to a new infectious agent and for levels of antibody to rise to detectable levels, so this kind of test may not be useful when an infectious process is starting. For this reason antibody tests (also known as serology tests) are often repeated several weeks after the initial testing. Once an individual has recovered from an infectious illness, some of the immune cells that produced the antibodies become "memory" cells and are stored in lymph nodes*. These memory cells will recognize the same antigen in the event it is reintroduced to the body and will be able to mount a rapid response to the disease-causing agent. This process often gives a person immunity (protection from) to future infection. Many infectious diseases are diagnosed using antibody testing, including hepatitis*, Lyme disease*, and HIV* infection. Antibody tests are helpful in the diagnosis of some autoimmune diseases (in which the body is likely to produce antibodies to some of its own antigens).

Unlike antibody tests (which detect the presence of the disease-causing agent indirectly), antigen tests detect the presence of the disease-causing agent directly, by identifying the specific proteins that the infectious

- * **enzymes** (EN-zimes) are proteins that help speed up a chemical reaction in a cell or organism.
- * **heart disease** is a broad term that covers many conditions that prevent the heart from working properly to pump blood throughout the body.
- * **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.
- * **cholesterol** (ko-LES-ter-ol) is a fatlike substance found in the blood and body tissues.
- * **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.
- * **neurologist** (new-RHAL-eh-jist) a physician who specializes in diagnosing and treating diseases of the nervous system.
- * **bone marrow** is the soft tissue inside bones where blood cells are made.
- * **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.
- * **antigens** (AN-tih-jens) are substances that are recognized as a threat by the body's immune system, which triggers the formation of specific antibodies against the substance.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **hepatitis** (heh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.
- * **Lyme disease** (LIME) is a bacterial infection that is spread to humans by the bite of an infected tick. It begins with a distinctive rash and/or flu-like symptoms and, in some cases, can progress to a more serious disease with complications affecting other body organs.
- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).
- * **chlamydia** (kla-MIH-dee-uh) are microorganisms that can infect the urinary tract, genitals, eye, and respiratory tract, including the lungs.
- * **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

organism has on its surface. Unlike antibody test results, which might indicate that there had been an infection in the past, the presence of a specific antigen probably means that the infection is present at that moment. Examples of antigen testing include rapid strep tests, chlamydia* tests, and some HIV testing.

Nucleic acid tests Nucleic acid tests (NATs) are highly sensitive tests that can detect the presence of exceedingly small amounts of nucleic acid (DNA* or RNA*) in a blood or tissue sample. They use a nucleic acid amplification technique that multiplies (makes many copies of) the existing DNA/RNA so that it rises to detectable levels. Polymerase chain reaction (PCR) is the most frequently used technique to accomplish this amplification. Polymerase enzymes are used to catalyze (increase the rate) the formation of new DNA or RNA. Nucleic acid tests can detect viruses that are at extremely low concentration in the blood by multiplying a small segment of that virus's DNA or RNA to create a larger sample that can then be detected. They are a new and valuable tool in the identification of many infectious agents, particularly those that are difficult to culture. NATs are used in the diagnosis of hepatitis C and HIV infection. They are useful in making the diagnosis of HIV infection in infants because antibody testing in such young people is not reliable. NATs have also been used in the diagnosis of *Helicobacter pylori** infection, and research work in the early 2000s sought to develop tests of this kind for the rapid diagnosis of many serious infectious diseases. The use of these molecular technologies is not restricted to detection and identification of microbial pathogens but also can be used for genotyping, allowing one to determine antibiotic resistance or to perform microbial fingerprinting.

Imaging tests Imaging tests, using a range of technologies, provide doctors with images, including cross-sectional images, of the body's interior.

RADIOGRAPHY Radiography is the use of x-radiation, or x-rays, to view the body's interior. X-rays are a form of electromagnetic radiation. The term "x-ray" originally referred only to the electromagnetic radiation itself (waves of oscillating energy), but over time the term came to refer to the x-ray image or radiogram (the radiographic image that is produced) as well. X-ray images help physicians to see aspects of the body that are usually unseen. X-radiation is energetic enough to pass through the body. In general, a controlled amount of x-radiation is emitted by an x-ray tube and allowed to strike a specific area of the body. An x-ray image is generated when the x-rays that pass through the body are recorded on a photographic plate that has been positioned on the side of the body opposite to the source of the x-rays. Photographic plates are sensitive to x-rays. The resulting image has light and dark areas because differing amounts of x-radiation are absorbed by different tissues and organs, and differing amounts of x-radiation reach different regions of the plate. If the part of

the body through which the x-radiation has passed is relatively dense (such as bone) or has a high water content (for example, lung tissue in a person who has pneumonia*), relatively greater amounts of the radiant energy are absorbed, relatively smaller amounts reach the photographic plate, and the corresponding regions on the radiogram will appear whiter. In digital radiography, digital x-ray sensors replace the photographic plate. Doctors sometimes use a medical contrast medium, a substance that enhances and improves the contrast between light and dark in medical images. Contrast media are often used to enhance the visibility of structures, such as blood vessels or the gastrointestinal tract. They are usually swallowed or injected intravenously*.

NUCLEAR MEDICINE IMAGING Nuclear medicine imaging, also called radionuclide scanning, is an imaging technique in which very small amounts of radioactive materials (radionuclides or radiotracers) are introduced into the body, either orally or by intravenous injection, and the small amounts of radiation that are emitted by these materials are used to create an image. The radionuclides travel to locations in the body via the bloodstream and are absorbed by tissues and organs in the body. The radionuclides that have found their way to these tissues and organs emit extremely small amounts of gamma radiation. Gamma rays, emitted by the nuclei of radioactive atoms, are a type of electromagnetic radiation. The gamma ray signals are detected by a gamma camera (similar to a Geiger counter). The signals that are detected by the camera are converted to digital signals that are processed by computer software to produce an image, or scan. The places in organs where the radionuclides have accumulated in greater amounts are called “hot spots.” The hot spots show up on the scan. Hot spots usually indicate increased circulation to an area and may indicate a disease process. Some of the more common nuclear medicine diagnostic imaging tests are bone scans, liver scans, renal (of or relating to the kidneys) scans, brain scans, and breast scans. Positron emission tomography, or PET, is a nuclear medicine imaging technique. It is a computer-based technique that generates three-dimensional images, including three-dimensional images of the brain that show areas of increased radioactive signaling, which correspond to areas of increased brain activity.

COMPUTERIZED TOMOGRAPHY Computerized tomography (kom-PYOO-ter-ized toe-MAH-gruh-fee), or CT, is a diagnostic imaging technique that uses x-rays in which the source of the x-rays (and the x-ray detectors) rotate around the body. Computer software processes the vast amount of data that is collected by the x-ray detectors and assembles it into images, or scans, of the body, including cross-sectional images.

MAGNETIC RESONANCE IMAGING Magnetic resonance imaging (MRI) uses strong magnetic fields that generate slight changes in the “magnetic resonance” of individual protons in the body. A change in magnetic resonance produces a small signal. These signals are detected by a scanner,

* **RNA** or ribonucleic acid (ry-bo-nyoo-KLAY-ik AH-sid), is the chemical substance through which DNA sends genetic information to build new cells.

* **Helicobacter pylori** (HEEL-ih-ko-bak-ter pie-LOR-eye) is a bacterium that causes inflammation and ulcers, or sores, in the lining of the stomach and the upper part of the small intestine, also known as peptic ulcer disease.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **intravenously** (in-tra-VEE-nus-lee) means given or injected directly through a vein.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **thyroid gland** (THY-roid GLAND) is located in the lower part of the front of the neck. The thyroid produces hormones that regulate the body's metabolism (me-TAB-o-LIZ-um), the processes the body uses to produce energy, to grow, and to maintain body tissues.

which converts the signals into digital information. Computer software processes the information and generates an image.

ULTRASOUND IMAGING Ultrasound imaging, also known as sonography and ultrasonography, is a diagnostic imaging technique that uses ultrasound (sound waves with frequencies that are beyond the upper limit of human hearing). Ultrasound imaging is used to visualize the body's internal structures and to visualize the developing fetus* as part of routine prenatal care. Sound waves travel through liquids and solids as well as air. When sound waves encounter solid materials, they are likely to travel through, be absorbed by, and be reflected by those materials. With ultrasound imaging, a probe that emits high-frequency sound waves is placed near the surface of the body. Some of the sound waves penetrate to tissues and organs inside the body and are reflected back to the probe. (The reflected sound waves are echo waves.) The echo waves are relayed to an electronic calculating device. This device, using time measurements of the echo's return and pre-existing data on the speed of sound in tissues, calculates the distances the echo waves have traveled and is then able to put together an image. Ultrasound imaging is widely used in medical diagnosis. Ultrasound is good at imaging a range of soft tissue organs, including the heart, the liver or kidneys, and the thyroid gland*. Ultrasound imaging can be used to detect the presence of tumors or cell masses of abnormal size or density. It can be used to distinguish between solid and cystic (hollow) masses. Ultrasound imaging can generate single images, somewhat like photographs, and real-time moving images, somewhat like videos. Some ultrasound imaging systems allow for three-dimensional real-time imaging.

ECHOCARDIOGRAPHY An echocardiogram (eh-ko-KAR-dee-uh-gram) is an ultrasonogram of the heart. Echocardiography can be used to visualize the size of the heart's valves and chambers, the movements of the heart walls, the heart's pumping capacity, and patterns of blood flow through the heart. It is especially useful in the diagnosis of diseases of the heart's valves.

Resources

Books and Articles

Bellenir, Karen, ed. *Medical Tests Sourcebook: Basic Consumer Health Information about X-Rays, Blood Tests, Stool and Urine Tests, Biopsies, Mammography, Endoscopic Procedures, Ultrasound Exams, Computed Tomography, Magnetic Resonance Imaging (MRI), Nuclear Medicine, Genetic Testing, Home-Use Tests, and More*, 3rd ed. Detroit, MI: Omnigraphics, 2008.

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Johnson, David, and David Sandmire, with Daniel Klein. *Medical Tests That Can Save Your Life: 21 Tests Your Doctor Won't Order—Unless You Know to Ask*. Emmaus, PA: Rodale, 2004.

Ricotta, Mary C. *A Consumer's Guide to Laboratory Tests*. Amherst, NY: Prometheus Books, 2005.

Organizations

Lab Tests Online—American Association for Clinical Chemistry.

1850 K Street NW, Suite 625, Washington, DC, 20006. Web site: <http://labtestsonline.org>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/laboratorytests.html>.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

Diarrhea

Diarrhea is a condition in which bowel movements are abnormally frequent and stools are abnormally fluid. It is not itself a disease but is usually a symptom of some underlying disorder. Diarrhea may be a result of food poisoning, infection, diseases such as dysentery or cholera, emotional upsets, or many other conditions.

What Is Diarrhea?

Diarrhea is very common, a condition with which almost everyone is familiar. Usually, it is little more than an unpleasant nuisance that briefly interferes with work or play. Sometimes, however, severe attacks can seriously endanger a person's health by causing dehydration*. Diarrhea can last different lengths of time: It may be either acute (sudden onset and short term) or chronic (recurrent and long-lasting).

Diarrhea develops in the small or large intestines. The intestines may become irritated and inflamed by an infection or by certain foods. The inflamed intestine does not reabsorb as much water from the stool (bowel contents) as it normally would. In some infections, the intestines actually add more water to the stool. This extra water makes the stools very loose.

What Are the Symptoms of Diarrhea?

Although diarrhea may occur by itself, often it is accompanied by abdominal pain, gurgling bowel sounds, nausea, vomiting, and general weakness. The stools, or bowel movements, are loose or watery and may contain blood, pus, mucus, or droplets of fat. Sometimes attacks of diarrhea alternate with periods of constipation.

* **microorganisms** are tiny organisms that can only be seen using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

What Causes Diarrhea?

Bouts of diarrhea that range from mild to severe can be caused by several types of infectious microorganisms* (my-kro-OR-gan-iz-ims) in contaminated food or water. Diarrhea can also result from the body having trouble digesting dairy products or other foods. Mild cases of diarrhea can be caused by eating spicy food or by anxiety about some stressful event, like having to give a speech in front of a lot of people.

Food poisoning Everyone has heard of a party at which a lot of people got sick after eating the same food. Foods that are not cooked thoroughly or kept refrigerated until just before serving can cause food poisoning. It is important to make sure that raw meat or poultry does not come in contact with cooked foods, that the hands are washed thoroughly before handling any foods, and that all dishes and utensils are thoroughly washed after they have been in contact with raw meat or poultry. These measures help prevent food poisoning.

Bacteria such as staphylococcus (staf-i-lo-KOK-us) can cause digestive upsets of this kind. Certain strains of a common intestinal bacterium known as *E. coli* (EE KO-ly) can cause very serious illness with symptoms that include diarrhea. A group of bacteria called salmonella (sal-mo-NEL-la) can also lead to food poisoning. Salmonella causes gastroenteritis (gas-tro-en-ter-I-tis), or inflammation of the gastrointestinal tract. Salmonella infection can cause diarrhea for a week or longer.

Causes of diarrhea

Causes	Examples
Viral infections	Rotavirus, Norwalk virus
Bacterial infections	<i>E. coli</i> , <i>Vibrio cholerae</i> , <i>Campylobacter</i> , <i>Shigella</i>
Parasites	<i>Giardia</i> , <i>Entamoeba</i>
Helminths (intestinal worms)	<i>Strongyloides</i>
Allergic	Lactose intolerance, celiac sprue, medication side effects
Autoimmune	Ulcerative colitis, Crohn's disease
Malabsorptive	Pancreatic deficiency, biliary disease
Nutritional	Zinc deficiency, vitamin A deficiency, enteral feedings consisting of liquid nutritional formulas delivered straight to the bowels
Functional	Irritable bowel syndrome, short bowel syndrome, cancer

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Cengage Learning.

Dysentery Dysentery is an intestinal infection that causes severe diarrhea, often with blood, pus, and mucus in the stools. It is especially common in poor countries with inadequate sanitation facilities, causing the food and water supply to be contaminated. The most common causes of dysentery are bacteria and amebas*. Amebic dysentery can cause chronic diarrhea.

Cholera Outbreaks of cholera often accompany natural disasters such as earthquakes and great storms that disrupt sanitation and cause food and water to be contaminated. It also is widespread in refugee camps and other wartime situations in which people live in severely overcrowded conditions. Food and water contaminated by the cholera bacteria cause a watery form of diarrhea that can rapidly lead to death from severe dehydration.

Giardiasis A mainly tropical disease that can give rise to severe diarrhea is giardiasis (jee-ar-DY-a-sis). Caused by a parasite*, it usually enters the body in contaminated drinking water. Travelers to tropical countries can develop this form of diarrhea, but it can also be contracted in more temperate areas.

In the 1990s and early 2000s, giardiasis became increasingly prevalent in developed countries such as the United States, especially among preschool children. In settings such as households and day-care centers, where children are in close contact, giardiasis can be caught by touching stool-contaminated objects or from hand-to-hand contact.

Traveler's Diarrhea Traveling to foreign countries and drinking water or eating foods washed in the local water supply can cause digestive upsets that include diarrhea; these are sometimes called traveler's diarrhea.

Often, the exact cause of traveler's diarrhea cannot be determined. Likely suspects are certain viruses and strains of bacteria such as *E. coli* that are present in the local water supply. Sometimes parasites such as *Giardia lamblia* and amebas such as *Entamoeba histolytica* may cause traveler's diarrhea. Diarrhea caused by such parasites usually lasts longer than traveler's diarrhea caused by other substances. Other causes of traveler's diarrhea may include changes in diet, excessive alcohol intake, and salmonella or shigella bacteria.

Traveler's diarrhea usually occurs about one week after a person enters the foreign country. People who travel to Latin America, Africa, and Southeastern Asia have a high risk for developing traveler's diarrhea.

Lactose Intolerance Sometimes people get diarrhea from eating dairy products such as milk, cheese, and ice cream. This condition occurs because there is a sugar in milk and milk products called lactose (LAK-tos), which some people cannot digest. To be able to digest this sugar, there must be an enzyme* in the body called lactase (LAK-tays). Some people do not make enough of this enzyme, and when they eat milk or milk products they get diarrhea.

* **amebas** (a-MEE-buz) are small, one-celled animals that live in fresh and salt water. Amebas can be seen only with a microscope.

* **parasite** (PAIR-uh-site) is an organism such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

* **enzyme** (EN-zime) is a protein that helps speed up a chemical reaction in cells or organisms.

Malabsorption and Maldigestion Many diseases can interfere with the intestine's ability to digest (break down) foods or absorb (soak up) digested foods. Problems breaking down foods are called maldigestion (mal-di-JES-shun). Failure to absorb digested foods is called malabsorption (mal-ab-SORP-shun). If foods are not properly digested and absorbed, diarrhea may occur. Problems with the pancreas, Crohn's disease, and lactose intolerance are some of the medical conditions that cause digestion or absorption problems.

Antibiotic-Induced Diarrhea Antibiotics are medicines that kill bacteria. Diarrhea is a common side effect of antibiotics. This condition occurs because antibiotics kill both the bad bacteria that make people sick and the good bacteria that live in the large intestine. Good bacteria help keep unhealthy, disease-causing bacteria from growing too much. An overgrowth of certain unhealthy bacteria, such as *Clostridium difficile*, can cause diarrhea. Good bacteria also add thickness, or bulk, to the stools, which makes them less watery.

What If Diarrhea Lasts a Long Time?

Diarrhea caused by parasites, such as in amebic dysentery and giardiasis, can become chronic. Infestation with worms also can produce lasting diarrhea.

More often, the cause of chronic diarrhea is not an infection. Instead, it may be the result of inflammatory bowel diseases, which include ulcerative colitis (ko-LY-tis) and Crohn's disease. A disorder known as diverticulitis (di-ver-tik-yoo-LY-tis), in which abnormal pouches in the walls of the intestines become inflamed, can also cause chronic diarrhea. Other causes include cancer of the intestine, irritable bowel syndrome, and the inability to digest certain foods.

Diarrhea in Infants

Infants and young children commonly get diarrhea from viral infection or giardiasis. When a baby has diarrhea, usually the condition is more serious than in adults or older children. An infant with these symptoms can lose body fluids so rapidly that it is life threatening, especially if vomiting also occurs. Signs of dehydration in infants, such as a dry mouth, lack of urine production, or unresponsiveness, require immediate medical attention. Bacterial intestinal infections such as cholera cause many infant deaths in developing countries.

How Is Diarrhea Treated?

Most cases of diarrhea are mild and do not require medical attention. For bouts that last more than a few days, that recur, or that show blood in the stool, a doctor should be consulted. For infants, medical advice should be sought if the diarrhea lasts more than 48 hours. Medical tests used in diagnosis may include examination and culture of stool samples (for bacteria, viruses, or parasites), x-rays, or use of a colonoscope (ko-LON-o-skope),

an instrument for viewing the lining of the colon. Changes in the diet may be recommended in order to find out if diarrhea is due to a food allergy or problems digesting or absorbing foods. For example, diarrhea symptoms may get better if a person with lactose intolerance avoids milk products.

Treatment of diarrhea consists mainly of drinking liquids to replace lost fluids and prevent dehydration. The World Health Organization's salt, sugar, and water formula is commonly used to hydrate (add water to) children with severe diarrhea. It is easy-to-use and inexpensive and has helped save the lives of millions of people around the world.

In some cases, doctors may prescribe medications that ease mild diarrhea symptoms. Treatment of severe diarrhea depends largely on the cause. For example, antibiotics may be prescribed for dysentery or certain kinds of food poisoning.

Milk products, greasy foods, and sweets can make diarrhea worse. Such foods and drinks should be avoided until after the diarrhea stops. Some doctors recommend that children who are recovering from diarrhea eat bananas, plain rice, applesauce, and toast. Adults may add other soft, non-spicy foods to their diet as symptoms lessen. Such foods include boiled potatoes and baked, skinless chicken.

Can Diarrhea Be Avoided?

Washing one's hands thoroughly after using the toilet is always important, but especially so where contagious forms of diarrhea such as giardiasis can be spread. Also people should wash hands thoroughly before and after handling foods, especially raw meats. Travelers in foreign countries should use bottled (not tap) water, even for brushing teeth, and avoid eating raw meats, fish, fruits, and vegetables. Medicines may be given to prevent traveler's diarrhea in persons at high-risk for the condition or who have certain medical conditions that can be made worse by diarrhea or dehydration.

People should be cautious about eating foods that are left out of the refrigerator for a long time. Bacteria thrive in warm temperatures. Leftovers should be refrigerated quickly. All food preparation surfaces, including cutting boards and countertops, should be washed before and after food preparation.

▶ See also **Cancer: Overview • Cholera • Food Poisoning • Giardiasis • Lactose Intolerance • Maldigestion and Malabsorption Syndromes • Travel-related Infections**

Resources

Books and Articles

Janowitz, Henry D. *Your Gut Feelings*. New York: Oxford University Press, 1994.

Did You Know?

More people died from unsanitary conditions during the American Civil War than from bullets. Of the estimated 600,000 fatalities during the war, the majority were due to epidemics of diarrhea-inducing diseases such as dysentery and typhoid fever. These diseases were caused by contaminated food and water in the encampments. A voluntary organization called the U.S. Sanitary Commission was founded to combat the conditions and provide medical assistance, and they held sanitary fairs to raise money.

* **nutrients** are the components of food (protein, carbohydrate, fat, vitamins, and minerals) needed for growth and maintenance of the body.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **metabolic** (meh-tuh-BALL-ik) pertains to the process in the body (metabolism) that converts food into energy and waste products.

Miskovitz, Paul, and Marian Betancourt. *The Doctor's Guide to Gastrointestinal Health: Preventing and Treating Acid Reflux, Ulcers, Irritable Bowel Syndrome, Diverticulitis, Celiac Disease, Colon Cancer, Pancreatitis, Cirrhosis, Hernias and More*. Hoboken, NJ: Wiley, 2005.

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Organization

National Digestive Diseases Information Clearinghouse.

2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/diarrhea>.

Dietary Deficiencies

Dietary deficiencies are disorders that occur due to a lack of essential nutrients in the diet or because the body cannot absorb and process those nutrients once they are eaten. Most dietary deficiency diseases are caused by a lack of protein, vitamins, or minerals.*

What Are Dietary Deficiencies?

The human diet is divided into five nutritional groups: proteins, carbohydrates, fats, vitamins, and minerals. These five groups include about 50 nutritional items that are necessary for good health and growth. Each of these items plays a vital role in the functioning of the human body. The amount of nutrients needed for good health varies from individual to individual. Age, gender, and overall health condition affect how much of these nutrients a person needs for good health.

Whenever individuals do not get enough of an essential nutrient, they are at risk for a dietary deficiency disease. Most dietary deficiency diseases result from a lack of protein, vitamins, or minerals. Protein deficiency diseases occur when a person does not eat enough protein; these diseases are prevalent in developing countries where people are too poor to buy protein-rich foods or where such foods are hard to find. Generally speaking, vitamin and mineral deficiencies result from diets that lack some of the nutrients found in fresh vegetables and fruit, as well as milk, cheese, or eggs. In some cases, genetic* disorders, metabolic* disorders, or illnesses that prevent the body from digesting or absorbing particular nutrients cause the deficiencies.

The Supplement Habit

Use of vitamin and mineral supplements grew in the United States during the 1990s and early 2000s. Estimates suggest that from 30 to 40 million people in the United States alone use nutritional supplements on a daily basis. The potency of small amounts of vitamins to cure deficiency diseases may have led to the unrealistic expectation that vitamins and minerals can ensure good health when taken in large amounts as supplements. Despite this widespread habit, few scientific studies exist to prove these supplements can make a difference.

It is important to check with a doctor before adding nutritional supplements to the diet and to keep in mind the following facts:

- Most vitamins are water-soluble. The body can absorb only so much of a vitamin, and the rest is excreted in the urine throughout the day.
- Large doses of some vitamins, such as A and D, can be harmful. Vitamins A and D are fat-soluble vitamins and can accumulate in the liver to the point of becoming toxic.
- Too much of certain trace elements, such as zinc, copper, fluoride, and selenium, can be toxic.
- Most nutritionists recommend eating a well-balanced diet as the most effective and least expensive way of getting the nutrients needed to stay healthy.
- Vitamin supplements are warranted for certain people, such as pregnant women, newborns, and people on special diets.
- The health-food and vitamin industries that market supplements claim that the minimum daily amounts recommended by the Food and Drug Administration (FDA) are too low. The American Dietetic Association (ADA) recommends that doctors or licensed dietitians be the source of supplement prescriptions.

Protein Deficiencies

Proteins are the essential components of all organs and chemical activities. Proteins make up muscles, connective tissue, skin, and other tissues, as well as hormones and various components of blood. In addition, some proteins are enzymes, chemicals that cause reactions to occur that allow the body to function. For example, some enzymes digest food or convert sugar into energy. Proteins are composed of strings of building blocks called amino acids. When a person eats and digests proteins, these proteins break down into amino acids that are then distributed throughout the body where they form new proteins and enzymes. When protein is missing from the diet, the body cannot function properly. Milk, meat, and legumes are important sources of dietary protein.

Protein-energy malnutrition (PEM) The term protein-energy malnutrition (PEM) is used to describe the range of conditions related to calorie

* **weaning** means accustoming a child to take food other than by breastfeeding.

* **edema** (e-DEE-ma) means swelling in the body's tissues caused by excess fluids.

* **retina** (RET-i-na) is the tissue that forms the inner surface of the back of the eyeballs; it receives the light that enters the eye and transmits it through the optic nerves to the brain to produce visual images.

(energy) and protein deficiency disorders. These diseases are prevalent in developing countries where people lack sufficient food. In this category of malnutrition are the diseases kwashiorkor (kwash-e-OR-kor) and marasmus (ma-RAZ-mus). These diseases affect mainly children, with as many as half of the children in starvation-prone countries not surviving to five years of age. Adults rarely suffer from protein deficiency diseases unless they experience a problem in the intestines that prevents absorption of amino acids.

Kwashiorkor The disease kwashiorkor is caused specifically by a lack of protein in the diet. The term originates from an African word that describes the situation of an infant being weaned* from breast milk to make room for the next baby. When weaning occurs and protein-rich food (such as milk, meat, or legumes) is not available, the baby experiences tiredness, muscular wasting, and edema*. The hair and skin lose color, the skin becomes scaly, and the child may experience diarrhea and anemia.

Marasmus Marasmus is a wasting away of body tissue from a lack of both calories and protein in the diet. A child with marasmus is cranky and irritable and is skinny rather than swollen with edema.

Vitamin Deficiencies

While animals, including humans, can construct all the proteins they need from the building blocks called amino acids, they cannot make most vitamins. Vitamins are chemicals, and almost all of them must be obtained from foods. Thirteen vitamins are essential for healthy growth, development, cell function, and metabolism: vitamins A, C, D, E, K, and eight B vitamins (together they are called the B-complex vitamins). All vitamins must be taken into the body from outside food sources, except for vitamins D and K, which can be made under specific circumstances by the body.

Vitamin A, night blindness, and xerophthalmia Vitamin A is necessary to protect the retina*, and for the normal growth and health of skin and membrane cells. A deficiency of vitamin A can cause night blindness, a condition in which the eyes fail to adjust to the dark due to problems with the retina. The deficiency also may cause glare blindness, or problems seeing when the eye is exposed to too much light or to a sudden change in the amount of light when entering a darkened room.

Vitamin A deficiency can also cause the disease xerophthalmia (zeer-off-THAL-mee-a). The symptoms of this disease are eye dryness and thickening of the surface of parts of the eye. If left untreated, xerophthalmia may lead to blindness.

Vitamin A can be obtained directly from foods such as milk, eggs, and liver, as well as from carotene, a chemical that is found in green and yellow fruits, and vegetables such as apricots, cantaloupe, oranges, peaches, collards, broccoli, turnip greens, kale, carrots, sweet potatoes, and squash. Carotene is converted to vitamin A in the body.

Vitamin B1 and beriberi Beriberi (BER-ee-BER-ee) is a disease that affects the heart, digestive system, and nervous system. It results from a lack of vitamin B1 (also called thiamin) in the diet. Thiamin is used to help the body make energy. Food sources for this vitamin are meats, wheat germ, whole grain and enriched bread, legumes, nuts, peanuts, and peanut butter. The early stages of beriberi are characterized by fatigue; loss of appetite; and a numb or tingling feeling in the legs.

Beriberi has three forms:

- **Infantile beriberi:** Although a nursing mother may not have the disease herself, her infant gets sick from not getting enough thiamin in the breast milk. The child may die in infancy, or the child may develop wet or dry beriberi.
- **Wet beriberi:** This disease affects the cardiovascular system and can lead to such symptoms as an enlarged heart and increased heart rate, in addition to congestion in the lungs, shortness of breath, and swelling in the lower legs.
- **Dry beriberi:** This disease affects the central nervous system, which encompasses the brain and spinal cord. Its symptoms include pain, loss of feeling in the hands and feet, vomiting, confusion, difficulties in speaking, and muscle damage. Some people with dry beriberi experience paralysis of the lower legs or coma*. People with dry beriberi often require the aid of a cane in order to walk, and they may become bedridden and susceptible to infectious diseases. Dry beriberi is sometimes known as Wernicke-Korsakoff syndrome. The syndrome involves damage to the central nervous system as well as the nerves elsewhere in the body. People who are heavy drinkers of alcohol may be diagnosed with this syndrome, because alcohol use interferes with the body's ability to break down and absorb thiamine. Even if individuals get enough of this vitamin in their diet, the body cannot access it.

Beriberi is found in Japan, Indonesia, China, Malaysia, India, Burma, the Philippines, Brazil, Thailand, and Vietnam. In the United States and other developed nations, it usually occurs in a milder form, often accompanying malnutrition and alcoholism. Beriberi may also affect pregnant women who have a poor diet, and people in institutions in which there is poor nutritional planning, such as some prisons, geriatric hospitals, or institutions for the mentally ill.

Vitamin B3 and pellagra A deficiency of vitamin B3 (also known as niacin) leads to the disease pellagra (pe-LAG-ra). Good sources of niacin include liver, lean meat, whole wheat products, fish, eggs, roasted peanuts, the white meat of poultry, avocados, dates, figs, prunes, kidney, wheat germ, and brewer's yeast.

Pellagra affects the skin, nervous system, and digestion, and can cause the "four Ds": diarrhea*, dermatitis*, dementia*, and death. A person who is developing pellagra may feel weak and tired, may have trouble

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

* **dermatitis** is a skin condition characterized by a red, itchy rash. It may occur when the skin comes in contact with something to which it is sensitive.

* **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

JOSEPH GOLDBERGER'S DISCOVERY

Joseph Goldberger (1881–1929) was a member of the U.S. Public Health Service. In 1914 he joined a commission to study the high number of pellagra cases in the southern United States. Goldberger determined that pellagra was not an infectious disease and that a pellagra-preventing factor in certain foods could prevent its occurrence. In 1928 niacin (vitamin B3) was accepted as the factor that prevents pellagra.

Niacin is also known as nicotinic acid. The active form of niacin used by the body is called niacinamide.

sleeping, and may lose weight. The skin that is exposed to the sun may become scaly, rough, and reddened, and painful sores may develop in the mouth. Loss of appetite is accompanied by indigestion and diarrhea. A person with pellagra might also experience headaches, dizziness, and muscular tremors. Sometimes mental disorders (or dementia) appear.

Pellagra is common around the world, although the “fortification” of processed wheat with vitamin B in the United States keeps the numbers low. Pellagra is seen in people who eat mostly corn rather than wheat and in people whose diets lack enough protein. People with gastrointestinal diseases that prevent their bodies from using B vitamins properly may also develop pellagra.

Other B complex vitamins Cobalamin (B12) deficiency can result from a lack of the substance called gastric intrinsic factor in the stomach that is necessary to absorb the vitamin. People who are on a vegan diet can also get too little of this vitamin. Vitamin B12 deficiency can lead to megaloblastic anemia, which is characterized by enlarged blood corpuscles and in some cases to severe damage to the nervous system, including degeneration of the spinal cord and paraplegia.

Vitamin B6 can protect against anemia, skin problems, and irritability.

Vitamin C and scurvy Vitamin C affects blood vessels, skin, gums, connective tissue, red blood cells, wound healing, and the absorption of iron. A vitamin C deficiency leads to scurvy. The main symptom of scurvy is hemorrhaging, or bleeding under the skin, which results in many bruises. A person with scurvy may also have swollen and infected gums. Wounds heal slowly, and bleeding in or around vital organs can be fatal.

Scurvy is one of the oldest deficiency diseases recorded and the first one to be cured by adding a vitamin to the diet. It was a common malady of sailors during the fifteenth century, the age of exploration of the New World. In modern times, people whose diets lack vitamin C-rich foods,

such as citrus fruits, are still at risk of developing scurvy. Those most at risk are infants, the elderly, and people on fad diets.

Vitamin D, rickets, and osteomalacia Vitamin D is essential for proper bone formation because it helps regulate the amounts of certain bone-forming minerals (calcium and phosphate) in the bloodstream. Vitamin D is added to milk and infant formula* and is found in other foods, such as sardines, salmon, and tuna. Vitamin D is also made by the skin in response to exposure to sunlight.

Without enough vitamin D, a person can develop the disease rickets, which is characterized by bone deformities. Rickets affects mainly children, because bone growth occurs during childhood. Rickets can cause the legs to become bowed by the weight of the body, and it can cause the wrists and ankles to become thickened. Teeth are badly affected and take a longer than usual to come in. All the bones are affected by not having sufficient calcium and phosphorous for their growth and development. Childhood rickets was once a common disease of infants and children, but it is rarely seen in the early 2000s because milk and infant formulas have vitamin D added to them.

Osteomalacia (os-tee-o-ma-LAY-sha) is an adult version of rickets caused by a deficiency of Vitamin D, calcium, and phosphorous. The bones become soft, deformed, and painful. This disease is seen more often in the Middle East and Asia than in Western countries.

Vitamins E and K Vitamin E helps prevent reproductive problems and promotes good skin health. Vitamin K promotes normal blood clotting by aiding in the manufacture of fibrinogen (fy-BRIN-o-jen) and other proteins needed for clotting. Vitamin E deficiencies are not very common, and vitamin K deficiencies are rare except in newborns. To prevent newborn bleeding, newborns receive a shot of vitamin K.

Folate and birth defects A deficiency in folate (also known as folic acid or folacin) in pregnant women can result in some central nervous system birth defects in their babies. To help prevent these birth defects, pregnant women should supplement their diets with folate very early in their pregnancies. Excellent food sources for folate include deep-green and leafy vegetables, carrots, liver, egg yolk, cantaloupe, apricot, pumpkin, avocado, beans, and whole wheat and dark rye flours.

Mineral Deficiencies

Minerals are formed as a result of geological processes, are normally crystalline, and usually appear in the form of simple salts. The human body contains about 25 minerals. Those minerals that appear in large amounts are called macrominerals, whereas those that are in small or trace amounts are called microminerals. Minerals known to be essential to a healthy body include calcium, phosphorous, cobalt, copper, fluorine, iodine, iron, and sodium. The result of a mineral deficiency depends on the which mineral is missing from the diet.

* **formula** is a prepared, nutritious drink or a dry drink mix designed specifically for infants.

- * **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **hemoglobin** (HE-muh-glo-bin) is the oxygen-carrying pigment of the red blood cells.
- * **prostate** (PRAH-state) is a male reproductive gland located near where the bladder joins the urethra. The prostate produces the fluid part of semen.

Iodine, goiter, and hypothyroidism Iodine is necessary for the proper functioning of the thyroid, a gland that controls the body's metabolic rate and produces essential hormones*. Without sufficient iodine in the diet, the thyroid begins to enlarge its cells in an effort to produce its hormones, and this activity may produce a goiter, which causes a swelling in the front of the neck. In countries with high standards of living, most goiters result from diseases of the thyroid rather than from a dietary deficiency of iodine.

Some geographic regions lack iodine in the soil, which can lead to hypothyroidism (underactive thyroid), and to arrested physical and mental development in infants. One common source of iodine is iodized salt, which is produced and distributed in developed parts of the world. Another excellent source of iodine is kelp, a sea vegetable.

Iron and anemia Iron is necessary for the formation of certain proteins and enzymes. Hemoglobin (HE-mo-glo-bin), which is the oxygen-carrying protein in the blood, is one such iron-dependent protein. Iron deficiency can lead to anemia, which is characterized by low levels of either healthy red blood cells or hemoglobin*, which in turn can lead to fatigue and other complications. Good food sources of iron are liver, lean meats, legumes, dried fruits, and green leafy vegetables.

Other minerals A zinc deficiency can bring about prostate* and skin disorders, whereas a copper deficiency can lead to metabolic disorders. Deficiencies of calcium and phosphorus lead to softening of the bones or to hypercalcemia (hy-per-kal-SEE-mee-a), a condition in which too much calcium leads to a surplus formation of bone.

Zinc and copper are trace elements found in a variety of foods. Deficiencies of these minerals are rare. Dairy products, red meat, sunflower seeds, cooked dried beans, walnuts, sardines, and whole grains are good sources of zinc. Copper is found in many foods, including fish, poultry, organ meat, whole grains, nuts, and seeds.

How Are Dietary Deficiency Diseases Treated and Prevented?

In most cases, dietary deficiency diseases are treated by giving affected individuals foods that are rich in the missing nutrient and/or by giving them supplements. The recovery (none, partial, or full) depends on the particular disease, at what age the disease developed, and whether the effects are reversible once they have occurred.

Most dietary deficiency diseases can be prevented by people eating a well-balanced diet comprising many types of foods. Ongoing medical care can help prevent dietary deficiency diseases caused by genetic problems and by metabolic problems that prevent the body from absorbing or utilizing nutrients properly.

In countries where food and money are scarce, however, dietary deficiency diseases remain all too common.

▶ See also **Anemia, Bleeding, and Clotting** • **Kwashiorkor** • **Metabolic Disease**
• **Rickets** • **Scurvy**

Resources

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Organizations

Center for Food Safety and Applied Nutrition, Food and Drug Administration. 5100 Paint Branch Parkway, College Park, MD, 20740-3835. Toll free: 888-INFO-FDA. Web site: <http://vm.cfsan.fda.gov>.

International Food Information Council. 1100 Connecticut Avenue NW, Suite 430, Washington, DC, 20036. Telephone: 202-296-6540. Web site: <http://www.ific.org>.

National Institutes of Health. 9000 Rockville Pike, Bethesda, MD, 20892. Telephone: 301-496-4000. Web site: <http://health.nih.gov/topic/Nutrition>.

World Health Organization. Avenue Appia 20, 1211 Geneva 27, Switzerland. Web site: <http://www.who.int/topics/nutrition/en>.

Diphtheria

Diphtheria (dif-THEER-e-uh) is an infection of the lining of the upper respiratory tract (the nose and throat). It is a serious disease that can cause breathing difficulty and other complications, and it can be fatal. Routine vaccination against diphtheria has made it rare in the United States.*

What Is Diphtheria?

Diphtheria is an infection caused by a bacterium called *Corynebacterium diphtheriae* (kor-ih-nee-bak-TEER-e-um dif-THEER-e-eye) that infects the upper respiratory tract. As the bacteria infect the nose, throat, or larynx (LAIR-inks, the voice box), a distinctive thick membrane forms over the site of infection. The membrane can become large enough to interfere with a person's ability to breathe and swallow. Some strains of *Corynebacterium diphtheriae* also produce an exotoxin* that can cause arthritis and damage



▲ *Corynebacterium diphtheriae* which causes diphtheria in humans magnified 19,500 times. Kwangshin Kim/Photo Researchers, Inc.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

* **exotoxin** (ek-so-TOK-sin) is a substance produced by bacteria that has harmful effects on the infected person.

Canine Heroes

In the winter of 1925, a diphtheria epidemic swept through Nome, Alaska. Antitoxin was located almost 1,000 miles away in the city of Anchorage. The only way to transport the medicine was by dog sled. A relay of sled-dog teams, with the last leg led by a dog named Balto, successfully carried the medicine through frigid temperatures in time to save many lives.

In honor of that achievement, a statue of Balto was erected in Central Park in New York City.

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

* **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.

* **carrier** is a person who has in his body a bacterium or virus or gene for a disease that he can transmit to other people without getting sick himself.

to the nerves and heart. Sepsis, a potentially serious spreading of infection (usually bacterial) through the bloodstream and body, can result from diphtheria, causing shock*, heart failure, and even death.

How Common Is Diphtheria?

Diphtheria occurs throughout the world and is common in developing regions of Africa, Asia, and South America where children often do not receive the diphtheria vaccine. Cases usually occur in winter and the cooler months of autumn and spring.

Diphtheria infection is extremely rare in the United States due to the widespread use of diphtheria vaccination during childhood. From 1992 through 2008, 41 cases of diphtheria were reported in the United States with only one death. However, a diphtheria epidemic* has affected the countries that made up the former Soviet Union. Since 1990 more than 150,000 cases have been reported in these countries.

Is Diphtheria Contagious?

Diphtheria is highly contagious. An untreated person who has diphtheria can spread the infection for up to a month. Within 48 hours of receiving antibiotics, however, people infected with diphtheria are usually no longer contagious.

The bacteria that cause diphtheria are spread through the air in drops of moisture from the respiratory tract, often from coughing or sneezing. Sharing drinking glasses or eating utensils or handling soiled tissues or handkerchiefs that have been used by a person with the disease can also transmit the bacteria. A person can get diphtheria from someone who has symptoms of the disease or from someone who is just a carrier* of the bacteria.

What Are the Signs and Symptoms of Diphtheria?

Within five days after becoming infected, a person typically begins to have symptoms of diphtheria. Early symptoms often include a severe sore throat, runny nose, mild fever, and swollen glands in the neck. People infected with diphtheria in the nose, throat, or larynx usually develop a thick membrane at the site of the infection. Membranes in the nose are often white, whereas those at the back of the throat are gray-green.

As diphtheria progresses, respiratory symptoms can become more severe and include difficulty breathing or swallowing and a bark-like cough. Sometimes inflammation and swelling in the throat and the diphtheria membrane itself can cause blockage of the upper airways, making emergency treatment necessary.

How Is Diphtheria Diagnosed and Treated?

Diphtheria is diagnosed when the membrane that signals the disease is seen in the nose or throat during an examination of someone with symptoms of the disease. The diagnosis is confirmed by taking a swab of the coating from underneath the membrane and performing a laboratory test that identifies diphtheria bacteria.

Hospitalized people who are known to have diphtheria are isolated to prevent the disease from spreading to others. Patients are treated in the hospital with antibiotics and diphtheria antitoxin*. The antitoxin, which is produced in horses, is given intravenously (directly into a vein).

In severe cases of diphtheria, patients may need a ventilator (VEN-tuh-lay-ter) to help with breathing or medication to treat complications of the disease, such as septic shock*, heart inflammation, or heart failure. After they leave the hospital, bed rest at home for several weeks is generally recommended. Members of the same household are usually given a diphtheria booster vaccine to protect against possible infection. Recovery from diphtheria often takes four to six weeks or more.

Complications of diphtheria include abnormal heart rhythms, arthritis, and neuritis*. Diphtheria is most dangerous for children under five and adults over 40. Death occurs in up to 10 percent of people with diphtheria who receive medical treatment; death rates are higher in some parts of the world where treatment is not readily available.

Can Diphtheria Be Prevented?

In the United States, immunization programs have been very effective in preventing diphtheria. The diphtheria vaccine is given in combination with vaccines for tetanus* and pertussis* (this is called the DTaP vaccine) as part of a child's routine immunizations. Four doses of the vaccine are given before the child is two years of age. A first booster dose is given at four to six years of age when a child enters school. Additional booster doses are recommended every 10 years, in combination with a tetanus booster.

Sometimes people have mild reactions to the vaccine, including a low-grade fever, tenderness at the injection site, and irritability. Very rarely, stronger reactions such as seizures* or allergic reactions can occur.

▶ See also **Bacterial Infections • Vaccination**

Resources

Books and Articles

- Guilfoile, Patrick. *Diphtheria*. New York: Chelsea House, 2009.
- Miller, Debbie S. *The Great Serum Race: Blazing the Iditarod Trail*. New York: Walker, 2002.
- Standiford, Natalie. *The Bravest Dog Ever: The True Story of Balto*. New York: Random House, 2003.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/DBMD/diseaseinfo/diphtheria_t.htm.

* **antitoxin** (an-tih-TOK-sin) counteracts the effects of toxins, or poisons, on the body. It is produced to act against specific toxins, such as those made by the bacteria that cause botulism or diphtheria.

* **septic shock** is shock due to overwhelming infection and is characterized by decreased blood pressure, internal bleeding, heart failure, and, in some cases, death.

* **neuritis** (nuh-RYE-tis) is an inflammation of the nerves that disrupts their function.

* **tetanus** (TET-nus) is a serious bacterial infection that affects the body's central nervous system.

* **pertussis** (per-TUH-sis) is a bacterial infection of the respiratory tract that causes severe coughing.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

Immunization Action Coalition. 1573 Selby Avenue, Suite 234,
St. Paul, MN, 55104. Telephone: 651-647-9009. Web site:
<http://www.immunize.org>.

Disability

Disability is a potentially limiting reduction in the normal functioning of the human body. Disabilities can influence both the physical and mental well-being of a person, and they can have serious impact on self-esteem and social adjustment.

What Is Disability?

Disability is a deviation from the normal range of functioning that places a limit on what a person can do or that imposes special conditions or needs. These conditions or needs must be met to allow individuals to function in the normal range or up to their full capacity. Disabilities can be mental, physical, psychological, or a combination of all three. The disability may be obvious to the casual observer, such as the loss of a leg, or invisible, such as a back injury. Some people prefer to refer to anyone whose range of function falls outside the norm as “differently abled,” as a way to stress that the condition is a difference rather than a lack of completeness. Many people with disabilities do quite well meeting the same challenges people without disabilities meet.



Sean Halsted (left) turns a corner past Jacqueline Tyler (right) during the handcycle event in the 26th National Veteran Wheelchair Games in Anchorage, Alaska, July 4, 2006. Halsted won the men's Class 4, 5, open division in the 10K handcycle race. *AP Images.*

What Are Various Types of Disability?

Disability may be physical, mental, or psychological. Examples of physical disability include those resulting from blindness or due to amputation of a limb. Examples of mental disability are mental retardation and disability due to exposure to toxic substances such as lead or other hazardous chemicals. Examples of psychological disability are severe depression or chronic anxiety. Some types of disability can result from a combination of mental and physiological limitations, such as certain learning disabilities.

What Are Some Physical Disabilities?

People can be born with a physical disability. When they are, the problem is called a congenital* (kon-JEH-nih-tul) disability. In many cases, the cause of a congenital disability is unknown. Some congenital disabilities with known causes are:

- **Inherited disabilities:** Some disabilities are the result of genetic* disorders, for example, cystic fibrosis*.
- **Exposure of the mother to disease, alcohol, drugs, harmful medications, pollutants, or chemicals during pregnancy:** For example, a mother who has rubella* early in pregnancy may have a child who is deaf or who has other birth defects.

Physical disability also can arise at any time after birth. These types of disabilities commonly occur from accidents, illness, working conditions that expose a person to an unhealthy environment (such as coal miners who breathe in coal dust), or repetitive physical stresses (such as repeated heavy lifting).

What Are Some Mental Disabilities?

Individuals experiencing mental disability may appear slow in speech, movement, and interaction with others. In addition, they may learn and comprehend information at a different rate than those without mental disability. Behavioral problems and learning difficulties can coincide with this type of disability. Often times these individuals benefit from specialized teaching methods and one-to-one interaction. Individuals may have mental disability due to complications during birth such as low oxygen supply leading to brain damage and mental retardation. Others may experience mental disability later in life due to exposure to certain drugs or other hazardous chemicals, leading to changes in brain function. Those with mental disability may have varied levels of intellect due to different degrees of mental retardation.

What Are Some Psychological Disabilities?

Severe depression or chronic anxiety are forms of psychological disability. Bipolar disease and schizophrenia* are also types of psychological disability. Those with psychological disability generally have biochemical characteristics in their brains that are different from individuals without

- * **congenital** (kon-JEH-nih-tul) means present at birth.
- * **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.
- * **cystic fibrosis** (SIS-tik fy-BRO-sis) is a disease that causes the body to produce thick mucus that clogs passages in many of the body's organs, including the lungs.
- * **rubella** (roo-BEH-luh) is a viral infection that usually causes a rash and mild fever.
- * **schizophrenia** (skit-so-FREE-nee-ah) is a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors, which distort their view of reality.

- * **psychologist** (sy-KOL-uh-jist) is a mental health professional who can do psychological testing and provide mental health counseling.
- * **psychiatrist** (sy-KY-uh-trist) is a medical doctor who has completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can diagnose mental illnesses, provide mental health counseling, and prescribe medications.
- * **chronic** (KRAH-nik) lasting a long time or recurring frequently.

psychological disability, and this difference in the brain chemicals causes them to think and act in a different way from people who do not experience psychological disability. They may experience periods of balance and imbalance depending on the severity and duration of the disability. These individuals often benefit from medication and therapy from a trained professional such as a psychologist* or psychiatrist*. Psychological disability may affect children as well as adult populations and may be short term; however, many psychological disabilities are chronic* in nature.

What Is the Connection between Disability and Self-Image?

Self-image is the mental picture people have of themselves, including their external appearance, intellectual abilities, strengths, and weaknesses. This mental picture begins to develop in infancy and continues to grow and change throughout life. People develop their mental pictures through their interactions with other people and the world around them. When individuals with disabilities confront negative reactions, they may internalize that negative judgment and develop a poor self-image. Self-esteem is strongly linked to self-image. Self-esteem is the value that people put on the mental image that they have of themselves.

What Impact Does the Onset of Disability Have?

Disability may occur at different stages in one's life, including at birth, as an unexpected incident after birth, or later on in life.

Disability noted at birth is called a congenital disability. Because congenitally disabled people may have never lived in a non-disabled body, they often feel complete, intact, and okay with the disability, even though the outside world may view them as different. Children whose parents accept them, support them, show pride in them and their abilities, and communicate factually and directly about the disability are more likely to develop good self-image and self-esteem.

Disability may also arise the result of an unexpected, sudden incident later in life, such as with a car accident or a machinery accident in the workplace. This type of disability may be called an acquired disability. People who acquire disabilities later in life have a different experience from those who are born with a disability. These people have lost some aspect of self that played a part in their development of their self-image, whether it is the loss of an arm or leg or the loss of an ability to perform a particular activity. People with acquired disabilities tend to feel an array of emotions such as grief, denial, anger, and depression as they learn to adapt and work out a new way to live. Many individuals obtain artificial limbs or specialized machinery, such as electric wheelchairs, to assist them with activities of daily living. Over time they adapt to varying degrees to their acquired disability.

Disability sometimes progresses over a longer period. For example, disability can develop as people age or as a complication from medical conditions such as diabetes or high blood pressure. Progressive chronic

illnesses, such as muscular dystrophy* or Alzheimer's (ALTS-hy-merz) disease*, may lead to mental or physical disability over time.

What Are the Connections between Disability and Health?

Many physicians and mental health practitioners agree that there is a connection between mental health and physical wellbeing. In general, the better a person's self-image and self-esteem, the more able a person is to cope with various changes and challenges and the better a person feels both mentally and physically.

Many studies have found that people with disabilities experience psychological problems (especially depression and anxiety) and behavior problems at about twice the rate of the non-disabled individuals. Family members of people with disabilities are also more likely to experience emotional problems brought on by the extra responsibilities, financial burdens, and limitations of caring for someone with a disability. Although chronic illness and disability include the risk of psychological problems, many individuals and families learn to cope with these conditions.

In 1996 the American Academy of Pediatrics reviewed many studies of people with disabilities and concluded that certain risk factors increase the chance that people with disabilities will experience psychological problems. Other protective factors appear to decrease the chance that a person with a disability will have psychological problems.

Risk factors that increase the likelihood of psychological problems include:

- Chronic illnesses that are painful, unpredictable (such as seizures), or embarrassing
- Invisible disabilities (because people may feel stressed by wondering if they should tell others about their limitations)
- Disabilities that require a schedule of time-sensitive special treatments
- Poor social skills and a rigid personality
- Failure of loved ones and professionals to talk honestly with the person about the disability
- Failure of parents to address sexuality in teens with disabilities
- Allowing the disability to become the focus of family life
- Fighting between the parents or break-up of the parents' marriage
- Overprotectiveness on the part of parents or caregivers

Factors that decrease the likelihood of psychological problems include:

- Family acceptance of the disability
- Strong bonds within the family that help the family work together
- Open and direct communication about the nature of the disability and what to expect

* **muscular dystrophy** (DIS-tro-fee) is a group of inherited disorders that causes muscle weakening that worsens over time.

* **Alzheimer's (ALTS-hy-merz) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.

- Balancing of family needs with the needs of the disabled person
- Good social skills and plenty of social interaction
- Appropriate expectations of accomplishments
- Strong support network in the community

What Are Some Myths about People with Disabilities?

Non-disabled people are often uninformed about the actual nature of a disabled person's life. False beliefs people with disabilities frequently encounter include the following:

Myth: Disabled people are usually mentally retarded.

Reality: Most disabilities do not affect intelligence.

Myth: Disabled people are sick.

Reality: Illness is not the same as disability. Some people are disabled with chronic illness, whereas others are healthy.

Myth: People with disabilities can never have a good quality of life.

Reality: Quality of life is mainly determined by the disabled person's character and by the degree of social acceptance that person experiences rather than on the disability itself.

Myth: People with disabilities need continuous supervision and cannot lead independent lives.

Reality: The degree of independence a person achieves depends on the nature of the disability, the person's education and training, and the accommodations that are available to make independent living physically possible.

▶ In the middle of his career, artist Chuck Close became partially paralyzed due to a blood clot in his spinal column. To continue painting, he developed a technique that allowed him to work with his weakened hands from his wheelchair. He is still able to create the large, multicolored portraits for which he is known. *AP Images.*



Myth: People with disabilities are especially noble, brave, and courageous for coping with their handicaps.

Reality: There are all kinds of people with disabilities. Most disabled people carry on with their lives just as non-disabled people do.

What Role Does the Community Play?

The Americans with Disabilities Act is the federal law that is intended to integrate people with disabilities into mainstream life as much as possible. It requires that disabled people be provided with access to public and private spaces and with workplace accommodations and, whenever possible, that they be included in mainstream public education. Although physical accommodations, such as wheelchair-accessible restrooms or Braille instructions for the blind on automatic teller machines, are common in new buildings, many older facilities and private spaces have not been renovated to accommodate people with physical disabilities.

Employers are increasingly willing to make workplace accommodations for people with physical disabilities, but they are still fearful of making such arrangements for people with mental or psychological disabilities. The unemployment rate among disabled people, especially disabled women, is very high, and many people with disabilities are employed at jobs below their skill levels. Service industries hire more people with disabilities than any other type of employer.

People with disabilities face some common challenges. At the same time, disabled people are individuals with differing personalities and needs. People who are born with a disability may have self-image issues that are different than people who acquire a disability later in life. Someone who is confined to a bed with a chronic, long-term illness faces challenges that are different from someone who is healthy but who has a disability such as blindness or mental retardation.

Although researchers can draw a group picture of people who are disabled, this picture does not represent an individual with a disability any more accurately than a general picture of the average American represents a non-disabled person. The challenge is to see people with disabilities as individuals, each with his or her own strengths, weaknesses, hopes, and dreams, regardless of each person's type of disability.

▶ See also **Body Image • Chronic Illness**

Resources

Books and Articles

Falvo, Donna R. *Medical and Psychosocial Aspects of Chronic Illness and Disability*. Sudbury, MA: Jones and Bartlett, 2008.

Ritter, Rick. *Coping with Physical Loss and Disability: A Workbook*. Ann Arbor, MI: Loving Healing Press, 2006.

* **amnesia** (am-NEE-zha) is the loss of memory about one or more past experiences that is more than normal forgetfulness.

* **psychiatrist** (sy-KY-uh-trist) is a medical doctor who has completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can diagnose mental illnesses, provide mental health counseling, and prescribe medications.

Organizations

Center for Disability Information and Referral. Indiana Institute on Disability and Community, 2853 East Tenth Street, Bloomington, IN, 47408-2696. Telephone: 812-855-9396. Web site: <http://www.iidc.indiana.edu/cedir>.

Enabled Online. 321 Wilton Circle, Sanford, FL, 32773. Telephone: 407-474-3841. Web site: <http://www.enabledonline.com>.

Social Security Administration Office of Public Inquiries. Windsor Park Building, 6401 Security Boulevard, Baltimore, MD, 21235. Toll free: 800-772-1213. Web site: <http://www.ssa.gov/disability>.

Disruptive behavior *See Conduct Disorder; Oppositional Defiant Disorder.*

Dissociative Identity Disorder

Dissociative identity (di-SO-see-a-tiv i-DEN-ti-tee) disorder (DID) is a mental disorder in which a person displays two or more distinct identities—sometimes called alters—that take control of behavior in turn. It was formerly called multiple personality disorder (MPD).

The Real-Life Sybil

Sybil Dorsett was a 22-year-old college student who had amnesia*. She also had terrible headaches and sometimes could not see, almost as if she were blind. Upon turning for help to the psychiatrist* Cornelia Wilbur in New York, Sybil soon started to show other personalities. It was as if there were more than one person inside Sybil's body. One personality, who called herself Vicky, said she was from Paris. Another personality, called Peggy Lou, was a tough woman who showed no fear. As time passed, Sybil displayed more personalities: a writer, a flirt, a pianist, a mother, and even an infant and two men.

Wilbur noticed that each personality acted and sounded different from the Sybil Dorsett she had first met. Each personality even described his or her physical features in different ways. One said that she had blue eyes, while another said that his eyes were brown. Almost everything, from details about hair color to gestures, changed as Sybil switched from one personality to another. In all, Sybil displayed 16 different identities.

Sybil's case became one of the most famous examples of dissociative identity disorder after a book about her experiences appeared in 1973.

A movie starring Sally Field as Sybil was made in 1976. Sybil's story offers a revealing glimpse of an often-misunderstood mental disorder.

What Is Dissociative Identity Disorder?

Dissociative identity disorder (DID) is a severe psychiatric condition in which a person has two or more distinct sub-personalities that periodically take control of his or her behavior. The sub-personalities are thought to be caused by repeated episodes of an extreme form of dissociation. Dissociation is a condition in which a person's thoughts, emotions, sensations, or memories become compartmentalized, usually as a result of a severe emotional trauma* or series of traumas. The symptoms of dissociation may include amnesia, depersonalization*, and derealization*. It is possible for survivors of natural disasters, plane crashes, criminal assaults, or military combat to develop dissociative symptoms without developing DID.

In contrast to dissociative symptoms that may develop in traumatized adults, dissociative identity disorder is thought to begin early in life when a child is subjected to repeated incidents of physical or sexual abuse in his or her family. The child splits off, or dissociates, memories of the abuse in order to survive. The memories later surface and are experienced in the form of a separate personality. This process can be repeated at different points in the child's development to form new alter personalities. The patient may eventually have as many as 100 alter personalities, although most patients display between 10 and 15 different personalities. Each alter takes control over the patient's behavior for a period of time, usually adopting a unique name, voice, dress style, and life history.

Descriptions of dissociative identity disorder can be found in ancient myths and many documents written through the centuries. However, until the early 1900s it was not regarded as a treatable mental disorder, when Morton Prince (1854–1929), a Boston psychiatrist, treated a patient he called Sally Beauchamp, who had four alter personalities. Prince used the term “dissociation” to describe his patient's symptoms. He published a book about Beauchamp in 1906 titled *The Dissociation of a Personality*. Much of what was learned about DID, however, was discovered during the last quarter of the twentieth century.

Dissociative identity disorder should not be confused with schizophrenia*. Schizophrenia usually occurs in people in their late teens or early adult years. Its name comes from the Greek for “split mind.” Unlike dissociative identity disorder, which is characterized by multiple personalities, schizophrenia causes a split between reality as others experience it and the delusional perceptions of the schizophrenic. These distinct mental disorders have quite different symptoms, causes, and treatments.

How Common Is Dissociative Identity Disorder?

Dissociative identity disorder is a controversial diagnosis; that is, some doctors believe it does not exist at all and others maintain that it is a subtype of post-traumatic stress disorder*. The number of reported cases of

* **trauma** refers to a wound or injury, whether psychological or physical. Psychological trauma refers to an emotional shock that leads to lasting psychological damage.

* **depersonalization** (de-per-son-al-i-ZAY-shun) is a mental condition in which people feel that they are living in a dream or are removed from their body and are watching themselves live.

* **derealization** (de-reel-i-ZAY-shun) is a mental condition in which people feel that the external world is strange or unreal.

* **schizophrenia** (skit-so-FREE-nee-ah) is a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors, which distort their view of reality.

* **post-traumatic stress disorder** (post-traw-MAT-ik STRES dis-OR-der) is a mental disorder that interferes with everyday living and occurs in people who survive a terrifying event, such as school violence, military combat, or a natural disaster.

- * **incidence** means rate of occurrence.
- * **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.
- * **addiction** (a-DIK-shun) is a strong physical or psychological dependence on a physical substance.
- * **personality disorders** are a group of mental disorders characterized by long-term patterns of behavior that differ from those expected by society. People with personality disorders have patterns of emotional response, impulse control, and perception that differ from those of most people.
- * **flashbacks** are intensely vivid, recurring mental images of a past traumatic event. People may feel or act as if they were reliving the experience.

DID in the United States rose sharply between the 1970s and 1990s but declined thereafter. Some researchers asserted that the increase occurred because doctors were increasingly aware of the disorder's symptoms. Others, however, speculated that the disorder was being diagnosed in some people because they were open to suggestion about memories of childhood trauma. Still other researchers noted that most cases of DID after the 1970s were reported in the United States and other English-speaking countries, which led to the possibility that dissociative identity disorder is a by-product of certain cultures or periods of history rather than a universal and fixed psychiatric condition.

Estimates for incidence* in the United States range from 0.01 percent to 1 percent of the general population, or between 30,000 and 300,000 people. These estimates vary widely because the disorder is difficult to diagnose; in addition, people with DID frequently suffer from such other disorders as depression*, alcoholism or drug addiction*, or personality disorders*. As a result, the doctor may think that the patient's dissociative symptoms are caused by these other disorders and not consider DID as a possible diagnosis. Consequently, a diagnosis of dissociative identity disorder typically takes at least six to seven years to be made.

How Do People Know They Have Dissociative Identity Disorder?

The first symptom of DID is amnesia. Like Sybil, people with the disorder often start to realize that there are abnormally long periods of time that they cannot remember. They might "wake up" in a different place or wearing different clothes and recall nothing that explains the changes. In some cases they find items in their closet that they do not remember purchasing. There have even been cases of DID patients meeting people at a party or on the street who call them by the name of one of their alters. Such episodes of amnesia can lead them to suspect that something is seriously wrong.

Patients often are skilled at hiding their alter personalities from family and friends. A person might be Sam, a shy clerk, at work. However, at night, he might lead life as Jack, an outgoing man who spends time in bars far from his neighborhood.

The patient's primary identity usually uses the name that the patient was given at birth. This identity often feels depressed, behaves passively, and displays guilt feelings that cannot be explained easily. This primary identity usually is not aware at first of the other identities, but the other identities may talk about the primary identity. For example, one of Sybil's identities Vicky often commented to Dr. Wilbur about Sybil's life and the lives of the other identities.

Other symptoms of DID include attempted suicide and self-inflicted injuries, such as cuts or burns. Many people with dissociative identity disorder also show signs of post-traumatic stress disorder. They may startle easily or have nightmares or flashbacks*.

A FOOTBALL HERO TELLS HIS STORY

Herschel Walker, a former professional football player, was a high school superstar. In 1980 college recruiters made him the most sought-after young athlete in the United States. Walker chose the University of Georgia and helped that school to win the national collegiate football title. In 1982 he was awarded the Heisman Trophy, given each year to the most outstanding college football player. In 1983 Walker left college to become a professional athlete, playing with such teams as the Dallas Cowboys and Minnesota Vikings.

After retiring from professional sports, however, Walker began to notice that he had memory problems. He could not remember the season he won the Heisman Trophy or even the dinner when the award was presented to him. His alter personalities emerged as bitter, angry people who threatened his wife with physical violence. On one occasion, Walker held a gun to his own head but could not remember the incident afterward. He then realized that he had some kind of mental disorder and sought help. Diagnosed with DID in 2000, Walker wrote a book about his psychological problems, *Breaking Free: My Life with Dissociative Identity Disorder* (2008). He told his story in order to help other people with DID know that the condition is treatable and that they are not alone.

How Do Doctors Diagnose and Treat Dissociative Identity Disorder?

DID is usually diagnosed by psychiatrists or other mental health professionals rather than primary care doctors. The first step in diagnosis is to exclude any physical disease or condition that might be causing the patient's symptoms, such as head injuries, brain tumors, alcohol or drug abuse, or seizures*.

In order for a psychiatrist to diagnose individuals as having dissociative identity disorder after possible physical causes have been ruled out, the doctor must observe two or more distinct identities in the patient. For example, patients may come to the doctor's office dressed very differently from their first visit or talk in a different tone of voice. Each identity must also become the dominant personality for a time. In some cases, doctors may talk to patients for long periods or ask them to keep a journal between visits, in hopes of learning more about the different personalities. Psychiatrists sometimes use hypnosis* to bring out different identities.

The psychiatrist may also use questionnaires or diagnostic interviews that are designed to help identify patients with DID. One brief screener is the Dissociative Experiences Scale (DES), which patients can fill out in the doctor's office in a few minutes. If individuals score high on the DES, they can be given one or two longer interviews in which the doctor

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **hypnosis** refers to a trance-like state, usually induced by another person. The person under hypnosis may recall forgotten or suppressed memories and be unusually responsive to suggestions.

asks them to describe their experiences in detail. These interviews take between 45 and 90 minutes to complete.

The goal of treatment is to bring the separate identities together into one primary identity. Therapy attempts to help patients recall past trauma and deal with emotions without the primary identity being split into parts. The doctor may also prescribe medications to help patients cope with the anxiety and depression that often accompany DID. Success in treatment is possible, but treatment can take many years; it took about 11 years for Sybil's 16 personalities to blend into one. Patients with DID who are still emotionally attached to their abusers, however, do not usually respond well to therapy.

Can Dissociative Identity Disorder Be Prevented?

DID can be prevented by healthy parenting and caregiving. Parents who are afraid that they might abuse their children should contact a doctor or member of the clergy and ask for help in locating a parents' support group or a family therapist. Some churches, synagogues, and community centers offer parenting classes. Parents with children who have suffered a criminal attack or other traumatic event should also consult a doctor or mental health professional to help their children cope with their memories and feelings.

▶ **See also Anxiety and Anxiety Disorders • Depressive Disorders • Memory and Amnesia • Post-Traumatic Stress Disorder • Schizophrenia**

Resources

Books and Articles

Chase, Truddi. *When Rabbit Howls: The Troops for Truddi Chase*. New York: Berkley Books, 2002.

Schreiber, Flora Rheta. *Sybil*. New York: Warner Books, 1995.

Walker, Herschel. *Breaking Free: My Life with Dissociative Identity Disorder*. New York: Simon and Schuster, 2008.

Organizations

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.psych.org>.

American Psychological Association. 750 First Street NE, Washington, DC, 20002-4242. Telephone: 202-336-5500. Web site: <http://www.apa.org/pubinfo/mem.html>.

National Alliance on Mental Illness. Colonial Place Three, 2107 Wilson Boulevard, Suite 300, Arlington, VA, 22201-3042. Telephone: 703-524-7600. Web site: <http://www.nami.org>.

Diverticulitis/Diverticulosis

Diverticulosis is the presence of diverticula (dy-ver-TIK-yoo-la) in the colon (large intestine). Diverticula are small sacs or pouches that bulge outward from the inside surface of intestinal wall. If diverticula become inflamed or infected, the resulting disease is called diverticulitis.

What Causes Diverticulitis and Diverticulosis?

Diverticulosis is caused by not enough roughage (fiber) in the diet. Roughage is coarse, bulky food that is rich in plant fiber. Observations show that people in developing countries whose diets include large amounts of plant materials (fruits and vegetables) almost never have diverticulosis. Diverticulosis is common in the United States and in other developed countries, where refined foods often lack significant amounts of fiber.

Young people rarely have diverticulosis, but it becomes more common as people age. By the time individuals in the United States reach the age of 60, they have about a 50 percent chance of having diverticulosis.

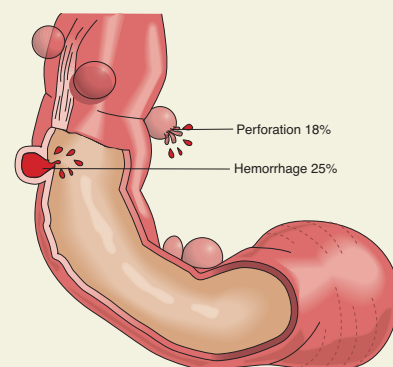
What Do Diverticula Look Like?

Diverticula are pouches that occur most commonly in the sigmoid colon, which is the S-shaped part of the large intestine closest to the rectum. Many diverticula are usually present, and they may range from pea-sized or smaller to about one inch in diameter. The pouches form due to transmural (across-the-wall) pressure in the lower intestine that often occurs during constipation. A high-fiber diet that keeps wastes moving smoothly through the bowel and distributes pressure more evenly is thought to reduce the likelihood of developing diverticulosis or the related condition called diverticulitis, which is described below.

How Do Doctors Diagnose and Treat Diverticula?

Symptoms People with diverticulosis may not know they have it because it does not always cause symptoms. Sometimes, however, the diverticula may become plugged with waste and infected, causing diverticulitis. The symptoms of diverticulitis may include abdominal* pain, fever, and tenderness when external pressure is applied over the abdomen. At other times the small artery feeding the diverticulum may rupture and cause severe bleeding from the rectum. Both of these conditions require immediate attention.

Diagnosis A doctor may discover that a person has diverticula by x-ray examination or by looking inside the colon through a viewing instrument such as a sigmoidoscope (sig-MOI-do-skope) or a colonoscope (ko-LON-o-skope). Doctors often discover diverticula that have not caused symptoms during routine medical procedures.



▲ Inflamed, perforated, and hemorrhaging diverticula in the descending (or sigmoid) colon. Diverticulosis is almost always located in the descending colon. © 1999. Reprinted with permission of Delmar Learning, a division of Cengage Learning.

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

* **intravenous fluids** (in-tra-VEE-nus) are fluids injected directly into a vein.

If the patient has symptoms of infection, such as fever or abdominal pain and tenderness, the doctor generally does not use a sigmoidoscope or colonoscope because these instruments may perforate the colon. The doctor may use another method such as a CAT scan in order to search for pus-filled diverticula. Often the symptoms alone are enough to allow the doctor to be confident of the diagnosis of diverticulosis/diverticulitis, and treatment may begin without any other diagnostic tests being performed.

Treatment Diverticulosis usually requires no special treatment, although doctors may recommend increased roughage in the diet. In mild cases of diverticulitis, treatment may include drinking more fluids, bed rest, and antibiotics to control infection. Sometimes doctors recommend intravenous fluids* containing antibiotics.

Occasionally, diverticulitis may be accompanied by serious complications. If diverticula rupture (RUP-chur, break open), intestinal contents may leak or spill out and cause an infection in the surrounding abdomen. Sometimes the intestine may become blocked or narrowed, in which case a patient may need surgery. Another situation that may call for surgery is a bleeding diverticulum. Often, bleeding diverticula can be corrected with medical treatments, but when that fails and a diverticulum continues to bleed, it may require surgical removal.

How Are Diverticula Prevented?

Medical professionals typically recommend adequate amounts of vegetable fiber in the diet as a way to avoid diverticulosis and diverticulitis. Bran, cabbage, beans, and whole-grain breads are examples of foods high in dietary fiber. Physicians may also suggest fiber supplements, especially for older adults, to maintain regular bowel habits and to reduce the risk of diverticulitis.

▶ See also **Constipation**

Resources

Books and Articles

Cartwright, Peter. *Coping with Diverticulitis*. London: Sheldon Press, 2007.

Miskovitz, Paul, and Marian Betancourt. *The Doctor's Guide to Gastrointestinal Health: Preventing and Treating Acid Reflux, Ulcers, Irritable Bowel Syndrome, Diverticulitis, Celiac Disease, Colon Cancer, Pancreatitis, Cirrhosis, Hernias and More*. Hoboken, NJ: Wiley, 2005.

Organization

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/diverticulosis>.

Down Syndrome

Down syndrome is a genetic condition that occurs when a person has three copies of chromosome 21 rather than the usual two. People with Down syndrome usually have a characteristic physical appearance, significantly lowered intellectual abilities, and sometimes a number of physical problems, such as heart defects.*

Jason's Sister Anna: A Look at Someone with Down Syndrome

First and foremost, Jason's sister Anna is a happy, active, five-year-old girl. She also is a girl with Down syndrome, and Jason feels more protective of his sister than do most big brothers. When they are out at the mall, everyone remarks about how adorable Anna is, but they also stare at her. Anna has many of the characteristic features of people with Down syndrome, and some of them are quite noticeable. These features may include:

- a flattened face
- up-slanted eyes
- low-set ears
- a protruding tongue
- a short neck
- a single, straight crease across the palm
- distinctive patterns on the ridges of the skin on her fingers, palms, and soles
- short arms and legs
- poor muscle tone
- mental retardation

All of these characteristics vary among affected people, and some people with Down syndrome have fewer of these features than others do. Anna is somewhere in the middle of the range. She is also moderately mentally retarded.

Jason did some research on Down syndrome for a school report and now worries about Anna's health. Many people with Down syndrome have health problems such as heart defects, increased susceptibility* to infection, respiratory problems, and digestive problems. Childhood leukemia occurs slightly more frequently in children with Down syndrome than in other children, and adults with the syndrome are at increased risk for Alzheimer's (ALTS-hy-merz) disease*.

What Is Down Syndrome?

All people have chromosomes in their cells. Chromosomes provide the genetic information needed for the cells of the body to work properly. Normally, most of a person's cells contain 23 pairs of chromosomes, for a

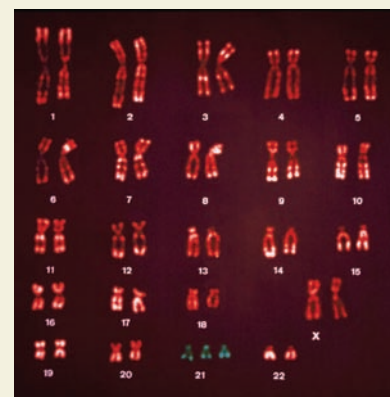


Chart showing the twenty-two chromosome pairs, in this case with three chromosomes instead of two in pair twenty-one, an abnormality producing Down Syndrome (Trisomy 21).

Dr. Dennis Kunkel/PHOTOTAKE Inc./Alamy.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **susceptibility** (su-sep-ti-BIL-i-tee) means having less resistance to and higher risk for infection or disease.

* **Alzheimer's (ALTS-hy-merz) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.

total of 46. The exceptions are eggs and sperm cells, which have only one set of 23 chromosomes. People who have Down syndrome, by contrast, have an extra copy of a certain chromosome, the one called chromosome 21, or extra chromosome 21 parts. Down syndrome can occur in three ways.

Nondisjunction About 95 percent of people with Down syndrome have three copies of chromosome 21, a condition called trisomy 21 (*tri* means three). This condition occurs due to an error in the way that cells divide. This error is known as nondisjunction.

The error starts in the reproductive cells: the egg or the sperm cell. These cells, each of which has 23 chromosomes, make identical copies of themselves in a process called meiosis (my-O-sis). In this process, a normal cell first duplicates its chromosomes and then divides in half, with each newly created cell getting a complete set of 23 chromosomes. If the two copies of chromosome 21 do not separate, however, the result is an

A BRIEF HISTORY OF DOWN SYNDROME RESEARCH

1866: An English physician, John Langdon Haydon Down (1828–1896), published the first description in the medical literature of a person with Down syndrome.

1959: Jérôme Lejeune (1927–1994), a French physician, found the extra chromosome 21.

2000: Scientists unraveled the genetic code of chromosome 21. Chromosome 21 is the smallest of all human chromosomes, and scientists believe it has 200–400 genes, each of which has a specific job to do. Some of these genes produce proteins, one of which regulates the auto-immune system, whereas other genes produce enzymes, one of which affects the amino acids that are the building blocks of proteins. When a cell has an extra chromosome, and therefore extra genes, the genes can make too much of their protein, and the extra proteins can cause an abnormality.

2006: Researchers found that a gene on chromosome 21 seems to be responsible for mental retardation among people who have Down syndrome. They did their study on mice instead of humans but believe it may work the same way in humans. They found that mice with three copies of the gene made too much of a certain protein, the extra protein caused certain nerve cells to be especially large, and this, in turn, caused retardation. The researchers later tried to figure out if they could find a way to “turn down” the gene so it makes less of its protein. If they were successful, they envisioned eventually using this knowledge to help treat people with the syndrome. In the meantime, scientists elsewhere were carefully studying other genes on chromosome 21 to learn the particular function of each and possibly find ways to treat or prevent Down syndrome.

egg or a sperm cell with two copies of the chromosome instead of the usual one. At least 95 percent of the time, trisomy 21 occurs when a normal sperm with one set of chromosomes fertilizes an egg with two copies of chromosome 21. The fertilized egg, therefore, has two pairs of all of the other chromosomes, but three copies of chromosome 21. As the embryo grows, its cells replicate* and continue to make new cells with the extra copy of chromosome 21—for a total of 47 chromosomes rather than the normal 46—throughout its body.

Translocation Some patients with Down syndrome have the normal number of 46 chromosomes in their cells. This infrequent condition occurs because they still have some extra parts of chromosome 21 in their cells. The extra chromosome 21 results when a piece of it breaks off while a cell is making a copy of itself, and that extra piece attaches to another chromosome. This abnormal process is called translocation. In this case, the incorrectly attached genetic material from chromosome 21 causes the features of Down syndrome. Translocation only accounts for 3 to 4 percent of all Down syndrome cases.

Mosaicism The third type of Down syndrome, mosaicism (mo-ZAY-i-siz-im), occurs when nondisjunction of chromosome 21 takes place after the initial fertilization of an egg with a sperm but still very early in the fertilized egg's development. In this case, cells can either replicate from originals (so-called parent cells) that have 46 chromosomes or from those with 47 chromosomes. As a result, some of the cells in the embryo's body may have 46 chromosomes, and others may have 47. Mosaicism is very rare, occurring in only 1 to 2 percent of people with Down syndrome.

What Causes Down Syndrome?

No one knows what causes the chromosomal abnormality that results in Down syndrome, a condition that affects one in 800 to 1,000 babies in the United States. Any woman can have a baby with Down syndrome. It is not associated with a person's culture, race, geographic location, or relative wealth.

A mother's age, however, does seem to be correlated* with her risk of having a child with Down syndrome. About 91 percent of women have babies before they reach 35 years of age, but they give birth to only 75 percent of children with Down syndrome. The remaining 25 percent are born to women who are older than 35. In other words, older women have a greater chance of giving birth to a baby with Down syndrome, and the risks increase with every passing year. Researchers estimate the chance of having a baby with Down syndrome to be as follows:

- less than 1 in 1,000 for a woman below age 30
- approximately 1 in 400 for a 35-year-old woman
- approximately 1 in 105 for a 40-year-old woman
- approximately 1 in 20 for a 46-year-old woman

* **replicate** (REP-li-kate) means to create an identical copy.

* **correlated** means linked in a way that can be measured and predicted.

- * **alpha-fetoprotein** (AL-fah-FEE-toe-PRO-teen) a substance produced by a fetus and present in maternal blood and amniotic fluid, measured to determine likelihood of neural tube defects.
- * **amniocentesis** (am-nee-o-sen-TEE-sis) is a test in which a long, thin needle is inserted in the mother's uterus to obtain a sample of the amniotic fluid from the sac that surrounds the fetus. The fetal cells in the fluid are then examined for genetic defects.
- * **umbilical cord** (um-BIH-lih-kul) is the flexible cord that connects a baby to the placenta, the organ that unites the unborn child to the mother's uterus, the organ in which the baby develops.

Can a Pregnant Woman Learn If Her Baby Has Down Syndrome?

Down syndrome is the most common chromosomal abnormality in humans, and medical professionals have several ways to test for it, but that does not mean all pregnant women decide to have the tests. Some women prefer not to know; many women do want to know. The reasons for getting tested may include early preparation for the child's medical care, making sure that funding or insurance to pay for the child's special needs is available, or, for women who decide for any number of reasons not to have a child with Down syndrome, ending the pregnancy.

Screening tests Medical professionals commonly use the triple screen test or the alpha-fetoprotein (AFP)* test to predict whether a woman is carrying a baby with Down syndrome. They are called screening tests because they do not give a definite answer. Instead, they measure the amounts of certain substances in the mother's blood that can indicate a problem. If one of these tests is positive, it does not necessarily mean that the fetus (the developing baby) has Down syndrome, but it does indicate that the woman should have more tests done. Sometimes the test results are false-negatives, meaning that the test did not indicate Down syndrome even though the fetus has it. Low levels of AFP in the mother's blood are correlated with Down syndrome in the fetus, but the test detects only about 35 percent of cases. The triple test, which measures levels of three substances, is correct about 60 percent of the time.

Another screening is called nuchal (NOO-kul) translucency screening. In this test, medical professionals perform an ultrasound, which uses sound waves, to examine the skin at the back of the fetus's neck. They look at the size of the clear space in the neck tissue. Babies with Down syndrome have extra fluids in this part of the neck, which makes the clear space look larger. This test is able to detect about 80 percent of Down syndrome cases.

Diagnostic tests Medical professionals recommend several different diagnostic tests for pregnant women older than 35, and for women with positive results on screening tests. A common diagnostic test is amniocentesis* (am-nee-o-sen-TEE-sis). In this test, medical professionals examine chromosomes from the fetus's cells. This diagnostic test gives a definite answer, which means they are correct 98 to 99 percent of the time. In this test, medical professionals extract fetal cell samples, which can be taken from the fluid surrounding the fetus or from the umbilical cord*. On rare occasions, these procedures cause the mother to have a miscarriage (lose the baby before birth). Women who plan to have diagnostic tests performed should receive information and have emotional support available to help them understand the procedures and cope with the possibility of miscarriage and also with the possibility of results indicating Down syndrome.

What Does Life Hold for Anna and Her Family?

In 1910, most children with Down syndrome did not live past the age of nine, often due to infections. When antibiotics were developed in the 1940s, the average child with Down syndrome survived to age 19 or 20. In the early 2000s, the average life expectancy is nearly 50 years. Because this is an average, some individuals live longer and some do not live this long.

Anna's family learned all they could about Down syndrome as soon as Anna was born. They knew Anna would learn to sit, walk, and talk somewhat later than her peers. Anna's family is providing her with a stimulating home environment, good medical care, and good educational programs. They are teaching her to be a happy productive member of the community. Whether she will be able to go to school or to work or live independently depends on the level of her mental development. However, Anna's family knows that the Americans with Disabilities Act of 1991 (ADA) helps to protect Anna's right to live her life free of unnecessary limitations or discrimination due to her disabilities.

▶ See also **Birth Defects and Brain Development • Genetic Diseases**

Resources

Books and Articles

- Brill, Marlene Targ. *Down Syndrome*. New York: Marshall Cavendish Benchmark, 2007.
- Selikowitz, Mark. *Down Syndrome: The Facts*, 3rd ed. New York: Oxford University Press, 2008.
- Skallerup, Susan J., ed. *Babies with Down Syndrome: A New Parents' Guide*, 3rd ed. Bethesda, MD: Woodbine House, 2008.
- Soper, Kathryn, ed. *Gifts: Mothers Reflect on How Children with Down Syndrome Enrich Their Lives*. Bethesda, MD: Woodbine House, 2007.

Organizations

- National Association for Down Syndrome.** P.O. Box 206, Wilmette, IL, 60091. Telephone: 630-325-9112. Web site: <http://www.nads.org>.
- National Down Syndrome Society.** 666 Broadway, 8th Floor, New York, NY, 10012-2317. Toll free: 800-221-4602. Web site: <http://www1.ndss.org>.

Drug Abuse/Addiction See *Substance Abuse*.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **cerebral cortex** (suh-REE-brul KOR-tek) is the part of the brain that controls functions such as conscious thought, listening, and speaking.

Dwarfism *See Growth and Growth Disorders.*

Dying *See Death and Dying.*

Dysentery *See Diarrhea.*

Dyslexia

Dyslexia (dis-LEX-ee-a) is a learning disability that affects a person's ability to interpret written words and read, write, and spell properly. Dyslexia, which is not a form of intellectual disability, affects people of all levels of intelligence.

What Is Dyslexia?

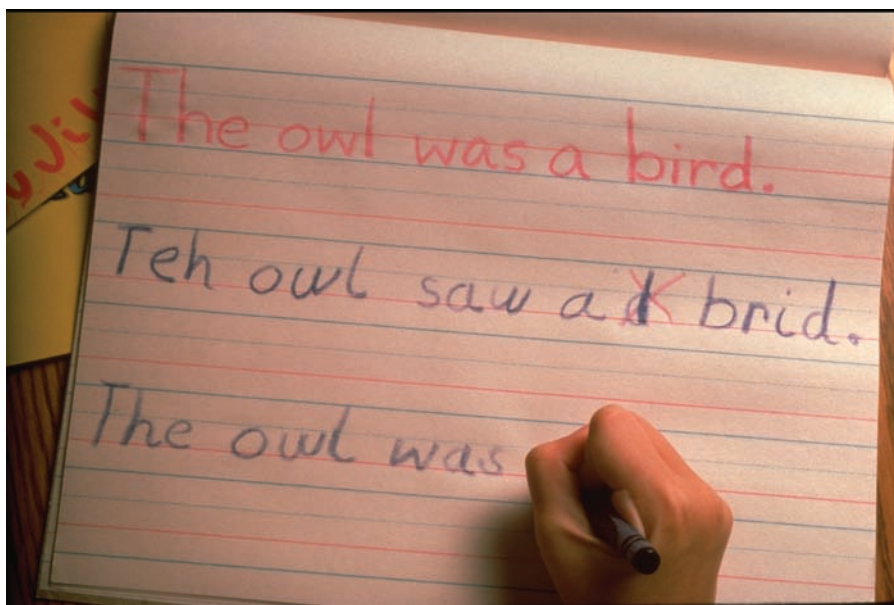
Dyslexia is a language processing disorder that makes a person unable to recognize written words and numbers properly. It comes from the combination of two Greek words: “dys,” which means “impaired,” and “lexis,” which means “words.” Most people with dyslexia also have trouble with writing and spelling. In addition, some have difficulty with numbers. Dyslexia is sometimes referred to as specific reading disability.

When people with dyslexia look at or hear words, their eyes and ears work properly, but a part of their brain misinterprets the words and delivers a faulty message back to them. In many cases, dyslexia may be genetic*, because people with the disorder often have a family history of learning disabilities.

Dyslexia affects more than 5 percent of school-age children. About four out of every five children with dyslexia are boys. The disorder affects all races equally and is the most common type of learning disability.

What Causes Dyslexia?

There are three forms of dyslexia. Primary dyslexia is caused by a genetic malfunction in the left side of the brain (cerebral cortex*), which is the part of the brain that recognizes and interprets words. Primary dyslexia is usually hereditary, and patients often struggle with this type of dyslexia throughout their lives. Secondary dyslexia occurs during fetal development. This type of dyslexia often diminishes as a child ages. Traumatic dyslexia occurs after an injury that affects the part of a person's brain that reads and interprets words. This type of dyslexia is uncommon in school-age children.



Students with dyslexia often have trouble with writing and spelling as well as reading. *Will and Deni McIntyre/Photo Researchers, Inc.*

People with dyslexia are not unintelligent or lazy. In fact, most people with dyslexia have average or above-average intelligence and work very hard at learning how to read well. They simply have a part of their brain that does not correctly translate messages about written words.

How Do People Know They Have Dyslexia?

Dyslexia usually is not diagnosed very early in a child's life, because children are not expected to learn to read until about six years of age. However, once children with dyslexia start school, they may have a hard time keeping up with their classmates. Words and letters appear much differently to a person with dyslexia than to a person without it. Sometimes words look all jammed together, while other times there seem to be spaces between words where they do not belong.

The biggest problem for people with dyslexia is that they do not recognize that words are made up of small units of sound, known as phonemes*. As a result, people with dyslexia struggle to connect the sounds that make up words. They may see p's where there are b's; for example, "pall" instead of "ball."

Because the skill of reading goes along with the skill of writing, children with dyslexia often have a difficult time learning to write, spell, and even speak correctly. They may flip letters or write letters upside down. Letters that look similar may confuse such children when they try to write; for example, "doll" may become "boll." Because the letters are shaped incorrectly, the children's handwriting may be very hard to read. The ability to spell properly also is affected by dyslexia. Letters may not appear in the right order; for example, "purple" may become "pruple." Some letters may be left out entirely, making the word "puple."

* **phonemes** (FO-neemz) are the smallest units of spoken language, such as the puh' sound at the start of the word pat.

* **neurologic exam** refers to systematic tests of how well various parts of the nervous system are functioning.

* **intelligence quotient test** also known as an IQ test, refers to a test designed to estimate a person's intellectual potential.

When children have this kind of difficulty with reading, writing, and spelling, they may quickly fall behind in school and feel frustrated, even though they may be intelligent. Not surprisingly, many adults with dyslexia say that they hated reading when they were young. Fortunately, most teachers as of the early 2000s are trained to recognize dyslexia and take action to help children who have this problem.

How Is Dyslexia Diagnosed?

Sometimes, children who are having difficulty with reading or writing will feel embarrassed or ashamed and try to hide it from their parents, teachers, and friends. Dyslexia may be suspected when a child shows difficulty with reading, keeping up in school, or following directions.

Once a parent or teacher recognizes that there is a problem, such children should be referred to their doctor for a thorough physical exam. The physician can run various tests, including vision and hearing tests, to rule out other problems. The physician also can do a neurologic exam* to measure how well the different parts of the nervous system are working.

If dyslexia is suspected, the physician may enlist the help of a specialist in learning disabilities. The specialist can administer tests to figure out how the children's brains process information. The children may take an intelligence quotient test* as well as academic achievement tests that assess reading and writing skills. Sometimes the children also take tests that assess abilities in other areas, such as math, logic, and creative thinking.

Once testing is completed, the specialist can determine whether the children have dyslexia by comparing their intelligence test against the reading and writing tests. Average or high scores on an intelligence test

READING DISABILITY

When Tommy opened his history book, this is the story he saw:

*Wenthe Pilgrims la n bed ta Plymouththey wer ein a mostbre carioussitua
tion. T heye ar saw lateandther e wasmuc h sicknes s a mon g the sett l ers.*

When Jason opened his book to the same page, this is what he saw:

*When the Pilgrims landed at Plymouth they were in a most precarious
situation. The year was late, and there was much sickness among the
settlers.*

For Jason and most of his classmates, reading about the first American settlers is easy and interesting. For Tommy and any other students in the class with dyslexia, reading is difficult and frustrating, because they do not see the words correctly.

and low scores on reading and writing tests are typical of people with dyslexia.

What Can Be Done about Dyslexia?

The earlier children are diagnosed with dyslexia and the earlier their families and teachers are made aware of the diagnosis, the better the outcome. Children with dyslexia must learn to read in a different way from those who do not have the disorder. Many children who do not have their dyslexia diagnosed until later do poorly in school year after year, as they try to learn to read the same way everyone else does. Eventually, after their dyslexia is diagnosed, they must go back and relearn how to read.

Whether it is a younger child with dyslexia who is first learning to read or an older child who is relearning, a special approach must be taken. In many cases, an individualized reading program is the first step. A reading specialist creates a plan that is designed just for the child. The plan is based on many factors, such as how severe the child's dyslexia is and what the child's strengths are in other areas in school.

Many times, the reading plan for a student with dyslexia includes a multisensory approach, which means that instead of just using the sense of sight, the student also uses other senses, such as touch or hearing. In some cases, a student might feel clay or wooden models of letters while saying the letters aloud. In other cases, the student might learn letter sounds while looking at pictures or listen to letter sounds on a tape while looking at the letters. The use of computers is also beneficial to children with dyslexia. The student can also work with the reading specialist on phonemes. Eventually, the student learns to create combinations of phonemes to form words and from there to recognize and read words.

Students with dyslexia can be taught in different settings. Some are placed in special classrooms with other students who have reading disabilities, while others work one-on-one with a reading specialist at certain points during the school day.

Living with Dyslexia

Children with dyslexia face a special challenge: not only must they learn to read, but they also must learn to read in a special way. People with dyslexia usually learn to read slowly, and it can take lots of practice. Emotional support is important. Many children with dyslexia feel inadequate because they cannot read as easily as most of their classmates. With enough help and support, however, children with dyslexia can learn to read and write well. The reading and writing level that a person with dyslexia can achieve depends a lot on the severity of the disorder. For example, someone with a mild form of dyslexia may learn to read and write well, whereas a person with severe dyslexia may always find reading and writing difficult.

Children with dyslexia usually grow into healthy adults with normal lives. Many people with dyslexia go to college and excel in their classes, sometimes by using special methods such as tape recording their lectures

Dyslexia Hall of Fame

Many people with dyslexia go far beyond merely living up to their potential. The following list identifies some of the famous people who achieved their career dreams despite dyslexia or other learning disabilities:

Albert Einstein
 Hans Christian Andersen
 Cher
 Winston Churchill
 Tom Cruise
 Leonardo da Vinci
 Thomas Edison
 Danny Glover
 Whoopi Goldberg
 Bruce Jenner
 Greg Louganis
 Walt Disney
 Michelangelo
 Auguste Rodin
 Woodrow Wilson
 William Butler Yeats
 Orlando Bloom

or taking oral exams instead of written ones. Adults with dyslexia can do well in many different kinds of jobs.

Can Dyslexia Be Cured?

As of 2009 there was no cure for dyslexia. There was no drug that people with dyslexia could take to correct the problem. Scientists have studied the various parts of the brain to learn why information is interpreted incorrectly in some people. However, the brain is complex, and there remain many mysteries about what causes dyslexia and other learning disabilities.

▶ See also **Attention Deficit Hyperactivity Disorder (ADHD)**

Resources

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Moore-Mallinos, Jennifer. *It's Called Dyslexia*. Hauppauge, NY: Barron's, 2007.

Tridas, Eric Q., ed. *From ABC to ADHD: What Parents Should Know About Dyslexia and Attention Problems*. Baltimore, MD: International Dyslexia Association, 2007.

Organizations

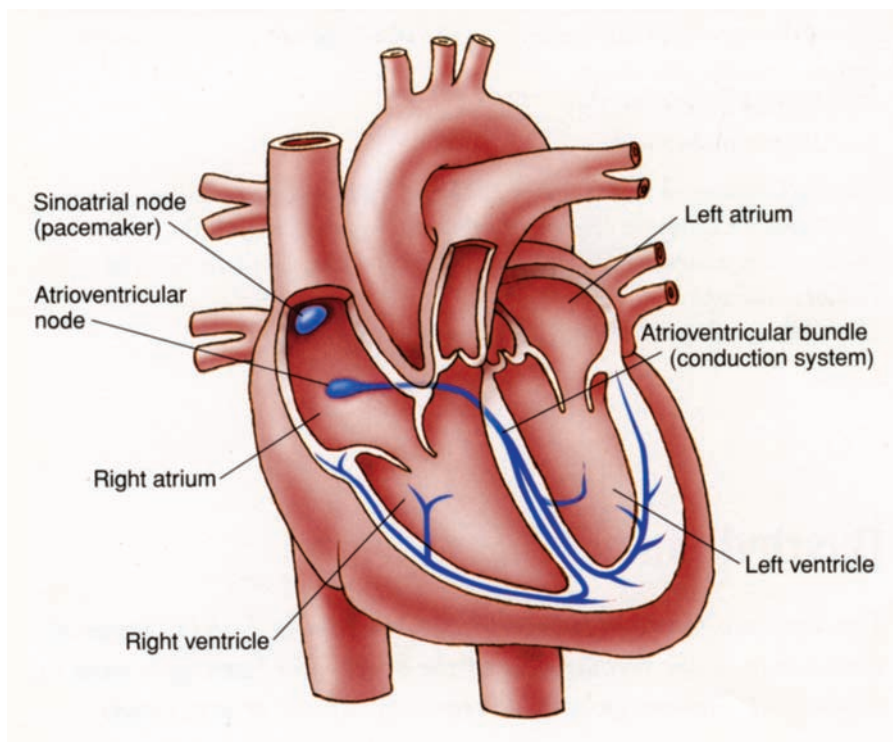
International Dyslexia Association. 40 York Road, 4th Floor, Baltimore, MD, 21204. Telephone: 410-296-0232. Web site: <http://www.interdys.org>.

LD OnLine. 2775 S. Quincy, Arlington, VA, 22206. Web site: <http://www.ldonline.org>.

Dyspepsia See *Heartburn (Dyspepsia)*.

Dysrhythmia

Dysrhythmia (dis-RITH-mee-a), or arrhythmia (a-RITH-mee-a), is a change in the regular beat of the heart. The heart may seem to skip a beat, beat irregularly, or beat very rapidly or very slowly.



The sinoatrial node is the heart's pacemaker. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Annie's Story

Annie, who had just turned 15, was running for student council treasurer. On the morning she had to give her campaign speech before the entire student assembly, her heart began to race. Stepping behind the podium in the auditorium, she felt a little dizzy and out of breath. During the first few minutes of her speech, she worried that she might faint, but as she kept speaking and gained confidence, the sensations vanished and her heartbeat slowed down. By the time she reached her last sentence, she felt completely normal.

What Is Dysrhythmia?

Dysrhythmia is any variation in the regular beat of the heart. Some of these changes are normal—like Annie's palpitation*—whereas others are more serious. People's hearts naturally speed up with emotion or exercise, and slow down during sleep. Other dysrhythmias are associated with heart disease and can be life-threatening.

The human heart is a muscular pump divided into four chambers: two atria located on the top and two ventricles located on the bottom. But it is more than a pump; it is also an amazing piece of electrical machinery that, when healthy, keeps these chambers beating in an organized manner.

Normally, the heartbeat begins in the right atrium when the sinoatrial (SA) node, a special group of cells, transmits an electrical signal across the

* **palpitation** is the sensation of a rapid or irregular heartbeat.

* **stimulants** (STIM-yoo-lunt) a drug that produces a temporary feeling of alertness, energy, and euphoria.

* **autonomic nervous system** is a branch of the peripheral nervous system that controls various involuntary body activities, such as body temperature, metabolism, heart rate, blood pressure, breathing, and digestion. The autonomic nervous system has two parts—the sympathetic and parasympathetic branches.

heart. This signal spreads throughout the atria and to the atrioventricular (AV) node. The AV node connects to a group of fibers in the ventricles that conducts the electrical signal and sends the impulse to all parts of the ventricles. This exact route is necessary to ensure that the heart pumps properly.

As the electrical impulse crosses through the heart, the heart contracts. This contraction normally occurs about 60 to 100 times per minute, with each contraction equaling a single heartbeat. The atria contract about one-fifth of a second before the ventricles, allowing them to empty their blood into the ventricles before the ventricles contract.

Under some conditions, almost all heart tissue is capable of starting a heartbeat, or becoming the pacemaker. A dysrhythmia occurs in the following circumstances:

- The heart's natural pacemaker (SA node) becomes defective
- The normal conduction pathway to the AV node and the ventricles is interrupted
- Another part of the heart takes over as pacemaker

What Causes Dysrhythmia?

External and internal forces can cause dysrhythmia. External factors include exhaustion, overexertion, emotional stress (such as Annie's delivering her campaign speech), cigarette smoking, alcohol consumption, and ingesting stimulants*, such as caffeine, decongestants, and cocaine. Internal factors include heart defects present at birth, thyroid problems, inflammatory diseases, and problems in the autonomic nervous system*, which carries nerve impulses from the brain and spinal cord to the heart. The most important factor that contributes to serious dysrhythmias, however, is heart disease, including coronary artery disease, abnormal heart valves, and congenital heart disease.

What Are Different Types of Dysrhythmia?

The more common dysrhythmias are as follows:

- **Bradycardia** (bray-dee-KAR-dee-a), a heart rate of fewer than 60 beats per minute in an adult
- **Tachycardia** (tak-i-KAR-dee-a), a heart rate of more than 100 beats a minute in an adult
- **Sick sinus syndrome**, in which the heart rate slows down or varies between slow and fast rates
- **Atrial flutter**, in which the atrial rate reaches 240 to 350 beats per minute (the ventricular rate in this condition rarely goes above 180 due to a protective effect of the AV node)
- **Atrial fibrillation** (AY-tree-al fib-ri-LAY-shun), in which the atria quiver instead of beating effectively. This is a major cause of stroke.

- **Ventricular fibrillation** (ven-TRIK-yoo-lar fib-ri-LAY-shun), in which the ventricles quiver instead of beating, and the heart cannot pump any blood. Without emergency treatment, the person will die within minutes.
- **Ventricular tachycardia**, rapid heartbeat (> 150 beats per minute) that can lead to ventricular fibrillation. This rhythm is abnormal because it originates in the ventricles themselves and, therefore, has the potential to deteriorate into ventricular fibrillation.
- **Premature ventricular contractions**, extra heartbeats that are often felt as “missed beats” or “flipflops” in the chest

* **electrocardiogram** (e-lek-tro-KAR-dee-o-gram), also known as an EKG, is a test that records and displays the electrical activity of the heart.

How Are Dysrhythmias Diagnosed?

Symptoms of dysrhythmias can vary. Some people have no symptoms, whereas others experience fatigue, lightheadedness, dizziness, palpitations, fainting, shortness of breath, and in some cases, sudden collapse and death. Although many dysrhythmias are harmless, a doctor should check them because they can signal heart disease or other conditions that need treatment.

Like fingerprints found at a crime scene, electrocardiogram* (ECG or EKG) tracings are important pieces of physical evidence that track irregularities in the heartbeat. Sometimes, however, an abnormal heartbeat does not show up during a visit to the doctor. In that case, the patient can wear a 24-hour Holter ECG monitor to track the heartbeat. A stress test, in which the patient walks on a treadmill while being monitored, can help a physician see the effect of exercise on the heart.

How Are Dysrhythmias Treated?

Normally, people’s heart rates vary a bit—even from one beat to the next. Many dysrhythmias—such as Annie’s—require no treatment at all.

Some abnormal rhythms may need to be controlled with medication or, on occasion, electric shock. Dysrhythmia can also be treated with the implantation of a battery-powered pacemaker that sends small electrical charges through an electrode placed next to the wall of the heart. A cardioverter/defibrillator, a sophisticated device that actually senses an abnormal rhythm and delivers one or more lifesaving jolts of energy to shock the heart back to normal rhythm, can replace a defective natural pacemaker or a blocked pathway. Catheter ablation is a surgical technique that uses a tiny device at the end of a catheter (a flexible tube) inserted into the heart to burn away the part of the heart causing the abnormal rhythm.

If heart disease is not the culprit, the doctor may suggest that the patient not drink coffee, tea, and colas (which all contain the stimulant caffeine), or alcoholic beverages. Over the long term, it is important to eat a balanced, low-fat diet and exercise regularly to keep the heart healthy.

▶ See also **Heart Disease • Heart Murmur**

Resources

Books and Articles

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Organization

American Heart Association. 7272 Greenville Avenue, Dallas, TX 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://americanheart.org/presenter.jhtml?identifier=8>.

E

E. coli Bacteria See *Diarrhea; Food Poisoning*.

Ear Infections See *Otitis (Ear Infections)*.

Eating Disorders: Overview

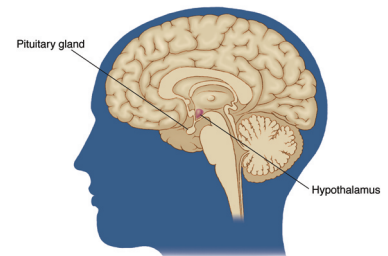
Eating disorders are habits or patterns of eating that are out of balance and may involve major health and emotional problems.

What Are Eating Disorders?

Eating disorders are not merely unhealthy eating habits; they involve patterns of eating too little or too much, and they may cause a variety of physical and emotional problems. Eating disorders usually develop during adolescence and usually affect girls, although boys can also be affected. Eating disorders include anorexia (an-o-REK-see-a), bulimia (bull-EE-me-a), binge eating disorder, and obesity (o-BEE-si-tee).

Anorexia Anorexia (also called *anorexia nervosa*) is an eating disorder that involves the fear of becoming or being fat, intensive dieting or exercise, and a distorted body image*. People with anorexia see themselves as fat even though they may be dangerously underweight. They severely restrict their food intake and/or exercise to extremes in order to lose weight. People may be diagnosed with anorexia if they refuse to eat enough food to maintain a healthy weight and have lost more than 15 to 20 percent of their healthy weight. For example, a girl with anorexia whose healthy weight is 125 pounds might weigh 105 pounds. She might eat as little as 500 calories per day (most healthy teenagers eat 2,000 or more calories per day).

Bulimia Sometimes referred to as the binge-purge disorder, bulimia (or bulimia nervosa) involves repeated episodes of binge eating (consuming large quantities of food while feeling little control over the behavior) followed by purging (trying to rid the body of the food by vomiting or by using laxatives or enemas*). Some people with bulimia also exercise



▲ Eating disorders have multiple causes, which may include social and cultural pressures, emotional issues, and family stressors. Chemical imbalances in the brain, shown here in cross-section, may also cause eating disorders. These imbalances affect the hypothalamus, which is believed to control appetite. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **body image** is a person's impressions, thoughts, feelings, and opinions about his or her body.

* **enemas** (EH-nuh-muhz) are procedures in which liquid is injected through the anus into the intestine, usually to flush out the intestines.

AT A GLANCE

According to Walden Behavioral Care, more than 1,000 women and girls die of anorexia each year. More than 90 percent of people with anorexia are adolescent and young women, but it can affect boys too, especially boys who are active in sports that overly praise body image. The factors increasing the risk of an eating disorder are complex and may include the following:

- **Gender.** Teenage girls and young women are more likely to develop eating disorders than teenage boys and young men.
- **Age.** Eating disorders are much more common in teenagers and young adults in their early 20s.
- **Family issues.** Teenagers who feel less secure in their families, whose parents and siblings are overly critical, or who are teased or ridiculed about their appearance are at higher risk of developing eating disorders.
- **Negative body image.** People with negative body image are at high risk of developing an eating disorder and are more likely to suffer from obsessions with weight loss.
- **Other psychological factors.** Low self-esteem, feelings of inadequacy or lack of control in life, loneliness, and troubled personal relationships have all been shown to contribute to eating disorders.
- **Emotional disorders.** Depression, anxiety disorders, and obsessive-compulsive disorder are often associated with an eating disorder. People with anorexia often have perfectionist traits, whereas some with bulimia have been shown to be overly impulsive.
- **Excessive exercise.** People who pursue highly competitive athletic activities are at greater risk of developing an eating disorder.
- **Genetic contribution.** Eating disorders may be more common in people who have close family members with eating disorders.
- **Biological causes.** Some research focuses on potential biochemical or biological causes of eating disorders. In some patients, certain chemicals in the brain that control hunger, appetite, and digestion have been found to be imbalanced.

excessively. In bulimia, self-image is overly tied to body shape and weight, and people with this disorder are dissatisfied with these aspects of their body. However, unlike those with anorexia, people with bulimia usually stay at a fairly healthy weight.

Binge eating disorder Binge eating disorder involves out-of-control overeating but lacks the purging that is seen with bulimia. Binge eaters often are obese or constantly dieting, and they often feel guilty after a binge. Painful emotions or stress may trigger binges.

Obesity Obesity is an excess of body fat. People are considered overweight if extra body fat causes them to weigh 20 percent more than the healthy weight for their height and obese if they weigh more than 30 percent above what is healthy for their height.

Who Develops Eating Disorders?

Most teenagers are concerned about how they look. After all, their appearance changes very quickly. Girls develop breasts and their hips become round and fuller. Boys' voices deepen and body hair increases. Most teenagers have an ideal image of what they should look like, and images

Symptoms of eating disorders

Anorexia nervosa

Resistance to maintaining body weight at or above a minimally normal weight for age and height

Intense fear of gaining weight or becoming fat, even though underweight

Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight

Infrequent or absent menstrual periods (in females who have reached puberty)

Bulimia nervosa

Recurrent episodes of binge eating, characterized by eating an excessive amount of food within a discrete period of time and by a sense of lack of control over eating during the episode

Recurrent inappropriate compensatory behavior in order to prevent weight gain, such as self-induced vomiting or misuse of laxatives, diuretics, enemas, or other medications (purging); fasting; or excessive exercise

The binge eating and inappropriate compensatory behaviors both occur, on average, at least twice a week for 3 months

Self-evaluation is unduly influenced by body shape and weight

Binge-eating disorder

Recurrent episodes of binge eating, characterized by eating an excessive amount of food within a discrete period of time and by a sense of lack of control over eating during the episode

The binge-eating episodes are associated with at least 3 of the following: eating much more rapidly than normal; eating until feeling uncomfortably full; eating large amounts of food when not feeling physically hungry; eating alone because of being embarrassed by how much one is eating; feeling disgusted with oneself, depressed, or very guilty after overeating

Marked distress about the binge-eating behavior

The binge eating occurs, on average, at least 2 days a week for 6 months

The binge eating is not associated with the regular use of inappropriate compensatory behaviors (e.g., purging, fasting, excessive exercise)

SOURCE: National Institute of Mental Health, National Institutes of Health, U.S. Department of Health and Human Services

of film stars on television and in the movies reinforce the goal of thinness as perfection.

Many young people, particularly girls, go on diets to control their body weight. Dieting has been reported to start as early as elementary school. Dieting without guidance by a medical doctor can cause problems with growth and development for children and teens. Sometimes an earnest but misguided effort to control weight can evolve into an eating disorder.

Diane, a 13-year-old seventh grader, began dieting. She thought she was 10 to 15 pounds overweight and switched her lunch from a sandwich and cookies to a salad. She lost a few pounds. She liked feeling thinner and got a lot of compliments. Soon she reduced the salad at lunch to a carrot and a piece of cheese. Diane trimmed her dinner as well, telling her parents that she had eaten a big lunch and was not hungry. Before long, Diane had lost 20 pounds. But Diane was surprised that she did not feel happy; instead, she was obsessed with food and her weight (she still felt fat) and was embarrassed whenever anyone commented on her body. Diane continued dieting and also began to exercise two times per day to try to lose more weight.

Diane is not alone. Experts say that more than five million American women and girls and one million men and boys suffer from eating disorders. About 1 in 100 girls between 12 and 18 years old has an eating disorder. As many as 1 in 10 college females has anorexia or bulimia. More than 1,000 young women die each year from the serious medical problems that develop due to eating disorders.



*Illustration by GGS Information Services.
Reproduced by permission of Gale, a part
of Cengage Learning.*

- * **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.
- * **menstruate** (MEN-stroo-ate) means to discharge the blood-enriched lining of the uterus. Menstruation occurs normally in females who are physically mature enough to bear children. Because it usually occurs at four-week intervals, it is often called the monthly period. Most girls have their first period between the age of 9 and 16.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **heart disease** is a broad term that covers many conditions that prevent the heart from working properly to pump blood throughout the body.
- * **high blood pressure** also called hypertension, is a condition in which the pressure of the blood in the arteries is above normal.
- * **osteoarthritis** (os-tee-o-ar-THRY-tis) is a common disease that involves inflammation and pain in the joints (places where bones meet), especially those in the knees, hips, and lower back of older people.

Young people who participate in sports that prize thinness are at particularly high risk of developing eating disorders. Female dancers, ice skaters, and gymnasts are three times more likely to develop an eating disorder than girls not involved in such activities. Boys who participate in similar sports or in wrestling are also at higher risk. Girls who enter puberty* early and girls who are overweight may also be more likely to develop eating disorders.

What Causes Eating Disorders?

There is no clear-cut, single cause for any eating disorder. Many factors seem to contribute, including social influences (such as the glorification of thinness by the mass media), emotional issues (such as a teenager's striving for perfection, exposure to intensely stressful situations, and fears of maturity, puberty, or sexuality), family factors (such as overly controlling parents, serious emotional conflicts, or problems expressing feelings), or poor childhood feeding and eating patterns. People who have an eating disorder usually do not set out deliberately to have this problem. Generally, eating disorders develop slowly, as do the signs and symptoms.

What Medical Complications Are Caused By Eating Disorders?

Eating disorders are serious problems and can cause a variety of medical complications. In anorexia, rapid weight loss can lead to blood chemical imbalances, failure to menstruate*, slow pulse, low blood pressure, and heart problems. In some cases, damage to vital organs is so serious that it can result in death. The frequent vomiting associated with bulimia can cause throat tears or sores, damaged tooth enamel, broken blood vessels in the eyes, and puffy cheeks from swollen salivary glands. With both anorexia and bulimia, bowel and intestinal problems can occur and serious vitamin and mineral deficiencies can cause serious and long-lasting problems. Binge eating often results in obesity, which in turn can lead to other health problems. People who are obese are at greater risk of developing diabetes*, heart disease*, high blood pressure*, osteoarthritis*, and other ailments.

How Do Doctors Diagnose Eating Disorders?

Teenagers with anorexia, bulimia, and binge eating disorder often try to hide the problem, so formal diagnosis can be delayed or difficult. Even when caring friends or family members ask about the weight loss or other symptoms, most teenagers with eating disorders are ashamed or embarrassed, especially by the purging that accompanies bulimia. Because of distorted body image, those with anorexia may not be able to recognize the seriousness of their extreme weight loss. Unbearable fear of being fat may cause people with anorexia to resist attempts to help them gain weight. A concerned health professional might ask questions about eating, body image, and exercise. Blood or other laboratory tests

can help determine if a person's nutrition is adequate and if general body chemistry is balanced. A careful interview and health history may reveal concerns about body image or distorted opinions about body appearance.

A doctor can generally determine if adults are obese by measuring their body weight and height. Obesity in children can be similarly determined but these measurements should be considered more carefully because the child is still growing. Through the late 1990s and early 2000s, there was a significant rise in obesity in children in the United States, in part a result of people eating more frequently in fast food restaurants, watching a lot of television, working or playing games on computers, and engaging in other activities that promote overeating and a sedentary (sitting too much with little exercise) lifestyle.

How Are Eating Disorders Treated?

Overcoming eating disorders may take a long time and lots of commitment and hard work. Most teenagers with eating disorders need the assistance of mental health and other healthcare professionals to manage the problem. Anorexia, bulimia, and binge eating disorder are treated most successfully with a combination of therapies. Behavior change programs, monitoring of diet and eating patterns, individual or group psychotherapy*, support groups, nutritional counseling, family counseling, and sometimes medication may all be part of treatment.

People with obesity can be helped by doctor-recommended weight-loss programs that teach healthy habits. To lose weight, people must take in fewer calories* than they use, and the best way to control weight is through exercising and eating a balanced diet. In some cases, doctors may also treat severe obesity by prescribing very low-calorie diets or medications. In rare cases, doctors may advise a surgical procedure that either limits the amount of food the stomach can hold or causes food to bypass the stomach or part of the intestines.

▶ See also **Anorexia Nervosa • Anxiety and Anxiety Disorders • Binge Eating Disorder • Body Image • Bulimia Nervosa • Depressive Disorders • Metabolic Disease • Obesity**

Resources

Books and Articles

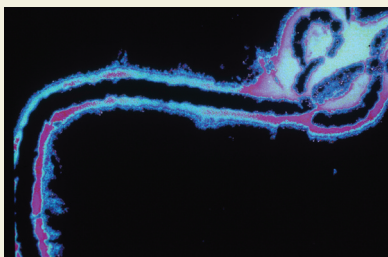
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* **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.

* **calories** (KAL-o-reez) are units of energy that are used to measure both the amount of energy in food and the amount of energy the body uses.



Enhanced electron micrograph of the Virus which causes Ebola Hemorrhagic Fever. CDC/Custom Medical Stock Photo, Inc. Reproduced by permission.

* **incubation** (ing-kyoo-BAY-shun) is the period of time between infection by a germ and when symptoms first appear. Depending on the germ, this period can be from hours to months.

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Organizations

American Psychological Association. 750 First Street NE, Washington, DC, 20002-4242. Toll free: 800-374-2721. Web site: <http://www.apa.org/topics/topiceating.html>.

Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857-0001. Toll free: 888-INFO-FDA. Web site: <http://www.cfsan.fda.gov/~dms/wh-eat.html>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov/health/publications/eating-disorders/complete-publication.shtml>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/eatingdisorders.html>.

Ebola Hemorrhagic Fever

Ebola hemorrhagic (e-BO-luh heb-muh-RAH-jik) fever is a rare viral disease that may cause severe internal and external bleeding and that results in death in 50 to 90 percent of those who have been infected. Its contagiousness, high lethality, and short incubation period (seven days is the average), have raised fears of its use as a potential agent of bioterrorism.*

A Fast-Moving Epidemic

Ebola hemorrhagic fever appeared without warning in late 2000 in the northern district of Gulu, in Uganda, Africa. Health workers responded quickly, caring for people infected with the disease and isolating them so that they would not spread the devastating virus to others. Despite

the workers' efforts, more than 40 people died in the first wave of the epidemic*, and the disease spread throughout the district and beyond.

By February 2001, the epidemic had killed 224 people. Then, suddenly, it was over. The Ebola virus seemed to disappear back into the jungle.

What Is Ebola Hemorrhagic Fever?

Although much remains unknown about Ebola virus and Ebola hemorrhagic fever, scientists have begun to piece together some of the puzzle. Ebola hemorrhagic fever was first identified in 1976 in the Democratic Republic of Congo (formerly Zaire) and named for a river that flows through that African nation. Part of the filovirus family, Ebola virus had as of 2008 four known subtypes, each named for the location in which it was discovered: Ebola-Zaire, Ebola-Sudan, Ebola-Ivory Coast, and Ebola-Reston. The Ebola-Reston virus, first detected in the United States in 1989, was discovered in sick monkeys imported from the Philippines to a research laboratory in Reston, Virginia. Although a few laboratory workers later showed signs of the virus in their blood, none of them became ill. The Reston strain was assumed to be harmless to humans.

The geographic locale of the virus is probably the rain forests of Africa and Asia. Scientists think that the Ebola virus is animal-borne (or zoonotic) and that it is passed to primates (monkeys and apes) and humans by another animal. Decades after its identification, researchers continued to search for the natural reservoir, or long-term animal host, of the Ebola virus.

How Common Is Ebola Hemorrhagic Fever?

Although outbreaks of Ebola hemorrhagic fever have been widely publicized because of the scary symptoms that became manifest in most outbreaks of the disease and the suddenness with which infected individuals die, the disease is actually quite rare. Between the late 1980s and early 2000s, about 1,850 cases of Ebola virus infection were reported in humans, and approximately 1,200 of those infected died.

Is Ebola Hemorrhagic Fever Contagious?

Ebola virus is extremely contagious*, but scientists do not know exactly how it spreads. They do know that it can spread through direct contact with infected blood, especially from contaminated needles, and possibly through contact with the nasal or respiratory secretions of someone who is infected. Healthcare workers and family members tending to the people who have the virus are at high risk of becoming infected and dying of Ebola virus infection. The needles used to take blood samples from patients are an extreme biohazard*, because accidental needle pricks expose healthcare workers to the virus and are therefore potentially life-threatening. Traditions in some African cultures may contribute to the spread of Ebola virus. For example, some funeral rites require a ritual cleansing of the corpse, which can bring the person performing the rite

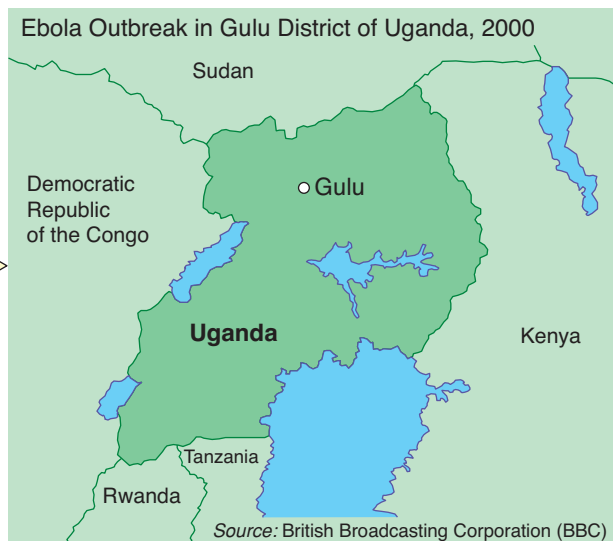
* **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

* **biohazard** is a biological agent or condition that causes a threat to humans.

Ebola Hemorrhagic Fever

In October 2000 an epidemic of Ebola broke out in Gulu, Uganda, and in 4 months it killed 224 people. Some doctors believe that eating ape meat contaminated with the virus may be one source of infection. It is hoped that research to determine the natural source of the virus and the ways in which it is transmitted to primates and humans will provide information about how to prevent future outbreaks. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



- * **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.
- * **hemorrhage** (HEH-muh-rij) is uncontrolled or abnormal bleeding.
- * **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.
- * **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

into contact with the blood or other body fluids of the deceased. Ebola virus infects nonhuman primates, such as monkeys and apes. Ape meat is considered a delicacy in parts of Africa; however, some scientists recommend that people who live in these regions not eat it because it may contain the Ebola virus, which can infect nonhuman primates such as monkeys and chimpanzees.

What Are the Signs and Symptoms of Ebola Hemorrhagic Fever?

In the first few days after individuals are infected with Ebola virus, symptoms are variable. They often resemble those of many other diseases: fever, severe sore throat, headache, and muscle aches. The symptoms of Ebola hemorrhagic fever will often rapidly progress to more serious symptoms such as rash, chest pain, severe bloody vomiting and diarrhea, uncontrolled internal bleeding, kidney and liver failure, and shock*.

Doctors can diagnose Ebola hemorrhagic fever on the basis of the signs and symptoms that become manifest in patients as they quickly become ill during outbreaks. Blood tests can sometimes identify the virus directly, or antibodies* to Ebola virus produced by the body during infection can be detected in the blood. Doctors have to be careful when performing tests because simply injecting a needle into a patient who is prone to hemorrhage* can trigger uncontrolled bleeding.

How Is Ebola Hemorrhagic Fever Treated?

There is no medication to treat or cure Ebola virus infection. Patients with Ebola hemorrhagic fever are hospitalized and receive supportive care to treat symptoms. They may receive intravenous* (IV) fluids to protect against dehydration*; monitoring of blood pressure, heart rate,

STRANGER THAN FICTION

The tale reads like something from a Stephen King novel. Ebola virus infected and killed monkeys in a laboratory in Reston, Virginia. A biohazard SWAT team descended on the Reston Primate Quarantine Unit and, working in secret just miles from the nation's capital, struggled to decontaminate the monkey house.

In his suspenseful book, *The Hot Zone*, Richard Preston recounts in detail how the U.S. Veterinary Corps at Frederick, Maryland, detected Ebola virus in the primate population at Reston in 1989 and recruited the secret SWAT team to contain the deadly virus.

Scientists later named the virus subtype Ebola-Reston and determined that, although it is deadly to monkeys, it does not cause Ebola hemorrhagic fever in humans. The following year the same virus was found in monkeys in labs in Texas and Pennsylvania.

Researchers were able to trace the infected monkeys to a single exporter in the Philippines. In the United States, several of the monkeys died and four people were infected with the virus, although none of them became ill.

and breathing; and treatment for bleeding or other infections that may develop during the illness. During past outbreaks, 50 to 90 percent of people who developed symptoms of the disease died. Those who survive usually recover in several weeks.

Researchers discovered a protein on the surface of the Ebola virus that attaches to and damages specific cells of blood vessels, and this finding may help to explain the massive bleeding that leads to most Ebola virus deaths. Researchers have attempted to develop new drugs or a vaccine directed against this protein that might prevent the disease or at least reduce the severity of the symptoms and the number of deaths caused by the virus.

Can Ebola Hemorrhagic Fever Be Prevented?

Because there is no vaccine to prevent Ebola virus infection and no medication to halt it, the first line of defense for health officials is to isolate infected patients in a hospital. Healthcare workers use gloves and masks when coming into contact with patients to try to prevent the virus from spreading. However, the epidemic in Gulu, Uganda, demonstrated that even those precautions sometimes fail.

Research efforts to determine the natural source of the virus and how it is carried to nonhuman primates and humans was anticipated to provide information that could help in the prevention of future outbreaks.

▶ See also **Viral Infections • Zoonoses**

* **mononucleosis** (mah-no-nu-kee-O-sis) is an infectious illness caused by a virus with symptoms that typically include fever, sore throat, swollen glands, and tiredness.

* **strains** are various subtypes of organisms, such as viruses or bacteria.

Resources

Books and Articles

Hirschmann, Kris. *The Ebola Virus*. Detroit, MI: Lucent Books, 2007.

Preston, Richard. *The Hot Zone*. New York: Random House, 1994.

Smith, Tara C. *Ebola*. Philadelphia, PA: Chelsea House, 2006.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dvrd/spb/mnpages/dispages/Ebola.htm>.

Directors of Health Promotion and Education. 1015 18th Street NW, 3rd Floor, Washington, DC, 20036. Telephone: 202-659-2230. Web site: <http://www.dhpe.org/infect/ebola.html>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: 41 22 791 2111. Web site: <http://www.who.int/csr/disease/ebola/en>.

Eczema See *Allergies; Skin Conditions*.

Ehrlichiosis

Ehrlichiosis (air-lik-e-O-sis) is an infectious disease caused by various strains of Ehrlichia (air-LIH-kee-uh) bacteria, transmitted to humans by ticks.

What Causes Ehrlichiosis?

Caused by an organism once thought to infect only dogs, sheep, cattle, goats, and horses, ehrlichiosis was first discovered in humans in 1953 when researchers in Japan found that Sennetsu fever, an illness that resembles mononucleosis*, was caused by *Ehrlichia sennetsu* bacteria. Between the 1980s and early 2000s, scientists identified three additional strains* of *Ehrlichia* bacteria that cause forms of human ehrlichiosis in the United States: *E. chaffeensis*, which causes human monocytic ehrlichiosis (HME); bacteria similar or identical to *E. phagocytophila* or *E. equi* (known to cause ehrlichiosis in animals), which cause human granulocytic ehrlichiosis (HGE), which later was called anaplasmosis; and *E. ewingii*, which has only been seen in a few patients in the midwestern United States and Tennessee.

What Is Ehrlichiosis?

Ehrlichiosis can be a very severe disease. It interferes with the body's immune system* by attacking white blood cells, a vital part of the body's defense against invading bacteria, viruses, and other microorganisms* or harmful substances. Untreated, the disease can leave people vulnerable to other infections. About 50 percent of all cases require hospitalization.

Ehrlichiosis does not spread from person to person. The *Ehrlichia* bacteria that cause the disease are spread through tick bites. The species that most commonly spread the disease are the lone star tick, the black-legged tick, and the western black-legged tick.

The number of cases of ehrlichiosis reported to the Centers for Disease Control and Prevention (CDC) climbed steadily between 1999 and 2006. Most occurred along the Atlantic Coast and in southern and central states, although cases were reported in almost every region of the country. The number of cases peaks during tick season, which runs from April to October.

What Happens When People Get Ehrlichiosis?

Most cases of ehrlichiosis are associated with mild flu-like symptoms, such as fever, chills, headaches, muscle or joint pain, nausea and vomiting, cough, stomach pain, and sore throat. Other cases may have diarrhea (frequent, soft or watery bowel movements), skin rashes, or confusion (trouble thinking). Some people with the infection show no symptoms at all. Symptoms usually start within two weeks after a tick bite but can take up to a month to appear.

Because ehrlichiosis shares many symptoms with Lyme disease* and other infections transmitted by ticks, diagnosis based on symptoms alone can be difficult. Blood tests are done to look for evidence of *Ehrlichia* infection, such as antibodies* to the bacteria or the presence of the germ itself in the blood.

If treated early, ehrlichiosis responds very well to certain antibiotics. As a result, doctors often treat this disease presumptively, meaning that patients who have had tick exposure and who have fevers, low white blood cell count, and decreased platelets* are often treated with appropriate antibiotics even before the diagnosis has been definitively confirmed in the laboratory. Over-the-counter medicine such as acetaminophen* can help lower fever and relieve pain. Usually, people recover from mild cases of ehrlichiosis soon after finishing a week of antibiotic treatment. About one-half of all patients need treatment in the hospital, in part due to a lack of diagnosis of ehrlichiosis and in part due to increased severity of illness.

Although many cases of ehrlichiosis are mild, the infection can become serious if it is not diagnosed and treated early. Some people who get ehrlichiosis develop anemia* and inflammation of the liver and kidneys. Breathing problems, internal bleeding, encephalitis (en-seh-fuh-LYE-tis; brain inflammation), and seizures* can also develop. People with weakened immune systems, such as those with HIV* infection, certain

How to Remove a Tick

- Using thin-tipped tweezers, grasp the tick as close to the person's skin as possible.
- Pull straight upward firmly and steadily until the tick lets go (do not squeeze or twist the tick body).
- Clean the skin with soap and warm water, alcohol, or other antiseptic.
- Save the tick for identification.
- Petroleum jelly, lit matches, nail polish or other products do not help in tick removal and should not be used.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **microorganisms** are tiny organisms that can only be seen using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

* **Lyme disease** (LIME) is a bacterial infection that is spread to humans by the bite of an infected tick. It begins with a distinctive rash and/or flulike symptoms and, in some cases, can progress to a more serious disease with complications affecting other body organs.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.

- * **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.
- * **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.
- * **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.
- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-nodih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

types of cancer, or the elderly, tend to develop more severe symptoms and complications. For these people, ehrlichiosis can be fatal.

Can Ehrlichiosis Be Prevented?

Avoiding direct contact with ticks is the best way to prevent ehrlichiosis. Experts recommend that people use tick repellent and wear light-colored, long-sleeved shirts (to help find ticks more easily) and long pants tucked into socks when entering potentially tick-infested areas such as woods or campgrounds. After visiting such areas, it is wise to carefully check the body, clothes, and hair for ticks. Pets need to be checked as well.

▶ See also **Tick-borne Illnesses**

Resources

Books and Articles

Bowman, Alan S., and Patricia A. Nuttall, eds. *Ticks: Biology, Disease, and Control*. Cambridge, UK: Cambridge University Press, 2009.

Drummond, Roger. *Ticks and What You Can Do about Them*. Berkeley, CA: Wilderness Press, 2004.

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Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ticks/diseases/ehrlichiosis>.

Illinois Department of Public Health. 535 West Jefferson Street, Springfield, IL, 62761. Telephone: 217-782-4977. Web site: <http://www.idph.state.il.us/public/hb/hbehrlic.htm>.

Electrolyte Disorders See *Fluid and Electrolyte Disorders*.

Elephantiasis

Elephantiasis (el-e-fan-TY-a-sis), the medical name of which is lymphatic filariasis, is the result of a tropical worm infection called filariasis (fil-a-RY-a-sis). When injected mosquitoes transmit the parasitic worm Wuchereria bancrofti to people, the worm blocks the lymphatic system. The blockage causes swelling in the legs or other parts of the body, making these body parts appear large and puffy, or elephant-like. Elephantiasis is not elephant man disease, which is an inherited condition with completely different causes and symptoms.

An Ancient, Widespread Disease

Elephantiasis was known to the early Greeks and Romans. It is a tropical or subtropical disease, occurring where many kinds of disease-carrying mosquitoes are found: South America, Cuba, Puerto Rico, West Indies, Africa, Spain, Turkey, Asia, Australia, and many South Pacific Islands. About 100 million people worldwide are affected.

The Mosquito Carrier

Insects that carry diseases are known as vectors*, and several species of mosquito are vectors of *Wuchereria bancrofti*, the nematode worm that causes elephantiasis. When a *Culex* (KYU-lex), *Anopheles* (a-NOF-e-LEEZ), *Aedes* (ay-EE-deez), or *Mansonia* (man-SO-ne-a) mosquito carrying the *Wuchereria bancrofti* organism bites a human, the mosquito may inject worm larvae* into the body. The tiny larvae then may make their way into the lymph glands and the lymphatic system.

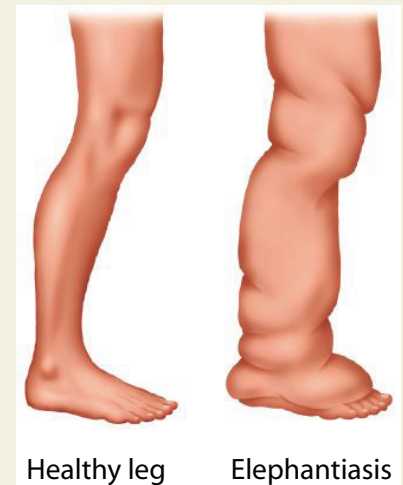
Lymphedema The lymphatic system is a complicated network of very fine tubes, about the diameter of a needle, which crisscross body tissues to collect a fluid called lymph. Lymph is a milk-like substance (containing white blood cells, proteins, and fats) that plays an important role in absorbing fats from the intestine, in fighting infections, and in the proper functioning of the immune system. Lymph is returned to the bloodstream via many vessels known as lymphatics. At various points, the lymphatics drain into masses of tissue known as lymph nodes or glands. If a blockage occurs, fluid may collect in the tissues, causing a type of swelling known as lymphedema (limf-e-DEE-ma). In the lymph system draining the legs, for example, few connections exist, and the legs often are a site of swelling when lymphedema occurs.

Lymphatic filariasis Worm larvae that make their way into lymph vessels can mature into adult worms. Male worms are long and slender, about 4 to 5 centimeters long, and 0.1 millimeter in diameter. Female worms are much larger, 6 to 10 centimeters long, and about three times wider than the males. The adults make their home mostly near the lymph glands in the lower part of the body. The adult female releases eggs enclosed within an egg membrane (microfilariae), and the microfilariae (mi-kro-fi-LAR-ee-i) develop into larvae to continue the life cycle.

In most parts of the world, microfilariae are at their peak in the blood during the night. The worms restrict the normal flow of lymph, resulting in swelling, thickening of the skin, and discoloration. This action can cause the appearance of an elephant's leg. However, the swelling of elephantiasis usually does not occur until a person has been bitten by the disease-carrying mosquitoes many times and has had years of exposure to infected mosquitoes.

What Happens to People with Elephantiasis?

Symptoms In addition to the characteristic swelling, people with this disorder sometimes have bouts of fever and headache. Sometimes their



▲ Parasitic worms transferred to people by infected mosquitoes can block the lymphatic system, causing the puffiness and swelling of lymphatic filariasis (elephantiasis). *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **vectors** (VEK-tors) are animals or insects that carry diseases and transfer them from one host to another.

* **larvae** (LAR-vee) are the immature forms of an insect or worm that hatches from an egg.

THE ELEPHANT MAN

Joseph “John” Cary Merrick (1862–1890) was known as the Elephant Man, but he did not have elephantiasis.

Born in 1862 in Leicester, England, Merrick became a human attraction in circus side shows. His appearance was normal at birth, but when he was about five years old, he developed extensive growths of skin that affected his face, head, torso, arms, and legs. He was reported to have had a 12-inch wrist and a fin-like hand.

For many years, researchers believed that Merrick had neurofibromatosis (neur-o-fib-ro-ma-TO-sis), a genetic condition that causes large growths on the skin and in tissues. Later research using x-ray studies, however, suggested that Merrick in fact had Proteus syndrome, a condition so rare that only 100 cases in history have been reported.

swollen limbs become infected. Elephantiasis commonly causes marked swelling of the scrotum in males.

Diagnosis Microfilariae sometimes can be seen in blood under a microscope. Often the doctor diagnoses the disorder based on the symptoms and a medical history, after ruling out other disorders with similar symptoms.

Treatment Medications are not very effective against adult worms. New microfilariae produced by the adult worms often continue to show up months after treatment. For this reason multiple treatments with diethylcarbamazine (DEC) are often necessary.

Prevention Because elephantiasis is found mainly in poorer countries, money for research into the cure and prevention of the disease has been limited. Effective treatment and preventive efforts would include:

- spraying to kill mosquitoes
- giving antibiotics to prevent infection
- giving medications (DEC) to kill microfilariae circulating in the blood
- applying pressure bandages to reduce swelling
- surgically removing infected tissue.

▶ See also **Filariasis** • **Parasitic Diseases: Overview** • **Worms: Overview**

Resources

Organization

World Health Organization. Avenue Appia 20, CH-1211 Geneva 27, Switzerland. Telephone: 41-22-791-2111. Web site: <http://www.who.int/mediacentre/factsheets/fs102/en>.

Embolism

An embolism (EM-bo-liz-um) is a blockage in the bloodstream, caused by a blood clot, air bubble, fatty tissue, or other substance that plugs a blood vessel.*

What Is an Embolism?

The body's circulatory system* is like a huge network of small roads and large interstate highways. It is important that blood continuously flow through the body to carry nutrients, oxygen, and other substances to cells and organs. But like a road, sometimes a part of the circulatory system can become blocked by an accident.

An embolism is a blockage that plugs up a blood vessel and slows or even stops blood flow to the area of the body supplied by the artery*. Many substances can cause blockages. Usually, the embolus (EM-bo-lus) is something small that has broken free from another part of the body and travels through the bloodstream until it gets jammed in a blood vessel that is too narrow for it to pass freely.

Emboli (EM-bo-ly; plural of embolus) may be life threatening. They may cause death if they block a major artery, such as the large pulmonary artery that runs through the lungs. They may also cause death of body tissue if they prevent blood flow to a given area.

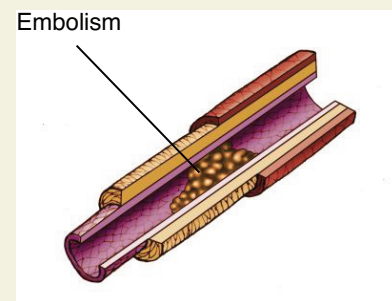
How Do Emboli Happen?

The most common type of embolism results from the clotting* of blood. When blood clots form inside blood vessels, which is a process called thrombosis*, they may break free and travel to the pulmonary artery. The pulmonary artery carries blood from the right side of the heart into the lungs. In the lungs, blood disposes of carbon dioxide and picks up more oxygen. When blood clots get stuck in the pulmonary artery, they can prevent blood from picking up oxygen. This condition is a medical emergency that causes symptoms similar to a heart attack.

Thrombophlebitis (throm-bo-fluh-BI-tis) can occur when a blood clot causes inflammation inside a vein (usually in the legs). If the clot forms in a vein found in the muscle, it causes what is known as a deep vein thrombosis (DVT). A DVT may break free, becoming an embolus that travels inside the blood vessel to the lungs and eventually causes blockage of the pulmonary artery inside the heart. When this occurs, it is called a pulmonary embolism.

The following are substances, although less common, that may cause embolism:

- Bubbles. Sometimes bubbles occur in the blood vessels of underwater divers as they ascend; as compressed nitrogen bubbles out of solution, divers develop joint pain, called the bends, from decompression sickness. Bubbles can also occur during injections of fluids



▲ An embolism in an artery. An embolism blocking blood flow through an artery may be a serious problem. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

- * **blood clot** is a thickening of the blood into a jelly-like substance that helps stop bleeding. Clotting of the blood within a blood vessel can lead to blockage of blood flow.
- * **circulatory system** (SIR-kyoo-luh-tor-e) is the system composed of the heart and blood vessels that moves blood throughout the body.
- * **artery** An artery is a vessel that carries blood from the heart to tissues in the body.
- * **clotting** is a process in which blood changes into a jellylike mass that stops the flow of blood.
- * **thrombosis** is the formation or development of a blood clot or thrombus.

* **tumors** (TOO-morz) usually refer to abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

into veins or arteries, which is one reason why doctors and nurses squeeze the air out of needles before using them on patients.

- **Tumors***. These growths may block blood flow or a piece of a tumor may break off into the bloodstream and get caught in another part of the body.
- **Fat**. An embolism may occur when fat breaks off in place and travels through the blood vessel. For example, when a serious injury occurs to an organ such as the liver, fat may break off and travel through the bloodstream.
- **Bone fragments**. A bone chip from a broken arm or leg may become lodged in a blood vessel.

An embolism may occur in any artery. However, it often occurs in the pulmonary arteries because all the blood returning to the heart from the body is pumped through the pulmonary arterial system first.

What Are the Signs and Symptoms of Embolism?

Symptoms of a pulmonary embolism may include chest pain that can feel worse when breathing deeply, shortness of breath, coughing or coughing up blood, dizziness, sweating, rapid breathing, and rapid heartbeat. These symptoms are similar to those of a heart attack. However, sometimes embolism does not cause any symptoms at all.

How Do Doctors Diagnose and Treat Embolism?

Doctors may use blood tests, an x-ray, a CT scans*, or a lung scan to check for the embolism. Sometimes dye is injected to make it easier to see the embolism on the x-ray or scan. Doctors may suspect an embolism (especially a pulmonary embolism) if a patient has had recent surgery, been immobile for an extended period, or had a fracture of a large bone such the thigh (femur) or hip (pelvis) bone. Doctors may extend the use of drug therapy or consider surgery to insert a filter to catch clots, for individuals having multiple chronic pulmonary emboli.

Pulmonary emboli develop in as many as 500,000 Americans each year, and up to 10 percent die within the first hour. With immediate treatment, many are saved and lead normal lives. Doctors may use drugs that dissolve the embolism and prevent others from forming. Exercise, weight loss if needed, and a proper diet can help prevent emboli from forming.

▶ See also **Anemia, Bleeding, and Clotting • Bends • Phlebitis and Venous Thrombosis**

Resources

Books and Articles

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Stein, Paul. *Pulmonary Embolism*, 2nd ed. Malden, MA: Blackwell, 2007.

Organization

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: http://www.nhlbi.nih.gov/health/dci/Diseases/pe/pe_what.html.

Encephalitis

Encephalitis is an inflammation of the brain and can range from mild to extremely serious. Often the inflammation also affects the meninges (the lining around the brain and spinal cord). Such cases are called meningoencephalitis. The usual cause of encephalitis is a viral infection.

What Is Encephalitis?

Encephalitis is an inflammation* of the brain that can result from many causes. One of the most common causes is infection with one of several different types of viruses. Depending on the type of virus or other cause, the condition may be mild to severe. Most cases of encephalitis are so

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



Causes of Encephalitis	How Spread	
Enteroviruses	Contact with body fluids	
Herpes simplex virus	Person to person contact	
HIV (human immunodeficiency virus)	When an infected person's blood or body fluids are introduced into the bloodstream of a healthy person	
Arboviruses	Bites from mosquitoes that pick up the virus from infected birds, chipmunks, squirrels, or other animals	
Animal-borne illnesses	Bites from infected animals such as cats, dogs, and bats	

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

mild that people do not realize they have it. A person, often a child, may have fever, headache, nausea, or sleepiness—symptoms much like the flu—that go away on their own. In more severe cases, however, the viral infection destroys so many neurons (nerve cells) in the brain that it can lead to seizures, breathing problems, personality changes, and coma*. When white blood cells arrive to fight the virus, they may cause brain tissues to swell, which also can destroy neurons or lead to bleeding within the brain. Permanent brain damage, or even death, can result.

Medical professionals report several thousand cases of encephalitis every year in the United States, but health officials believe that many

THE UNITED STATES AND THE WORLD

Some kinds of encephalitis are caused by arboviruses (ar-buh-VY-ruh-sez), which are viruses that are spread from animals to humans when blood-sucking insects, such as ticks and mosquitoes, bite infected birds, rodents, and other small animals, and then bite humans. In the United States these include the following:

- St. Louis encephalitis, a virus found in birds. The most common form of encephalitis, with 200 to 300 cases reported in the United States in a typical year, mostly in Midwestern and eastern states. Occasionally, outbreaks occur. Of cases severe enough to diagnose, about 5 to 15 percent are fatal, with the elderly at greatest risk.
- LaCrosse encephalitis, found in chipmunks and squirrels. An average of 100 cases are reported annually, mostly in Midwestern states and in children younger than age 16. It is rarely fatal.
- Eastern equine encephalitis, found in horses and birds, especially birds that live near the water. The most severe type, it can kill as many as half of those who experience symptoms, but usually fewer than a dozen cases occur each year in the United States, mainly in the eastern states.
- Western equine encephalitis, also found in horses and birds. It rarely affects humans and when it does, it is hardly ever fatal, but it sometimes causes permanent brain damage in babies.

In Asia, by contrast, Japanese encephalitis virus is common, with 30,000 to 50,000 cases reported each year in the region, usually in rural and agricultural areas. According to the World Health Organization, the fatality rate among those patients who experience symptoms ranges up to 60 percent. In addition, 30 percent of those who survive may have lasting effects. A vaccine to prevent this disease is available in Japan, China, India, Korea, and Thailand, but its high cost sometimes makes it unavailable to people of limited financial means. The Japanese encephalitis virus is related to the St. Louis form, and it infects mostly pigs, ducks, and wading birds.

more cases—mainly mild ones—probably occur. Serious encephalitis is particularly common in people with weakened immune systems*, such as those with AIDS*.

What Causes Encephalitis?

Many viruses and a few other microbes can cause encephalitis. One of the most common—and most dangerous—causes is infection with the herpes simplex virus* (HSV). It rarely infects the brain, but when it does, it can be life-threatening.

Encephalitis may also develop in a person who has meningitis (meh-nin-JY-tis), an inflammation of the membranes surrounding the brain and spinal cord, called the meninges (meh-NIN-jeez). It also can be a complication of other infectious diseases, such as rabies, cytomegalovirus* infection, listeriosis*, syphilis*, or Lyme disease. In people with a weakened immune system, for instance, those with HIV/AIDS, infection by parasites can lead to encephalitis, especially the parasite that causes toxoplasmosis*.

In addition, several arboviruses (meaning viruses spread by insects) cause encephalitis in horses or other animals and may spread to humans by mosquitoes. In the United States, this route of contagion was once rare, with a few hundred cases in an average year. In the late 1990s, however, the spread of West Nile virus (WNV) led to an increase in mosquito-borne encephalitis in humans. In 1999, for instance, the Centers for Disease Control counted 62 cases of WNV infections, all of which were located in and around New York. By 2006, that number had grown to 4,269 cases, which were spread to nearly every state in the nation. Of those 4,269, nearly two-thirds only experienced a fever, but more than one-third developed encephalitis or meningitis, and 177 individuals died.

In some cases, encephalitis develops after a person has a viral illness like measles, chickenpox, mononucleosis, mumps, or rubella (German measles). This condition is called post-infectious or parainfectious encephalitis.

Often, however, medical professionals cannot pinpoint exactly why a particular person has encephalitis.

How Does Encephalitis Spread?

Because several different germs can cause encephalitis, spread of the infection may take different paths. For example, mosquitoes transmit viruses that cause West Nile encephalitis, St. Louis encephalitis, and western equine encephalitis. Other viruses, such as herpes simplex virus or the varicella-zoster (var-uh-SEH-luh ZOS-ter) virus that causes chicken pox, spread between individuals through fluids from the mouth, throat, or nose. For example, tiny drops of these fluids, such as saliva and nasal mucus*, may disperse into the air when an infected person coughs or sneezes. Ticks spread Lyme disease, and humans can contract rabies from the bite of infected animals, such as raccoons and bats.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **herpes simplex (HER-peeZ-SIM-plex) virus** is a virus that can cause infections of the skin, mouth, genitals, and other parts of the body.

* **cytomegalovirus** (sy-tuh-MEH-guh-lo-vy-rus), or CMV, infection is very common and usually causes no symptoms. It poses little risk for healthy people, but it can lead to serious illness in people with weak immune systems.

* **listeriosis** (lis-teere-O-sis) is a bacterial infection that can cause a form of meningitis in infants and other symptoms in children and adults.

* **syphilis** (SIH-fih-lis) is a sexually transmitted disease that, if untreated, can lead to serious lifelong problems throughout the body, including blindness and paralysis.

* **toxoplasmosis** (tox-o-plaz-MO-sis) is a parasitic infection that usually causes no symptoms in healthy people, but it can cause serious problems in unborn babies and people with weak immune systems.

* **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

- * **double vision** is a vision problem in which a person sees two images of a single object.
- * **hallucinations** (ha-LOO-sin-AY-shuns) occur when a person sees or hears things that are not really there. Hallucinations can result from nervous system abnormalities, mental disorders, or the use of certain drugs.
- * **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.
- * **rabies** (RAY-beez) is a viral infection of the central nervous system that usually is transmitted to humans by the bite of an infected animal.
- * **toxoplasmosis** (tox-o-plaz-MO-sis) is a parasitic infection that usually causes no symptoms in healthy people, but it can cause serious problems in unborn babies and people with weak immune systems.
- * **Lyme disease** (LIME) is a bacterial infection that is spread to humans by the bite of an infected tick. It begins with a distinctive rash and/or flulike symptoms and, in some cases, can progress to a more serious disease with complications affecting other body organs.

What Happens When People Get Encephalitis?

Symptoms Symptoms range from mild to severe. Symptoms may appear suddenly and include sudden fever, headaches, sensitivity to light, loss of appetite, and muscle pain. If the meninges (me-NIN-jez) are involved, the neck and back often are stiff. In more serious cases, an individual may experience high fever, nausea (NAW-zee-uh), vomiting, confusion, double vision*, personality changes, problems with hearing and speech, hallucinations*, sleepiness, clumsiness, muscle weakness, loss of sensation, and irritability. In the most severe cases, seizures* and loss of consciousness may occur. Encephalitis can be particularly dangerous in elderly people and in babies, who are more likely to suffer permanent brain damage than adults. Any serious to severe symptoms require immediate medical attention.

Diagnosis To diagnose encephalitis, a doctor may use a number of techniques, including the followings:

- Various blood tests to look for encephalitis-related microorganisms in the blood or to tell whether the person's body is producing antibodies* in response to a specific virus or bacterium. For instance,

CAUSES OF ENCEPHALITIS

Encephalitis may result from a variety of viruses, bacteria, and other organisms. These agents include the following:

- Measles, chicken pox, rubella (German measles), mumps, polio, and other viral illness, which generally lead to a mild form of encephalitis known as postinfectious or para-infectious encephalitis.
- Enteroviruses (en-tuh-ro-VY-ruh-sez), viruses that typically infect the intestines and then may spread to other parts of the body, including the brain.
- Herpes simplex virus, a virus that can infect the mouth, skin, and other parts of the body.
- Animal-borne illnesses, such as rabies*, toxoplasmosis*, cat scratch disease, and Lyme disease*, that are transmitted to humans by contact with an infected animal's saliva (through a bite or lick, for example), contact with an infected animal's feces (FEE-seez, or bowel movements), or an insect that bites an infected animal and then bites a person.
- HIV (human immunodeficiency virus), the virus that causes AIDS (acquired immunodeficiency syndrome). This virus moves from one individual to another when an infected person's blood or body fluids are introduced into the bloodstream of a healthy person.

a blood test for Lyme disease checks for antibodies to that particular encephalitis-causing microbe, which is a bacterium.

- A spinal tap, also called a lumbar puncture, a procedure in which a sample of cerebrospinal fluid is taken from around the spinal cord to examine under a microscope for signs of infection.
- One or more imaging tests, such as computerized tomography* scans or magnetic resonance imaging*, to look for signs of bleeding or swelling in the brain.
- Sampling with cotton swabs of fluids from the nose, throat, and rectum* to test for certain viruses.
- A brain biopsy*, in which a small piece of brain is removed with a needle so it can be examined under a microscope.

These tests often cannot positively diagnose encephalitis, but they can help the doctor rule out other possible causes for the symptoms. In many cases, however, the doctor may never be able to identify the microbe causing the encephalitis.

Treatment Encephalitis can range from mild forms that can be treated at home to more severe forms that require hospitalization. Frequently, a doctor recommends over-the-counter medicines, such as acetaminophen*, to treat minor symptoms such as fever and headache. A doctor may also prescribe antiviral medications that sometimes can help prevent the spread of the virus and are very important in the treatment of encephalitis caused by herpes simplex virus. Other medications may include anticonvulsants* to help control seizures, and corticosteroids (anti-inflammatory medications) to lessen swelling in the brain, which can lead to a dangerous increase in the pressure within the skull.

If a patient is admitted to a hospital, medical professionals take special care to monitor body fluids. This information can help them prevent or control swelling of the brain. They may also take various supportive measures, such as providing machines to help with breathing, if needed, and caring for comatose patients to prevent bedsores* or other infections.

How Long Does the Illness Last?

The acute phase of the disease, the time when symptoms are most severe, usually lasts up to a week. Lingering symptoms can continue for weeks to months.

Most people recover from encephalitis completely, but some experience swelling of the brain that leads to permanent brain damage. These patients may face long-term complications, such as learning disabilities, seizures, speech problems, memory loss, lack of muscle control, paralysis*, or coma. In rare cases in which brain damage is severe, death can result. Infants younger than one year of age and adults older than 55 have the greatest risk of permanent brain damage and death from encephalitis.

Regional Forms of Encephalitis

Other regional forms of encephalitis include the following:

- Venezuelan equine encephalitis, a usually mild form that causes occasional epidemics in Central and South America.
- Russian spring-summer encephalitis, which is spread by ticks. This disease has death rates as high as 25 percent in some outbreaks, but a vaccine is available in Russia and Europe.
- West Nile encephalitis. Related to Japanese and St. Louis encephalitis, this disease was once only seen in Africa, Asia, and Europe. In 1999, however, medical professionals detected it in New York City, and it later spread through much of North America. It is sometimes fatal.
- Murray Valley encephalitis. Found in parts of Australia and New Guinea, this disease is also related to St. Louis and Japanese encephalitis. It is rarely fatal.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

- * **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.
- * **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- * **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.
- * **anticonvulsants** (an-tie-kon-VUL-sents) are medications that affect the electrical activity in the brain and are given to prevent or stop seizures.
- * **bedsores** also called pressure sores, are skin sores caused by prolonged pressure on the skin and typically are seen in people who are confined by illness or paralysis to beds or wheelchairs.
- * **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

How Is Encephalitis Prevented?

Childhood vaccines are available to prevent measles, mumps, chicken pox, and some of the other viral infections that cause encephalitis. To prevent encephalitis caused by West Nile virus or other viruses transmitted by mosquitoes, health officials urge people to avoid being outside at dawn and dusk when mosquitoes are most active. They also recommend that people wear light-colored, long-sleeved shirts and long pants; use insect repellent when they are outdoors in mosquito habitat; and empty any sources of standing water, such as birdbaths and flower pots, where the mosquitoes may breed. Individuals can help prevent rabies by vaccinating pets and by avoiding contact with wild mammals; and they can help prevent Lyme disease encephalitis by avoiding ticks. A partially effective Lyme vaccine is also available. In addition, individuals can prevent HIV infection and, therefore, eliminate many cases of encephalitis, by avoiding sexual contact and by never sharing needles.

▶ See also **AIDS and HIV Infection • Cytomegalovirus (CMV) Infection • Herpes Simplex Virus Infections • Immune Deficiencies • Lyme Disease • Measles (Rubeola) • Meningitis • Mononucleosis, Infectious • Mumps • Poliomyelitis • Rabies • Rubella (German Measles) • Syphilis • Toxoplasmosis • Varicella (Chicken Pox) and Herpes Zoster (Shingles) • Viral Infections • West Nile Fever • Zoonoses**

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Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/diseases/submenus/sub_encephalitis.htm.

World Health Organization. Avenue Appia 20, 1211 Geneva 27, Switzerland. Web site: http://www.who.int/topics/encephalitis_viral/en.

Encopresis See *Soiling (Encopresis)*.

Endocarditis, Infectious

Infectious endocarditis (in-FEK-shus en-do-kar-DYE-tis) is an inflammation of the valves and internal lining of the chambers of the heart, known as the endocardium (en-doh-KAR-dee-um), that is initiated by an infection.



A technician takes an echocardiogram (EKG) of a patient's heart. *Susan Leavines/Photo Researchers, Inc.*

What Is Endocarditis?

The heart has four chambers and four valves that regulate the flow of blood through the heart. Each valve is made up of two or three smaller parts, known as leaflets, that swing open and shut. As the heart beats, it pumps blood through the chambers and out of the heart to the lungs and the rest of the body. The valves open to allow blood to pass through and out of the heart and then close to keep the blood from flowing backward.

In a normal heart, the swift, smooth movement of blood sweeps foreign material such as bacteria away from the heart. However, some people have defects in their heart valves, the endocardium, or other parts of the heart that disrupt the flow of blood. This disruption can allow bacteria or other germs that reach the heart through the bloodstream to lodge there and multiply, which results in an infection that inflames the heart valves, muscles, and endocardium, producing endocarditis. The inflammation (in-flah-MAY-shun), which is the body's response to injury or infection, can be significant, in which case it may inflict damage on or even destroy the heart valves.

What Causes Infectious Endocarditis?

Viruses, fungi, or other microscopic organisms can all cause infectious endocarditis, but the disease usually arises from a bacterial infection. A common bacterium abundant in the oral cavity, *Streptococcus viridans* (strep-tuh-KAH-kus VEER-ih-danz), is responsible for up to half of all cases of bacterial endocarditis. Other bacterial culprits include bacteria from the staphylococcus, streptococcus, and enterococcus families and, less commonly, other types.

- * **intestines** are the smooth muscle tubes that food passes through during digestion after it exits the stomach.
- * **urinary tract** (YOOR-ih-nair-e TRAKT) is the system of organs and channels that makes urine and removes it from the body. It consists of the urethra, bladder, ureters, and kidneys.
- * **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.
- * **clot** is the process by which the body forms a thickened mass of blood cells and protein to stop bleeding.
- * **catheter** (KAH-thuh-ter) is a small plastic tube placed through a body opening into an organ (such as the bladder) or through the skin directly into a blood vessel. It is used to give fluids to or drain fluids from a person.
- * **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube that has penetrated the skin's surface and has been inserted directly into a vein.
- * **rheumatic fever** (roo-MAH-tik) is a disease associated with fever, joint pain, and inflammation of many body tissues, including parts of the heart. It occurs following infection with certain types of strep bacteria.
- * **heart murmur** is an abnormal heart sound that can be heard with a stethoscope and is usually related to abnormal flow of blood through the heart. Some murmurs indicate a problem with a heart valve or other part of the heart's structures, but many heart murmurs are benign (do not indicate any problem).

In most cases of infectious endocarditis, bacteria that normally live harmlessly on the body, such as in the mouth, on the skin, in the intestines*, or in the urinary tract* (YOOR-ih-nair-e TRAKT), enter the blood (a condition known as bacteremia, bak-tuh-REE-me-uh). The bacteria can enter tissues through a cut or a tear that has resulted from a dental or medical procedure, or they may enter the blood because of a site of an infection somewhere else in the body. Additionally, intravenous drug users are at high risk for infectious endocarditis, as staphylococcus bacteria in skin have many opportunities to enter the bloodstream through broken skin. Once in the bloodstream, the bacteria travel to the heart and may stick to the endocardium or heart valves. As they grow and multiply, the bacteria may become entangled in vegetations, which are composed of clumps of platelets*; bacteria; red and white blood cells; and fibrin, a protein that helps blood clot*.

Who Gets Infectious Endocarditis?

Infectious endocarditis is not contagious, so there is no reason to avoid contact with individuals who have it. The disease is not common among people with normal hearts, but people with a heart abnormality are more susceptible to it. Because bacteria can easily attach to a malformed or damaged part of the heart, people with an artificial or damaged heart valve or a heart defect are more likely to get endocarditis. Anyone who has had infectious endocarditis or who has an indwelling catheter* has a greater chance of becoming infected. Although many people with heart defects are born with them, other people acquire the defects during their lifetime, for example, as a consequence of intravenous* drug use or rheumatic fever*, which puts them at increased risk for endocarditis as well. In the United States between 1 and 4 cases of infectious endocarditis occur annually per 100,000 people.

What Are the Signs and Symptoms of Infectious Endocarditis?

Flulike symptoms, such as fever and chills and weakness, are the most common symptoms of infectious endocarditis. Some people experience weight loss, weakness, headache, tiredness, shortness of breath, joint and muscle pain, and excessive sweating at night (night sweats). A heart murmur* usually develops in the course of the illness, and individuals may look pale, have red spots on their skin, and see blood in their urine. An enlarged spleen*; small hemorrhages* in the nail beds and on the whites of the eyes; and swelling of the feet, legs, and abdomen also can occur with infectious endocarditis.

How Do Doctors Diagnose and Treat Infectious Endocarditis?

Doctors may suspect infectious endocarditis if someone with a known heart abnormality develops an unexplained long-lasting fever, an abnormal heart sound (a murmur), or symptoms of heart failure such as shortness of breath or swelling of the legs.

Certain tests can help doctors to diagnose infectious endocarditis, including blood cultures that can establish the presence of bacteria in

the bloodstream, a complete blood count, and laboratory tests that look for evidence of inflammation. For example, checking a patient's erythrocyte sedimentation rate (ESR) reveals how quickly the person's red blood cells, or erythrocytes (eh-RITH-ruh-sites), settle to the bottom of a test tube, which is a measure of inflammation in the body. Another blood test identifies levels of C-reactive protein, which are increased in the blood when there is significant inflammation in the body. Doctors may also use an echocardiogram to look for signs of infection on the heart valves or in the heart. An echocardiogram (eh-ko-KAR-dee-uh-gram) is a diagnostic test that uses inaudible sound waves to produce images of the heart's chambers and valves and enables visualization of blood flow through the heart.

Doctors treat infectious endocarditis with antibiotics. The medication is given intravenously in the hospital at first, but sometimes patients complete the treatment at home. Several weeks of antibiotic treatment may be necessary to eliminate the infection. In more serious cases, patients may need oxygen and medications to support heart function while hospitalized, and some people require surgery to repair damage sustained by the heart due to the inflammation.

Do People Recover from Infectious Endocarditis?

Infectious endocarditis can start suddenly or develop gradually over weeks or months. Left untreated, infectious endocarditis is often fatal. However, when treated successfully with antibiotics and when there has been little damage to the heart valves, patients usually begin to feel better and to recover within a few days. If the infection does not improve with antibiotics, or if there is evidence that a heart valve has been damaged significantly, surgery to repair or replace the valve may be required to clear the infection from the body and restore heart function.

Infectious endocarditis can cause other complications. In some people with the disease, small pieces of vegetations in the heart may break off and travel through the bloodstream to other organs. If one of these pieces travels to the brain and blocks a blood vessel there, for example, the affected person may develop a stroke*. If the pieces lodge in other organs, they may cause serious infections there. Infectious endocarditis that is allowed to progress can also engender an irregular heartbeat, congestive heart failure, jaundice*, kidney failure, and heart failure.

How Is Infectious Endocarditis Prevented?

Doctors give antibiotics to people as a protective measure, prior to their undergoing dental or medical procedures that could introduce bacteria into the bloodstream. For example, simple dental work, removal of the tonsils, or medical procedures in which parts of the upper respiratory tract* (such as the mouth and throat), urinary tract (specifically the urethra*), or lower gastrointestinal* tract are involved can all provide an avenue for bacteria to enter the bloodstream and travel to the heart.

* **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.

* **hemorrhages** (HEH-muh-rih-jes) are areas of uncontrolled or abnormal bleeding.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to and within the brain. A stroke may occur when a blood vessel supplying a region of the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific functions they support, stop working.

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

* **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air (and primarily oxygen) makes its way down into the lungs, and through which carbon dioxide leaves the lungs and the body.

* **urethra** (yoo-REE-thra) is the tube through which urine passes from the bladder to the outside of the body.

* **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.
- * **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.
- * **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.
- * **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

▶ See also **Heart Disease • Staphylococcal Infections • Streptococcal Infections**

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Organizations

American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://american-heart.org>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: http://www.nhlbi.nih.gov/health/dci/Diseases/hvd/hvd_what.html.

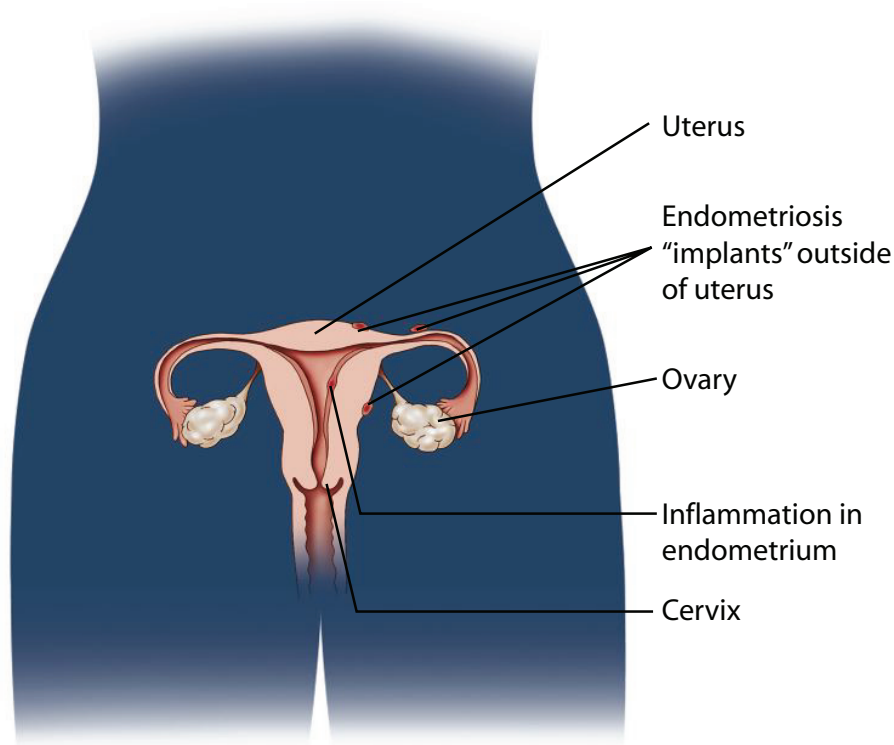
National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Toll free: 888-346-3656. Web site: <http://www.nlm.nih.gov>.

Endometriosis

Endometriosis (en-do-me-tree-O-sis) is a chronic (ongoing) condition in which pieces of the lining of the uterus (YOO-ter-us) become embedded in tissues outside the uterus.*

What Is Endometriosis?

The endometrium (en-do-ME-tree-um) is the lining of the uterus, which is the muscular organ where a fetus* develops during pregnancy. Endometriosis is a condition in which endometrial tissue implants and grows outside the uterus. During the monthly menstrual cycle*, chemicals called hormones* cause the endometrium to grow thick in preparation for receiving a fertilized egg at the beginning of pregnancy. If the egg is not fertilized, there is no pregnancy and the endometrium is shed as blood and tissue in the monthly menstrual period.



The endometrium is the lining of the uterus. In women with endometriosis, fragments of endometrial tissue become attached to other organs outside the uterus. The symptoms of endometriosis may include heavy bleeding, abdominal pain, lower back pain, and tenderness and pain in the pelvic area. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

In a woman with endometriosis, fragments of endometrial tissue develop outside the uterus. The cause of endometriosis is not fully understood. There are several theories. Some scientists think that some of the endometrial tissue that should leave the body during menstruation does not. Instead, these stray fragments find their way into other parts of the pelvic cavity. Here the stray pieces of tissue attach to other organs such as the ovaries* or intestines*, stick organs together, or form scar tissue. Scientists theorize that there may be a genetic predisposition* (inherited tendency) toward developing endometriosis. Research ongoing as of 2009 sought to determine if stray tissues develop in some women because their immune systems*, which normally destroy any unexpected material such as stray endometrium, do not function efficiently. In addition, some scientists were exploring whether exposure to human-made chemicals found in the environment may trigger endometriosis in some women. Estimates as of 2007 suggested that between 2 and 10 percent of women or 5.5 million women in North America have endometriosis.

What Are the Symptoms and Effects of Endometriosis?

Endometrial implants or clumps of tissue outside the uterus respond to hormones in the same way as endometrial tissue inside the uterus: They grow, break down, and bleed. When endometrial tissue breaks down outside the uterus, it releases chemicals that irritate internal tissues and cause

* **ovaries** (O-vuh-reez) are the sexual glands from which ova, or eggs, are released in women.

* **intestines** are the muscular tubes that food passes through during digestion after it exits the stomach.

* **genetic predisposition** is a tendency to get a certain disease that is inherited from a person's parents.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

Hormones and Endometriosis

Changing levels of hormones regulate the menstrual cycle. Estrogens, progesterone, and prostaglandins control the buildup and the shedding of the endometrial lining of the uterus. Altering these hormone levels, either during pregnancy or by taking oral contraceptives (birth control pills), may help to relieve symptoms of endometriosis.

Many women with endometriosis are able to have children, and many are free of symptoms when they are pregnant. During pregnancy, the hormone balance that usually causes the monthly menstrual cycle changes. Instead of causing the endometrium to grow and then break down, different hormones work to make the lining of the uterus hospitable to the developing fetus. Therefore, the implants may be free of the hormonal effects that cause the symptoms of endometriosis.

Oral contraceptives are mixtures of reproductive hormones that, when taken every day, act to change the hormone balance in the body to prevent pregnancy. Side effects of oral contraceptives include less cramping and lighter menstrual periods. By altering the body's hormonal balance, they also may be effective in reducing the symptoms of endometriosis.

* **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.

* **fallopian tubes** (fa-LO-pee-an tubes) are the two slender tubes that connect the ovaries and the uterus in females. They carry the ova, or eggs, from the ovaries to the uterus.

pain. Although some women with endometriosis do not have any symptoms, for others the symptoms of endometriosis include heavy bleeding during menstruation, abdominal and lower back pain, tenderness and pain in the pelvic area, diarrhea, constipation, and bleeding from the rectum*.

Endometriosis can develop in any woman who is menstruating, but it most often affects women who are between the ages of 25 and 40. Endometriosis is one of the three major causes of female infertility (the inability to conceive a child) and accounts for 10 to 15 percent of all instances of female infertility. Endometriosis can keep women from becoming pregnant if stray endometrial tissue attaches to the ovaries and forms scar tissue that prevents the egg from leaving the ovary. Alternately, stray endometrial tissue can block the fallopian tubes* that carry the egg from the ovaries to the uterus. Between 30 and 40 percent of women who have endometriosis have difficulty becoming pregnant.

How Is Endometriosis Diagnosed?

A doctor may suspect that a woman has endometriosis based on her history of symptoms. Initially the doctor may perform an ultrasound* or a magnetic resonance imaging* (MRI) test. These noninvasive tests use energy waves to produce a picture of the internal organs. However, to definitively diagnose endometriosis, the doctor uses a procedure called laparoscopy (lap-a-ROS-ko-pee), in which a laparoscope (viewing instrument) is inserted into the abdomen or pelvic cavity through a small incision. This procedure allows the doctor to examine the abdominal or pelvic cavity for pieces of endometrium that may have become implanted on surfaces of the intestines, ovaries, and other places where they are likely to be found.

How Is Endometriosis Treated?

Endometriosis is treatable, but there is no cure for the condition. In mild cases, treatment may not be necessary. When treatment does become necessary, it can be complicated. The age of the woman, her general health, the severity of her condition, and whether she wants to have children must all be considered.

Hormone medications can suppress the development of endometrial tissue or cause the fragments to wither away, which may take as long as six months. Other medications may be prescribed to relieve pain. Sometimes surgery is needed to remove some of the abnormal tissue. Older women not planning to have more children may consider having a hysterectomy (his-ter-EK-to-mee) to help solve the problem. This surgery removes the uterus and sometimes other reproductive organs. Women who wish to have children and are having difficulty becoming pregnant should consult a doctor who is a fertility expert.

▶ See also **Infertility • Menstruation and Menstrual Disorders • Pregnancy**

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Endometriosis Association. 8585 North Seventy-sixth Place, Milwaukee, WI, 53223-2600. Telephone: 414-355-2200. Web site: <http://www.endometriosisassn.org>.

National Institute of Child Health and Human Development. P.O. Box 3006, Rockville, MD, 20847. Toll free: 800-370-2943. Web site: <http://www.nichd.nih.gov/publications/pubs/endometriosis>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/endometriosis.html>.

Enteroviruses See *Coxsackievirus and Other Enteroviruses*.

Enuresis See *Bedwetting (Enuresis)*.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

Environmental Diseases

Environmental diseases are illnesses and conditions that result from human-made environmental problems.

Silent Spring

Rachel Carson's 1962 book *Silent Spring* described an environment ravaged by pesticides:

Over increasingly large areas of the United States, spring now comes unheralded by the return of birds, and early mornings are strangely silent where once they were filled with the beauty of bird song.

Carson questioned the use of pesticides, particularly DDT (dichloro-diphenyl-trichloroethane), and described how people were slowly destroying the world around them. Carson and her ideas received attacks from many sides, and one chemical company tried unsuccessfully to stop the book from being published.

Silent Spring marked the beginning of the environmental movement. Slowly the public began to listen to Carson, and ultimately, the government listened, too. In 1972 the United States banned the use of DDT because it had been linked to cancer in laboratory studies with mice.

What Are Environmental Diseases?

Illnesses and conditions caused by factors in the environment are collectively called environmental diseases. Pesticides, chemicals, radiation, air pollution, and water pollution are some of the human-made factors that contribute to human illnesses. Potential illness-causing agents are everywhere: at home, at work, and at play. The likelihood of individuals developing

WHAT HAPPENED AT LOVE CANAL?

From 1942 to 1953, the Hooker Chemicals and Plastics Corporation used the Love Canal in Niagara Falls, New York, as a dumpsite for its chemical wastes. When the site was full, the corporation covered the site with soil and later sold it to the Niagara Falls School Board with a warning about the chemical wastes buried beneath the land.

The land that once had been a hazardous waste site became a neighborhood called Love Canal, complete with a school and hundreds of homes. Homeowners, however, did not get the warning about the hazardous wastes buried under their houses.

From the 1950s to the 1970s, residents of Love Canal smelled unusual odors and discovered strange substances in their yards. Some people developed unexplained health problems. At various times, the city investigated complaints, but the government took no action to remedy the problems until 1978.

In April of that year, the New York State Department of Health Commissioner declared a public health emergency at Love Canal, and by August ordered the school closed and the evacuation of many residents from the neighborhood. Ultimately, President Jimmy Carter declared the Love Canal neighborhood a disaster area, which allowed federal funds to be used to relocate the 239 families living closest to the dump site.

Love Canal became a symbol for citizens, scientists, activists, and politicians who became more aware of their environment. It resulted in the passage of federal laws designed to force the clean up of landfill sites.

a specific disease depends on the hazards present in their particular environment and on their individual genetic makeup, which makes them susceptible to a specific hazard. For example, x-ray technicians are at risk for radiation-induced illnesses, whereas coal miners are prone to lung diseases caused by inhalation of dust. Proper use of safeguards can help to prevent these and other environmental diseases.

What Are Some Common Environmental Diseases?

Lung diseases Any substance other than air that is breathed into the lungs has the potential to cause damage to these organs. For example, air pollution, including smoke from other people's cigarettes (secondhand smoke*) and workplace chemicals can lead to lung diseases. Examples of lung diseases include the following:

- Asthma (AZ-ma), a condition in which breathing is difficult, affects millions of Americans. Environmental triggers for asthma include naturally occurring substances such as animal dander, plant pollen, dust, and mold, and human-made substances such as chemicals. Not everyone is sensitive to these triggers, but many people are sensitive to some of them.
- Black lung disease is an illness among coal miners, whose lungs become coated with coal dust, causing a chronic condition in which breathing becomes difficult and painful.
- Bronchitis (brong-KY-tis), an inflammation of the airways of the lungs, can result from breathing in certain chemicals or smoke. Welders and firefighters among others are at risk for this condition. Smokers are also at increased risk for developing bronchitis and lung cancer.
- Silicosis (sil-i-KO-sis) is a lung disease caused by exposure to the silica dust in clay. Pottery workers are at risk of developing this disease.

Asbestos Breathing asbestos (a natural mineral fiber) can lead to asbestosis (as-bes-TO-sis), a severe lung disorder, and lung cancer. Schools, homes, and businesses that have asbestos in them as a fire retardant put people at risk when the asbestos dust begins to leak into the air during repairs and renovations. These buildings used asbestos in the walls and ceilings as insulation before laws were passed to ban their use.

Cancers Besides asbestos, scientists have linked chromium and coal tar to lung cancer. Construction workers, welders, and steelworkers may be repeatedly exposed to these compounds. People working in plastics manufacturing are at risk for liver or bladder cancer. People who work with radioactive substances are at increased risk for cancer caused by radiation. Fortunately, legal restrictions and careful oversight of hazardous materials can reduce risks.



▲ Open sewers can pollute the water creating conditions that can lead to environmental diseases. *Image copyright Vankina, 2008. Used under license from Shutterstock.com.*

* **secondhand smoke**, also called environmental tobacco smoke or passive smoke, is smoke that is inhaled passively or involuntarily by someone who is not smoking. It is a mixture of gases and particles from a burning cigarette, cigar, or pipe and the smoke exhaled by smokers.

Gulf War Syndrome

Many U.S. veterans complained about disabling symptoms that they attributed to their participation in the 1991 Persian Gulf War. Gulf War syndrome encompasses symptoms such as chronic fatigue syndrome, aching muscles and joints, skin rashes, memory loss, miscarriages, and giving birth to babies who have birth defects.

Gulf War syndrome is a mysterious condition. While veterans experienced very real medical problems, physicians and scientists could not agree on the source of these problems. Some believed that the syndrome actually consisted of multiple illnesses for which symptoms overlap. Veterans could be reacting to chemical weapons, biological weapons, pesticides, vaccines, oil fires, or infectious diseases to which they were exposed during the Gulf War. A presidential commission set up to study the controversy surrounding the Gulf War syndrome proposed that psychological stress was the major cause. A 2004 report from the Department of Veterans Affairs suggested that chemical exposure, and not stress, was a more likely cause. A 2008 report from the Department of Veterans Affairs concluded that nearly one-third of Gulf War veterans, about 200,000 people, suffered a Gulf War syndrome caused by exposure to organophosphate nerve gas, nerve gas remedies, and insecticides, from which only a few veterans had recovered.

* **infertility** (in-fer-TIH-lee-tee) is the inability of females to become pregnant or of males to cause pregnancy.

* **nervous system** is a network of specialized tissue made of nerve cells, or neurons, that processes messages to and from different parts of the human body.

In addition, scientists have tied various pesticides, herbicides, and radioactive substances to cancer and suspect that almost 2,000 other chemicals may also cause cancer. Although the U.S. government restricts the use of some of them, it does not restrict them all as of 2009.

Birth Defects Infertility*, miscarriage, stillbirth (the baby is born dead), childhood cancer, and birth defects may be linked to various environmental toxins. When a pregnant woman is exposed to lead, her child has a higher than usual risk of being born with behavioral and nervous system* problems. Exposure to radiation, chemical wastes, pesticides, solvents, paints, lead, and methyl mercury all can cause problems in a developing fetus*.

Chemical poisonings Lead is a serious environmental hazard to children in many parts of the world, including the United States. It affects children's mental and physical development, and high doses can cause paralysis and death. Lead paint, leaded gasoline, lead water pipes, and certain ceramics can all expose people to lead. Although most of these products in the United States no longer contain lead, lead paint and pipes can still be found in older homes and in some imported products.

As of 2009, many people who worked at the site of the World Trade Centers following the 2001 attacks have reported respiratory illnesses that they believe resulted from exposure to debris and dust related to the buildings's destruction. Some workers have even died from respiratory illnesses that their families attribute to their work at the disaster site. Researchers have been studying data and following other workers to determine whether working conditions at the site are linked to the illnesses. In 2006 a large study by doctors at Mount Sinai Health Center reported that workers who experienced a variety of respiratory problems while working at the site continued to have the symptoms, and in some cases their symptoms became worse.

The metals mercury and cadmium can cause nerve damage, cancer, and liver and skin diseases. Many industrial processes have used mercury since the beginning of the 1900s. In earlier times, people who worked with mercury were often unknowingly poisoned. Mercury can accumulate in the food chain and present a health risk. For example, some fish in the Great Lakes are contaminated with mercury they acquired through eating plants and other fish. Eating a lot of these contaminated fish can transfer unhealthy levels of mercury to a person, and some states post dietary restrictions. The effects are cumulative (build up) because the body cannot rid itself of mercury. Mercury can occur in fluorescent lights, latex paint, batteries, dental fillings, and mercury thermometers.

Other sources of environmental poisoning can arise from the manufacture of refrigerants, plastics, and other industrial products and from the manufacture and misuse of pesticides.

Can Environmental Diseases Be Prevented?

Regulations protecting people from environmental hazards vary widely from country to country. The U.S. Congress has enacted laws to protect workers from intentional and accidental exposure to environmental hazards. The following resulted from these laws:

- The National Institute of Occupational Safety and Health (NIOSH) was established in 1971 to set standards for health and safety in the workplace.
- The Occupational Safety and Health Administration (OSHA) was also established in 1971 to enforce rules and regulations based on NIOSH's findings.
- In 1983 OSHA required industries to make full disclosure to their workers about the dangerous chemicals used in their facilities and to teach workers how to protect themselves from these hazardous substances.
- In 1987 the 1983 standards were extended to include more workers. Later a regulation was added to set standards to prevent occupational exposure to infectious diseases such as AIDS* and hepatitis* B and C.

▶ See also **Asthma • Birth Defects and Brain Development • Cancer: Overview • Carbon Monoxide Poisoning • Cold-Related Injuries • Heat-Related Injuries • Lead Poisoning • Lung Cancer • Mercury Poisoning • Pneumoconiosis • Radiation Exposure Conditions**

Resources

Books and Articles

Ashton, Karen, and Elizabeth Salter Green. *The Toxic Consumer: Living Healthy in a Hazardous World*. / New York: Sterling, 2008.

Conant, Jeff, and Pam Fadem. *A Community Guide to Environmental Health*. Berkeley, CA: Hesperian Foundation, 2008.

The Human Body & the Environment: How Our Surroundings Affect Our Health. Westport, CT: Greenwood Press, 2003.

Organizations

National Center for Environmental Health, Centers for Disease Control and Prevention. 4770 Buford Highway NE, Atlanta, GA, 30341-3724. Toll free: 888-232-6789. Web site: <http://www.cdc.gov/nceh>.

National Institute of Environmental Health Sciences. P.O. Box 12233, Research Triangle Park, NC, 27709. Telephone: 919-541-3345. Web site: <http://www.niehs.nih.gov>.

World Health Organization. Avenue Appia 20, 1211 Geneva 27, Switzerland. Web sites: http://www.who.int/topics/environmental_health/en; http://www.who.int/environmental_health_emergencies/en.

Sick Building Syndrome

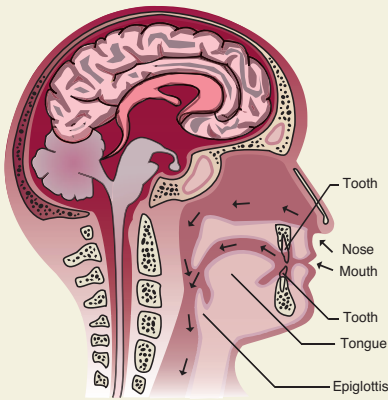
Sick building syndrome describes an elusive health problem in which people attribute a variety of symptoms to the buildings in which they work. Common complaints include headaches, dizziness, nausea, tiredness, concentration problems, sensitivity to odors, dry itchy skin, a dry cough, and irritated eyes, nose, and throat. Typically, as soon as affected people leave the building, their symptoms vanish and they feel well again.

As of 2009 scientists had not identified one specific illness or one common cause for sick building syndrome. In fact, no specific set of symptoms is common to all people complaining of the syndrome. Many factors may contribute to sick building syndrome, including humidity, inadequate ventilation, and poor temperature control. Pollution from outdoor sources (for example, car exhaust, pollen, or smoke) or chemicals from inside a building (cleaning supplies, glues, upholstery, or copy machine chemicals) may affect people who are sensitive to them. Bacteria, viruses, and molds also can invade buildings and make people sick.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **hepatitis** (heh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.



Normal airways allow the free flow of air through the nose and mouth past the epiglottis and then into the lungs. Bacterial infection may cause inflammation and swelling of the epiglottis, which can quickly bring about narrowing or even closing of the airway and severe breathing problems. *Illustration by Molly A. Moore Blessington. Reproduced by permission of Gale, a part of Cengage Learning.*

* **epiglottis** (eh-pih-GLAH-tis) is a soft flap of tissue that covers the opening of the trachea (windpipe) when a person swallows to prevent food or fluid from entering the airway and lungs.

Epiglottitis

Epiglottitis (eh-pih-glah-TIE-tis) is a condition involving life-threatening swelling of the epiglottis. It is usually caused by a bacterial infection of the epiglottis and can result in a blockage of the trachea (windpipe) and severe breathing difficulty.*

What Is Epiglottitis?

Epiglottitis, also known as supraglottitis (su-pra-glah-TIE-tis), is characterized by inflammation and swelling of the epiglottis and other upper airway structures. The epiglottis can become dangerously swollen within just a few hours, leading to narrowing of the airway and severe breathing difficulty.

Epiglottitis is usually caused by bacterial infection. *Haemophilus influenzae* type B (Hib) bacteria accounted for the majority of epiglottitis cases before the widespread use of the Hib vaccine. *Staphylococcus aureus*; *Streptococcus pneumoniae* and group A, B, and C streptococci bacteria; certain viruses; traumatic injuries; scalding; and severe smoke inhalation (causing burns in the upper airway) can also lead to epiglottitis.

Who Gets Epiglottitis?

Epiglottitis is most common in children under seven years of age. In the United States, cases of epiglottitis declined greatly after the Hib vaccine was introduced in 1985.

Epiglottitis itself is not contagious, but the bacterial infections that can lead to the condition are. Therefore, the bacteria can spread through person-to-person contact, often in drops of moisture from the respiratory tract when someone sneezes, coughs, or breathes.

What Are the Signs and Symptoms of Epiglottitis?

Epiglottitis often begins with a sore throat. Symptoms may come on suddenly and include the following:

- high fever
- inability to swallow and drooling
- difficulty breathing
- muffled voice
- stridor (STRY-dor, a high-pitched, squeaking noise that occurs while breathing in; it is present usually only if there is narrowing or blockage of the upper airway)
- a “sniffing” posture (when a young child leans forward, with chin extended, to make it easier to breathe)

Because their airways are smaller than those of adults, children with epiglottitis are at higher risk for developing severe breathing problems.

How Do Doctors Diagnose and Treat Epiglottitis?

Epiglottitis is a medical emergency that must be treated in a hospital. Ensuring that the person is able to breathe is the first and most important response. Often a procedure called intubation (in-too-BAY-shun) is performed, in which a tube is inserted into the windpipe through the mouth or nose to ensure that air can continue to flow into the lungs. In some cases, an emergency tracheostomy* must be performed to bypass the blocked part of the person's airway.

Doctors usually diagnose epiglottitis based on a physical examination and the patient's medical history. If the diagnosis is not clear, a doctor may order an x-ray of the neck that will show if the epiglottis is swollen. Blood cultures or other blood tests may be used to confirm that the person has a bacterial or viral infection.

Intravenous* (IV) antibiotics are usually given to combat the infection that led to epiglottitis. Corticosteroid* medication is sometimes given to further reduce the swelling of the upper airway so the person can breathe more easily.

How Long Does It Take to Recover from Epiglottitis?

People with epiglottitis are hospitalized, usually in intensive care, for several days to a week or more to manage the infection that led to epiglottitis. The time it takes to fully recover varies depending on the particular infection.

Possible complications of epiglottitis include pneumonia*, ear infection, and, rarely, meningitis* or bacteremia* caused by the same microorganism that caused the epiglottitis.

If not treated quickly, epiglottitis can result in complete airway obstruction (air can no longer flow into the lungs) and death.

Can Epiglottitis Be Prevented?

The best way to prevent epiglottitis is to avoid infection by the bacteria that most commonly cause it. The Hib vaccine, which is part of the routine childhood immunization schedule in the United States, has been extremely successful in decreasing the number of cases of epiglottitis resulting from *H. influenzae* infection. The Hib vaccine is given as four separate injections (shots) before individuals are two years of age.

▶ See also **Staphylococcal Infections • Streptococcal Infections • Vaccination**

Resources

Organizations

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905. Web site: <http://www.mayoclinic.com/health/epiglottitis/DS00529>.

* **tracheostomy** (tray-kee-AHS-tuh-me) refers to a small opening through the neck into the trachea, or windpipe, which has been made to allow air to enter the lungs more directly. The surgical procedure to create a tracheostomy is usually performed when a person's upper airway is narrowed or blocked or when there are other problems causing breathing difficulty.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **corticosteroid** (KOR-ti-ko-STER-oid) is one of several medications that are prescribed to reduce inflammation and sometimes to suppress the body's immune response.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

* **bacteremia** (bak-tuh-REE-me-uh) is the presence of bacteria in the blood.

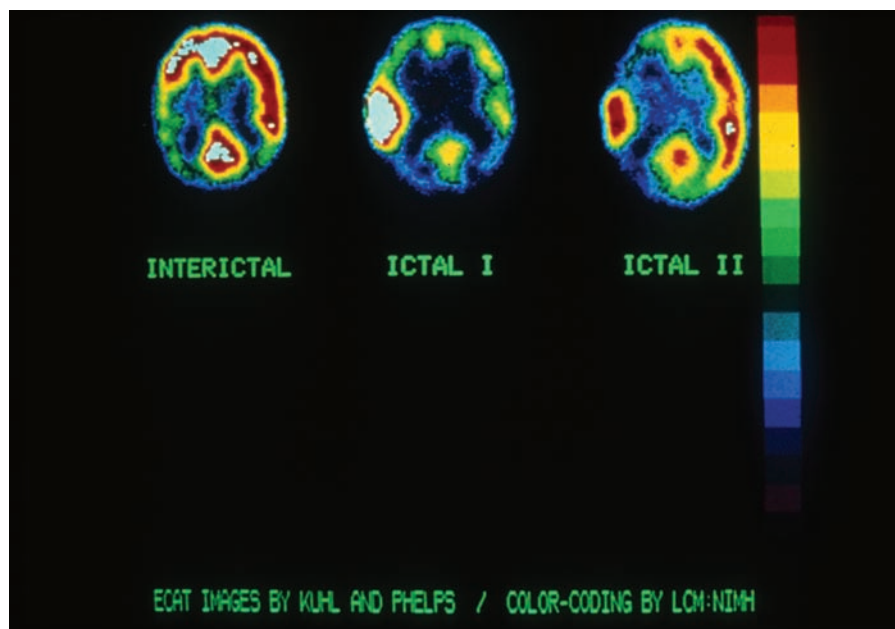
National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus>.

Epilepsy

Epilepsy (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Epileptic seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain. Some cases of epilepsy are hereditary, or run in families, but scientists do not know the cause of epilepsy in most other cases. Epilepsy is not contagious.

Erin's Story

It happened at her birthday party. Eleven-year-old Erin was ready to blow out the candles on her cake when she suddenly released a loud cry and dropped to the carpet and lost consciousness. Her entire body became rigid, and her girlfriends got scared. They became even more alarmed when Erin's arms and legs began to twitch and then to violently thrash about. Her friends called to her, but she did not respond. Her mother had seen this before and rushed to Erin's side, while telling the girls to move away nearby chairs and the glasses and other items that were near the edge of the table. She knelt beside her daughter and, to make sure her daughter could breathe easier, turned Erin onto her side and loosened the top button on her shirt. She also asked one of the girls to get Erin's older brother and



Epileptic seizures have different phases, as shown on these positron emission (PET) scans. The stage shown in the middle is the most severe. *Science Source/Photo Researchers, Inc.*

another to bring over a pillow from a sofa. She put the pillow under her daughter's head to keep it from banging on the floor. The thrashing seemed to go on for a long time, but it actually lasted less than two minutes. Once it slowed down and finally stopped, her friends became concerned again because Erin just laid there. Her mother continued to watch Erin, and Erin's brother explained to the girls that his sister had had an epileptic seizure that caused her to lose consciousness and made her body jerk around. He said Erin would come around in a minute or two and would be fine as soon as she had time to rest, and then he asked the girls to follow him out of the room. Erin regained consciousness just as her brother said she would. She was exhausted and more than a little embarrassed that her friends had seen what had happened. She was also frightened, because she had had a seizure before and now she was concerned that she would have more in the future. Erin was glad her mother was there to comfort her.

What Is Epilepsy?

In a normal brain, millions of tiny electrical charges pass between nerve cells and to all parts of the body. Those cells “fire” in an orderly and controlled manner. This is not the case with epilepsy. In the brain of a person with epilepsy, nerve cells in parts of the brain fire simultaneously and repeatedly, sending out powerful, rapid electrical charges that disrupt the brain's normal function. During a seizure such as the one experienced by Erin, brain cells can fire at up to four times their normal rate, temporarily affecting how a person behaves, moves, thinks, or feels.

Many people with epilepsy can sense that they are about to have a seizure by something called an aura*. An aura is a strange feeling—often of unease, anxiety, or discomfort—that may be accompanied by sensing or seeing flickering lights. Despite these warning signals, people with epilepsy still cannot stop the oncoming seizure.

What Causes Epilepsy?

Because epilepsy is not contagious, one person cannot catch epilepsy from another. In about 7 out of 10 cases, doctors describe the disease as idiopathic (id-ee-o-PATH-ik), which means the cause is unknown. Most people with idiopathic seizures are between 5 and 20 years of age and have no brain injuries or abnormalities. Many do, however, have a family history of epilepsy or seizure disorders.

Some cases of the disease have known causes, which include the following:

- Maternal injury, infection, or illness that affects a developing fetus during pregnancy.
- Brain injury. Although brain injuries can occur at any age, the highest incidence is among young adults. These injuries often result from car collisions, sports accidents, and falls. Blows to the head and gunshot wounds, particularly those that injure brain

The United States and the World

- Epilepsy is a common neurologic disease in the United States, affecting more than 6 out of every 1,000 people.
- Epilepsy can begin at any age, but most frequently it begins in early childhood, during adolescence, or after age 65.
- Among people with epilepsy, 20 percent develop the disorder before 5 years of age, and 50 percent develop it before age 25.
- Worldwide, some form of epilepsy affects about 50 million people, according to the World Health Organization. Some estimates indicate that up to 60 percent of people with epilepsy live in developing countries and have inadequate access to medical treatment.

* **aura** is a warning sensation that precedes a seizure or other neurological event.

* **withdrawal** a group of symptoms that occurs when a drug that causes physical or psychological dependence is regularly used for a long time and then suddenly discontinued or decreased in dosage.

membranes and tissues, can lead to epilepsy. In general, the more severe the injury, the greater the chance of developing the disease.

- Brain tumor or stroke. Either of these problems can lead to injury or irritation of brain tissue. Especially among people 65 years old and older, stroke is a common cause of epilepsy.
- Metabolic abnormalities that result from complications from diabetes, kidney failure, lead poisoning, use of alcohol or drugs, or withdrawal* from alcohol or drugs.
- Degenerative disorders, such as cardiovascular disease and Alzheimer's disease. Along with stroke, these are common causes of epilepsy among people over 65.
- Infections. Epilepsy may develop after a major brain illness such as meningitis, encephalitis, brain abscess, or severe infections of any part of the body. Less frequently, mumps, measles, and diphtheria can lead to the disease.
- Complications of AIDS or other immune disorders, including systemic lupus erythematosus.

What Triggers a Seizure?

Anyone can have a seizure, but seizures are usually very few and far between. A person with epilepsy, by contrast, has many more seizures and experiences them over a longer period of time. For a person with epilepsy, many conditions that affect the brain can trigger a seizure. These triggers include

THE ROAD TO UNDERSTANDING

Ancient Greeks believed epileptic seizures were blessed visitations from the gods. By contrast, during the Renaissance, a seizure was seen as a sign that a person was possessed by the devil.

Around 400 B.C.E., the Greek physician Hippocrates challenged the idea that epilepsy had a supernatural origin; he explained that it was a disease like any other. In his book on the subject, he described epilepsy as a brain disorder that “has a natural cause from which it originates like other affections.”

People had misunderstandings of epilepsy well into the early 1800s. At that time many believed they could catch it from those who had the disease, and often locked these individuals away in hospitals or “epileptics-only” sanitariums.

That changed in the mid-1800s, when neurologists (doctors who treat disorders and diseases of the brain and spinal cord) began to investigate epilepsy and understand it better. Their work removed the lingering and undeserved stigma associated with epilepsy and ushered in the modern understanding of the disease.

hormonal changes, such as those that occur during the menstrual cycle* or pregnancy; hunger; exhaustion or sleep deprivation; and rhythmic patterns of sound, touch, or light (particularly strobe lights). In many cases, an epileptic seizure is not a medical emergency. However, if a person goes into something called status epilepticus, in which a seizure lasts longer than 30 minutes or two seizures rapidly follow one another, his or her life may be in danger, and onlookers should summon medical assistance at once.

How Do Seizures Differ?

Because of the way a person appears during or after an attack, others sometimes mistakenly believe the person is drunk, drugged, or mentally ill. Epileptic seizures have different symptoms or characteristics depending on where the seizure begins in the brain and how the electrical discharge spreads across the brain. Epileptic seizures fall in two categories: generalized seizures and partial seizures.

Generalized seizures Generalized seizures affect nerve cells throughout the cerebral cortex* (the cauliflower-like outer portion of the brain), or across all of the brain. The most common generalized seizures are:

- **Generalized tonic-clonic seizure** (formerly called grand mal). Erin had this kind of seizure at her party. During the tonic phase of this seizure, people often lose consciousness, drop to the ground, and emit a loud cry as air is forced through their vocal cords. In the clonic phase, body muscles can contract at once or in a series of shorter rhythmic contractions. Usually, this kind of seizure lasts for about one or two minutes, and a period of exhaustion (called the postictal state) follows before the individual regains consciousness. Afterward, the individual may be sleepy and possibly have a headache. Incontinence* often occurs during this type of seizure.
- **Absence seizure** (formerly called petit mal). Loss of consciousness in this seizure is often so brief that a person does not even change positions. The person may display a blank stare, rapid blinking, or chewing movements. Facial or eyelid muscles may jerk rhythmically. Absence seizures often are genetic and occur mostly in children.

Partial seizures Partial seizures are contained within one region of the cerebral cortex. Types of partial seizures include the following:

- **Simple partial.** In this type of seizure, the strong and rapid bursts of electrical energy are only located in one part of the brain. The patient is awake and alert during the seizure. Symptoms, which vary depending on what area of the brain is involved, may include jerking movements in one part of the body, emotional symptoms such as unexplained fear, or an experience of abnormal smells or nausea.
- **Complex partial.** In this type of seizure, a person loses awareness of surroundings and is unresponsive or only partially responsive, because the seizures affect the part of the brain that controls awareness. An

* **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.

* **cerebral cortex** (suh-REE-brul KOR-teks) is the part of the brain that controls functions such as conscious thought, listening, and speaking.

* **incontinence** (in-KON-ti-nens) is loss of control of urination or bowel movement.

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

* **neurologist** (new-RHAL-eh-jist) a physician who specializes in diagnosing and treating diseases of the nervous system.

individual with this type of seizure may experience a blank stare, chewing movements, repeated swallowing, or other random activity. After the seizure, the patient has no memory of it. In some cases, the person who has had the seizure may suddenly become confused, begin to fumble, to wander, or to repeat inappropriate words or phrases.

Other seizures There are two other types of mild seizures:

- **Febrile seizures.** Two to five percent of children ages three months to five years of age have convulsions* caused by a sudden spike in body temperature often from an infection. Simple febrile seizures—the most common form—last from a few seconds to ten minutes and stop on their own. Complex febrile seizures last more than fifteen minutes. They may occur more than once in 24 hours and may also be confined to one side of the child's body. Children commonly outgrow febrile seizures.
- **Jacksonian seizures.** Named for British neurologist* John Hughlings Jackson (1835–1911), in Jacksonian seizures, abnormal electrical activity in a localized area of the brain causes brief alterations in movement, sensation or nerve function. Seizures of this type typically cause no change in awareness or alertness and are temporary and swift.

How Is Epilepsy Diagnosed?

Because not every person who has a seizure necessarily has epilepsy, the doctor must determine the seizure's cause by a physical exam and medical history, including descriptions of the seizures that have already occurred. The doctor must assess risk factors such as sleep deprivation and alcohol use, as well as possible head injuries, childhood seizures, or family history of seizures.

The physician also wants to know if the patient has experienced an aura; having experienced an aura helps confirm that the seizure is a brain disorder and establishes its location. The doctor also asks about the nature of the movements the person made during a seizure.

If the patient has indeed experienced an epileptic seizure, the doctor then tries to identify the type of seizure. The first tool doctors use is an electroencephalograph (e-lek-tro-en-SEF-a-lo-graf). Commonly known as an EEG, this machine records electric currents in the brain and can track abnormal electrical activity. If the EEG does not show the seizure activity, or if certain other features in the patient's physical exam or medical history are present, then the doctor may try other types of scans, including CT (computerized tomography) scans or MRIs (magnetic resonance imaging).

How Is Epilepsy Treated?

Treating epilepsy has three goals: to eliminate seizures or at least reduce their frequency, to avoid side effects of long-term medical treatments, and to assist in maintaining or restoring normal activities of daily living.

FYODOR DOSTOYEVSKY

The Russian writer Fyodor Dostoyevsky (1821–1881) is considered one of the world’s great novelists. With brilliant psychological and philosophical insight, Dostoyevsky examined the human soul in *Notes from the Underground*, *Crime and Punishment*, and his 1880 masterpiece, *The Brothers Karamazov*.

Dostoyevsky had epilepsy, and his fiction includes characters who have the condition. His book *The Idiot*, for example, describes the aura that many people with epilepsy experience just before they have a seizure, which he calls a “fit”:

He remembered that during his epileptic fits, or rather immediately preceding them, he had always experienced a moment or two when his whole heart, and mind, and body seemed to wake up with vigour and light; when he became filled with joy and hope, and all his anxieties seemed to be swept away for ever; these moments were but presentiments, as it were, of the one final second ... in which the fit came upon him.

Medication Anticonvulsant* medications can fully or partially control most cases of epilepsy. If a person is free of seizures for several years, doctors may reduce or even eliminate medication. In many cases, however, epilepsy remains a lifelong, chronic condition with no medical treatment guaranteeing remission* or a permanent cure.

Surgery If drug therapy does not work, a surgical procedure can remove the damaged cells that cause partial seizures. Cases qualify for surgery if the tissue resides in one small area of the brain and the surgeon can remove this tissue without harming a person’s mental abilities or personality. Surgery on adults is sometimes successful, but it usually has better results when performed on children and infants.

Diet Although it was discontinued as a therapy when medicines became available, a ketogenic diet (a doctor-monitored, high-fat, high-calorie diet) was reinstated in the treatment arsenal for epilepsy, especially for children who do not respond to medicines. It does not, however, work for all patients. Some people believe the diet can stop seizures by creating ketosis (ke-TO-sis), a condition in which the body burns fat for energy instead of glucose. Researchers continued as of the early 2000s to wonder why diet has an impact on seizures.

Biofeedback When combined with other therapies, biofeedback has been beneficial to some patients. Biofeedback uses electronic instruments

* **anticonvulsants** (an-tie-kon-VUL-sents) are medications that affect the electrical activity in the brain and are given to prevent or stop seizures.

* **remission** is an easing of a disease or its symptoms for a prolonged period.

Medical Alert Tags

People with epilepsy often wear medical alert identification tags or bracelets that provide vital information for caregivers during seizures.

Some companies offer tags with identification numbers so that medical personnel anywhere can retrieve a patient's medical history.

to monitor a person's brain waves, blood pressure, heart rate, and skin temperature. The patient learns techniques to lower these bodily functions to more relaxed levels.

Other treatments In the early 2000s epilepsy research was an active field. One promising technique called vagus nerve stimulation uses an implanted device to prevent or at least lessen seizures by sending small, regular bursts of electricity through the vagus nerve in the neck to the brain.

Can Epilepsy Be Prevented?

Many cases of epilepsy have no known cause, which makes prevention a challenge. Those cases of epilepsy that result from injuries to the brain can, however, often be prevented through safety precautions and good health practices. These strategies include:

- Buckling seat belts and observing speed limits when in a car
- Wearing approved helmets and protective headgear while skating, bicycling, playing sports, or riding motorcycles
- Using drugs only as prescribed
- Immunizing children against infectious diseases

Living with Epilepsy

Most people with epilepsy can lead normal and active lives, although they must follow a few safety restrictions. People with epilepsy must be free of seizures for a period of time specified by their home state before they are permitted to drive. Laws prohibit people with uncontrolled seizures from driving a car.

A person with a seizure disorder should avoid working in jobs that involve heights, dangerous machinery, or underwater environments. To avoid the risk of drowning during a seizure, taking showers is safer than taking baths, and swimming in a pool or lake with other people is safer than swimming alone.

People with epilepsy also are at risk for depression. In part, the depression may stem from loss of mobility or from the effects of prejudice at school or at work. Prejudice results when people fear the condition and do not understand it. Children with epilepsy may become depressed if their parents become overly protective and prevent them from engaging in normal childhood activities. Depression is a particular problem among adolescents, who may refuse to take their medication on schedule and, therefore, may run the risk of additional seizures.

In addition, alcohol consumption makes people who have epilepsy more susceptible to seizures, and the combination of alcohol and anticonvulsant medications can be deadly.

Understanding the facts about epilepsy and providing a positive environment in which treatment becomes a part of everyday life can help people with epilepsy and their families.

▶ See also **AIDS and HIV Infection • Brain Chemistry (Neurochemistry) • Brain Injuries • Brain Tumor • Kidney Disease • Lupus • Metabolic Disease • Seizures • Stroke**

Resources

Books and Articles

Appleton, Richard, and Anthony G. Marson. *Epilepsy: The Facts*, 3rd ed. New York: Oxford University Press, 2008.

Bjorklund, Ruth. *Epilepsy*. New York: Marshall Cavendish Benchmark, 2007.

Wilner, Andrew N. *Epilepsy: 199 Answers. A Doctor Responds to His Patients' Questions*, 3rd ed. New York: Demos Medical, 2007.

Organization

Epilepsy Foundation. 8301 Professional Place, Landover, MD, 20785. Toll free: 800-332-1000. Web site: <http://www.epilepsyfoundation.org>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Web site: <http://www.ninds.nih.gov/disorders/epilepsy/epilepsy.htm>.

Epstein-Barr Virus See *Mononucleosis, Infectious*.

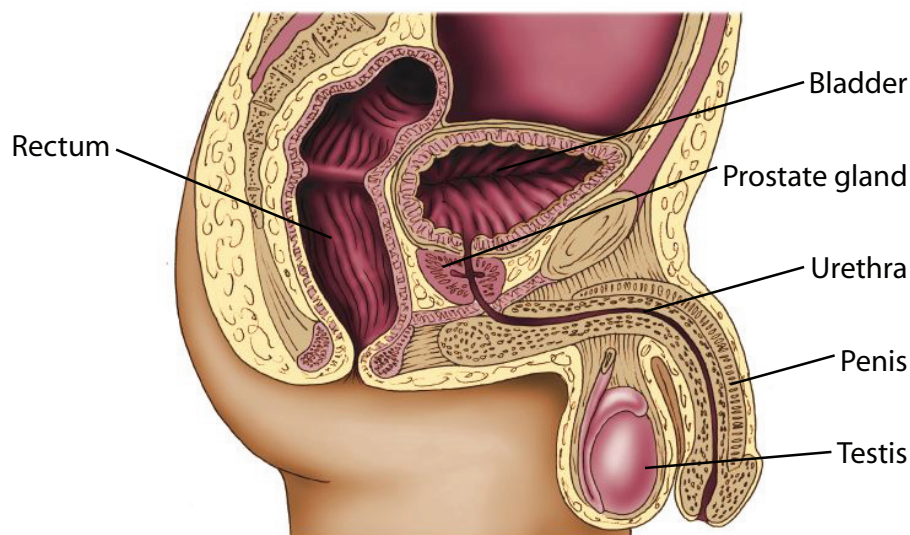
Erectile Dysfunction

Erectile Dysfunction (ED) is a medical condition in which a man cannot develop or maintain an erection of the penis. The condition may have physiological, psychological, or lifestyle related causes. While many causes are treatable and can be remedied with medication, there may be more serious underlying health conditions present. Erectile dysfunction can cause a great deal of emotional strain on both the patient and his partner.

What Is Erectile Dysfunction?

Erectile Dysfunction (ED) is a medical condition that affects more than 18 million American men. Men with ED are unable to achieve and maintain an erection long enough to have sexual intercourse. In order to understand what causes ED, it is important to know how the penis becomes erect.

Anatomy of the human male reproductive system. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



* **semen** (SEE-men) is the sperm-containing whitish fluid produced by the male reproductive tract.

* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

* **norepinephrine** (NOR-e-pi-ne-frin) is a body chemical that can increase the arousal response, heart rate, and blood pressure.

Anatomy of an Erection The shaft of the penis contains several structures that work together to make the penis erect. The corpus cavernosum are two long, sponge-like structures that run along the length of the penis. They contain erectile tissue, two main arteries, several veins, and nerves. Beneath the corpus cavernosa is the urethra, the tube that carries semen* and urine* to the outside of the body through the meatus, the opening in the head at the end of the shaft.

An erection occurs due to a combination of factors, both physical and mental. When a man becomes sexually aroused, his brain sends chemical signals such as epinephrine, norepinephrine*, acetylcholine, prostaglandins, and nitric oxide to the nerves inside the penis. When the nerves receive these signals, the muscles in the penis relax and the spongy corpus cavernosum fill with blood, causing the penis to become erect. As long as a man continues to be aroused, the volume of blood flowing into the penis remains high, maintaining his erection.

Understanding Erectile Dysfunction Sometimes, even when a man is sexually aroused, he may have difficulty developing an erection. Other times, a man may achieve an erection, but it does not last long enough to allow him to engage in sexual intercourse. Usually this happens because of a problem with the extra blood flow that the penis needs in order to maintain an erection. Many factors can cause ED. Sometimes, ED is caused by psychological factors such as depression, anxiety, and stress, and in other cases, a serious underlying medical condition present.

What Causes Erectile Dysfunction?

At one time, many physicians believed that erectile dysfunction was either psychological or a natural part of aging. In the early 2000s, however, physicians understand that ED is often linked to underlying, treatable medical conditions. These can include heart disease, neurological issues,

psychological problems, or lifestyle-related causes. Sometimes, the medication that a person takes may also contribute to erectile dysfunction.

Cardiovascular disease Heart disease*, one of the most common underlying medical conditions in men with ED, is the leading cause of death among men in the United States. Heart disease as a term encompasses several cardiovascular conditions, including coronary heart disease, atherosclerosis, heart failure, cardiomyopathy, and hypertensive heart disease. When a patient is suffering from heart disease, his heart has difficulty pumping blood to the different regions of the body, including the penis, which can lead to erectile dysfunction. Men need to speak frankly about their condition so that their physician can find and treat the underlying cause of ED.

Neurological causes Erections begin in the brain. After some sort of physical or mental stimulation, the brain sends chemical signals along the body's nerve pathways to the penis. The muscle tissue in the penis begins to relax and the penis fills with blood, becoming erect. For some people who suffer from neurological conditions, these pathways become blocked, resulting in erectile dysfunction. Neurological conditions that can cause ED include Parkinson's disease*, multiple sclerosis, spinal cord and brain injuries, Alzheimer's (ALTS-hy-merz) disease* and stroke*.

Psychological causes About 10 to 20 percent of all ED cases are related to psychological disorders. Because many of these are treatable, it is important for patients to discuss any emotional concerns they have with their physician. Often, therapy and/or medication may be helpful in resolving ED in these patients. Some common psychological causes of ED include stress, depression, anxiety, low self-esteem, and panic disorder. The issues may be related to sexual abuse or trauma, as well.

Pharmaceutical and Lifestyle Causes Sometimes, the use of different prescription and over-the-counter medications may be directly related to ED. Many of these medications contain ingredients that can interrupt blood flow or nerve impulses. Drug classes that may lead to ED include diuretics*, antihypertensive drugs, antidepressant medications*, anti-inflammatory drugs, muscle relaxers, and certain prostate cancer drugs. It is important for men to discuss with their doctors other medications that they are taking.

Lifestyle choices that may lead to ED include obesity* and the abuse of alcohol and recreational drugs.

How Is Erectile Dysfunction Diagnosed?

Most men have sexual performance problems some of the time. However, men who find it difficult to develop or maintain an erection at least 50 percent of the time are considered to have ED. Erectile dysfunction can affect a man's relationships, his self-esteem, and many other aspects of his life. Sometimes, a physician will refer men with ED to a urologist who specializes in the condition and its many treatments.

* **heart disease** is a broad term that covers many conditions that prevent the heart from working properly to pump blood throughout the body.

* **Parkinson's disease** is a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.

* **Alzheimer's (ALTS-hy-merz) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

* **diuretics** (dye-yoor-EH-tiks) are medications that increase the body's output of urine.

* **antidepressant medications** are used for the treatment and prevention of depression.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

ED MEDICATIONS AS DANGEROUS RECREATIONAL DRUGS

After the introduction of Viagra in 1998, there was an alarming trend among young men who take ED medications recreationally. While these young men do not suffer from erectile dysfunction, they sometimes combine ED drugs with methylenedioxymethamphetamine (Ecstasy), never really considering the dangerous and potentially deadly effects doing so may have. People using Viagra, Cialis, or Levitra for recreational purposes may experience a dangerous drop in blood pressure, painful erections that require medical intervention to reverse, and death. Studies have shown that these groups also experience much higher rates of STDs and HIV*/AIDS*.

Treatment Options

Fortunately, there are many treatments available for men with ED. The treatment options range from simple to invasive, and with the guidance of a physician, each individual must choose the option that is best for him.

- In some cases, simple changes in lifestyle may resolve ED. Diet and exercise, stress reduction techniques, and avoidance of alcohol and drugs are all positive changes that can lead to more frequent and lasting erections.
- ED medications such as sildenafil citrate (Viagra), tadalafil (Cialis), and vardenafil (Levitra) work by helping the muscles and vessels in the penis to relax so that more blood can flow to them, which allows the penis to become erect. These drugs have been successful in treating ED for many men, but they can be dangerous when combined with other medications and should only be used according to the directions given by a physician.
- Certain sexual aids can be helpful in achieving and maintaining erections. A penis pump works by creating a vacuum around the penis that encourages increased blood flow, allowing an erection. Once an erection develops, a penis ring can be placed at the base of the shaft to maintain the erection by preventing the flow of blood back out of the penis.
- Surgical intervention is also an option for men with ED. One type of surgical intervention involves the placement of a flexible rod in the penis that can be unfolded, making the penis erect and able to engage in sexual intercourse. Another option is the implantation of fluid filled sacs that can be pumped up to create an erection.

Some men may be enticed to purchase herbs and medications online that claim to cure ED. The FDA warns men against purchasing these

products, as they may contain ingredients that can be harmful. While it has been suggested that certain herbal treatments can be helpful in the treatment of ED, there has not been enough research as of 2009 into these claims to prove or disprove them. It is up to each individual to discuss the pros and cons of the various available treatments with his physician and choose the one that suits his needs.

Resources

Books and Articles

Ellsworth, Pamela. *100 Questions & Answers about Erectile Dysfunction*, 2nd ed. Sudbury, MA: Jones and Bartlett, 2008.

Metz, Michael E., and Barry W. McCarthy. *Coping with Erectile Dysfunction: How to Regain Confidence and Enjoy Great Sex*. Oakland, CA: New Harbinger, 2004.

Organizations

National Kidney and Urologic Diseases Information Clearinghouse.

3 Information Way, Bethesda, MD, 20892-3580. Toll free: 800-891-5390. Web site: <http://kidney.niddk.nih.gov/kudiseases/pubs/impotence>.

Sexual Medicine Society of North America.

1100 E. Woodfield Road, Suite 520, Schaumburg, IL, 60173. Telephone: 847-517-7225. Web site: <http://www.smsna.org>.

Evaluation See *Diagnostic Tests; Testing and Evaluation*.

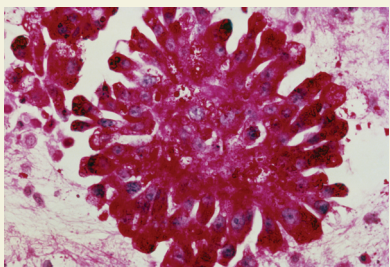
Ewing's Sarcoma

Ewing's sarcoma is a rare type of tumor that usually occurs between the hips, in the upper arm, in the thigh bones, or in the ribs but may also show up in other tissues of the body. About half of the people with this disease are younger than 15 years of age. Recovery from Ewing's sarcoma depends on many factors, including how early the tumor is diagnosed, its size and location, and whether it has spread to other areas of the body.*

It Felt like a Pulled Muscle: Tom's Story

Tom woke up one morning with a pain like a pulled muscle in his right leg about halfway up the upper leg bone. He noticed a tiny lump there, but he figured he had just gotten a bump when he was playing basketball

* **tumor** (TOO-mor) is an abnormal growth of body tissue that has no known cause or physiologic purpose. A tumor may or may not be cancerous.



▲
Ewing's sarcoma seen under a microscope. Darkly stained cancerous cells with large purple nuclei are seen spreading outwards in bone tissue. *National Cancer Institute/Photo Researchers, Inc.*

* **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

a day earlier, and it would go away. When the lump and the pain were still there the next day, he mentioned it to his mother. She told him to wait a few days and see if it got better. It did not. She scheduled an appointment with his doctor, who examined Tom and ordered several tests, including an x-ray. No long afterward, the doctor called to tell her that Tom had Ewing's sarcoma and should begin treatment right away. Tom was lucky because the doctor found the tumor when it was still very small. Surgery removed the tumor. Tom had to undergo physical therapy and had to stop playing basketball or other sports, but he recovered and returned to school.

What Is Ewing's Sarcoma?

Ewing's sarcoma is a rare type of cancer in which a malignant* tumor forms in the bone or in soft tissues near the bone. Usually, these tumors appear in the middle of the upper arm or upper leg bone, although they may show up elsewhere in the body, such as the ribs or the hip bones. People with this disease usually experience pain, tenderness, and/or swelling at site of the tumor. Sometimes, however, individuals have a tumor for many months before they have any pain or swelling. Ewing's sarcoma is a dangerous cancer, because it can spread to other areas of the body. A number of treatments are available and can be quite successful, especially if doctors find the tumors and diagnosed Ewing's sarcoma early and before it has spread.

Some medical professionals once used the name primitive neuroectodermal (ner-o-ek-toe-DERM-ul) tumor (PNET), sometimes called peripheral neuroepithelioma, when referring to Ewing's sarcoma, but while PNET is similar to Ewing's sarcoma, it is not the same. As of 2009, medical professionals refer to PNET as being in the "Ewing's family of tumors" (EFT) or a "tumor of the Ewing's family" (TEF). According to the American Cancer Society, Ewing's sarcoma is by far the most common tumor in this family, and it makes up 87 percent of TEFs.

Who Gets Ewing's Sarcoma?

Many types of cancer affect adults more frequently than they do children, but such is not the case of Ewing's sarcoma. This tumor occurs more often in teenagers than in people of other age groups. Nonetheless, the American Cancer Society reports that Ewing's sarcoma is very rare. Only about 150 children and adolescents in the United States each year find out they have a TEF. Of those who are diagnosed with a TEF, four-fifths are white, nearly two-thirds are between the ages of 10 and 20 years of age, and most are males. All told, Ewing's sarcoma makes up 2 percent of all teen cancers.

What Causes Ewing's Sarcoma?

Ewing's sarcoma results from an unusual arrangement, called translocation, of two of the patient's chromosomes. Chromosomes are packages of DNA*, as well as various proteins, that are found in a cell's nucleus. They

carry an individual's genes*, which carry the instructions for a person's cells to work properly. The two chromosomes* involved in Ewing's sarcoma are chromosome number 11 and chromosome number 22. The translocation of the two chromosomes allows a gene on one of the chromosomes to fuse to a gene on the other, and it is this fusion of genes that brings about Ewing's sarcoma. As of 2009, medical professionals and other scientists did not know what causes the translocation. They had found no evidence that it is something that is inherited from a parent, nor had they found a link to diet or to anything else in the individual's background. In other words, researchers knew of nothing that parents could have done differently to prevent Ewing's sarcoma in their children. This is important information for parents who may feel they are somehow to blame for a child's genetic disease.

What Are the Symptoms of Ewing's Sarcoma?

A typical symptom of Ewing's sarcoma is pain, sometimes accompanied by swelling, at the site of the tumor. Depending on the position of the tumor and how nearby it is located to nerves, the pain can be quite severe. Often, the tumor is located in the middle of the upper arm bone (the humerus) or the upper leg bone (the femur), but tumors may also be located in the area between the two hips (the pelvis), in the chest, or in the back. A lump may appear at the site of the tumor, and the patient may feel warmth at the site.

Besides these symptoms, a patient may experience a fever, fatigue, little or no appetite, and weight loss. Occasionally, individuals with Ewing's sarcoma break a bone even though they have had no accidents or other injuries that would cause a broken bone. Such a break happens because the disease can weaken the bones. Sometimes, individuals have no other symptoms of a tumor until a bone breaks, and this broken bone is what leads a doctor to diagnose the tumor.

In addition, tumors that are located near nerves can cause patients to feel numbness or tingling and can occasionally cause paralysis* or incontinence*.

In some cases, individuals may have a tumor for many months before it begins to cause symptoms, because a tumor starts out small and grows over time. Individuals may have no symptoms when the tumor is small but may begin to experience pain and/or swelling when the tumor get larger.

How Is Ewing's Sarcoma Diagnosed?

After hearing about the symptoms an individual is having, a doctor may order a number of tests to look more closely at the affected area. These can include x-rays, bone scans, magnetic resonance imaging*, or CT scans*. If these tests point to a tumor, the doctor will then conduct a biopsy (BY-op-see) that removes a tiny piece of tissue. A medical professional will then look carefully at that sample under a microscope to find evidence of cancer. In addition, doctors may conduct tests to look at chromosomes 11 and 22 to see if they are translocated.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **chromosomes** (KRO-mo-somz) are threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **incontinence** (in-KON-ti-nens) is loss of control of urination or bowel movement.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

- * **bone marrow** is the soft tissue inside bones where blood cells are made.
- * **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.
- * **radiation therapy** is a treatment that uses high-energy radiation from x-rays and other sources to kill cancer cells and shrink cancerous growths.
- * **grafts** are tissue or organ transplants.
- * **amputation** (am-pyoo-TAY-shun) is the removal of a limb or other appendage or outgrowth of the body.

Once Ewing's sarcoma is diagnosed, the doctor may order additional tests to determine whether cancer has spread from the site of the tumor to other areas of the body. This information helps determine how the doctor will treat the disease. If Ewing's sarcoma has spread, it usually moves into the lungs. It may also move into other bones or into the bone marrow*.

How Is Ewing's Sarcoma Treated?

The treatment for Ewing's sarcoma usually involves chemotherapy*, radiation therapy*, and/or surgery. Radiation or surgery are the typical treatments for tumors that have not spread elsewhere. A doctor's first choice is usually to remove the tumor surgically. Sometimes, however, doing so proves difficult because the tumor is located in such a spot that the doctor thinks its surgical removal may harm the person's use of that particular body part. In that case, the doctor may turn to radiation therapy to kill the tumor cells. The doctor may also use a combination of surgery and radiation. For instance, if surgery does not remove all of the tumor, the doctor may then use radiation to treat the leftover tumor. In addition, doctors sometimes use radiation to make sure the cancer does not return.

Doctors turn to chemotherapy especially when the tumor has spread, because chemotherapy kills both tumor cells and additional cancer cells in other areas of the body. The doctor will observe the tumor continuously as the patient is undergoing chemotherapy to determine whether the tumor is shrinking. When the tumor has shrunk sufficiently, a surgeon may remove it.

During surgery for Ewing's sarcoma, a doctor removes the tumor and makes repairs at the tumor site. Repairs may include reconstructing the bone or joint, and perhaps using artificial joints or bone grafts*. A bone graft is new bone or another material, such as a metal rod, that replaces the bone that was lost in the surgery. These artificial joints and bone grafts, along with physical therapy after the surgery, can help individuals return to many of their normal activities. The doctor directs the patient to avoid athletic competition and other movements that put too much stress on the repaired bones or joints. Occasionally, individuals need additional operations later in life to keep bones or joints functioning properly. Subsequent operations occur often among children, whose bones are still developing. Doctors may need to do several surgeries to lengthen the repaired bone as the child grows.

In the late 20th century, amputation* of arms or legs was a common treatment for Ewing's sarcoma. That is no longer the case. In the early 2000s, doctors can remove the tumors in most patients without having to amputate a limb. Occasionally, however, some patients with Ewing's sarcoma must have a limb amputated. After an amputation, individuals typically receive an artificial limb, called a prosthesis, and work with physical and occupational therapists to learn how to use it to the greatest advantage.

Even after individuals have the tumor removed, they still have to return for follow-up care to make sure that the tumor is indeed

gone. This care may include additional diagnostic tests, such as x-rays or bone scans. Overall, the survival rate for Ewing's sarcoma varies greatly and depends to a great extent on many factors. Some of these factors are:

- The size of the tumor
- The location of the tumor
- Whether the cancer has spread to other parts of the body
- How well the tumor responds to chemotherapy or other treatment
- The overall health of the patient

In addition to these treatments, a doctor may recommend psychological therapy to help individuals cope with the disease and its effect on their life. Teenagers may especially benefit from psychological therapy because they are also dealing with adolescent issues that can already be quite challenging.

Can Ewing's Sarcoma Be Prevented?

As of 2009, researchers knew of no way to prevent individuals from developing Ewing's sarcoma.

▶ See also **Cancer: Overview • Tumor**

Resources

Organizations

American Academy of Orthopaedic Surgeons. 6300 North River Road, Rosemont, IL, 60018-4262. Telephone: 847-823-7186. Web site: <http://orthoinfo.aaos.org/topic.cfm?topic=A00082>.

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-ACS-2345. Web site: http://www.cancer.org/docroot/CRI/CRI_2_3x.asp?dt=48.

Melissa's Living Legacy Foundation. 3111 Winton Road S., Rochester, NY, 14623. Web site: <http://www.teenslivingwithcancer.org/cancerFacts/whatIs/ewingsSarcoma.asp>.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov/cancertopics/types/ewing>.

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Factitious Disorder

Factitious disorder is a psychiatric condition in which an individual deliberately produces or falsifies symptoms of an illness for the sole purpose of assuming the role of a patient. Individuals with factitious disorder want to be under medical care, perhaps to obtain attention, care, or nurture. Generally this disorder signifies a very serious unmet psychological need or psychological trauma.

Anjali's Story

Anjali needed extra hours of volunteering at the hospital to fulfill her high school community service obligation. For some reason, this year there was less demand for the volunteers than in previous years. Therefore, she found herself serving at a third hospital in as many months when most students could expect to stay at one hospital the entire year. In many ways the hospitals were similar, but every difference in this new hospital reminded her that she wanted a “home” site. While she was thinking this, she felt relieved to see a familiar face. She saw someone she knew being pushed in a wheelchair by a nurse. Deanna had been a patient at Anjali's first hospital.

One night when Anjali was on duty, Deanna wanted someone to talk to, and Anjali spent some time with her. Deanna told her all about her illness. It was a strange one that the doctors did not understand. The day that Deanna was released, Anjali overheard some nurses commenting that her illness was not so serious and that she would be all right.

Now, Anjali was wondering why Deanna was back in the hospital. “Hi, Deanna!” she called out, but Deanna did not respond. “Do you remember me?”

Deanna looked a bit shocked to recognize Anjali, but muttered “Oh, hello.”

“Are you all right?” Anjali asked.

“Yes,” said Deanna. “I just had a relapse.”

The nurse pushing Deanna's wheelchair had a quizzical smile.

“Relapse? You mean you have had this before? You should have told the ER doctor.”

“Oh, well, that time was not as bad as this time,” Deanna replied

After the nurse settled Deanna in her hospital room, Anjali asked the nurse. “Is she all right?”

* **malingering** (ma-LING-er-ing) means intentionally pretending to be sick or injured to avoid work or responsibility.

“Yes,” said the nurse. “She thinks she has some form of exotic infection. The doctor thinks she has Munchausen syndrome.” Anjali had to look up the term. She found it is the most common factitious disorder.

What Is Factitious Disorder?

Factitious disorder is when a person seeks medical treatment for a falsified condition. The person with a factitious disorder visits the doctor persistently complaining of different symptoms of illnesses. The doctor can find no physical or mental condition associated with the symptoms. There is no external reward for faking an illness such as collecting workman’s compensation or escaping some stressful situation. The main motivation appears to be the desire to be treated as a sick person.

Underlying motives distinguish factitious disorder from malingering*. Someone who is malingering is seeking immediate external reward by faking a sickness. The motivation may include absence from work, avoidance of responsibility, receiving financial compensation, or obtaining prescription drugs. The main focus in handling malingering has been on how to detect the malingerer. The goal has been to prevent unfair worker’s compensation, escape from military service, and unnecessary medical expenses.

Factitious disorder is also distinguished from conversion disorder. With conversion disorder, afflicted persons actually believe they have the physical symptoms. Patients may actually appear to have the symptoms, but the cause is psychological, not physical, relating to internal conflict or external stressors. Conversion disorder may be the result of dissociation, characterized by a disconnection between past and present, lack of identity, no immediate sensations, and loss of control of the body. Dissociation is caused by trauma, extreme problems, or harmful relationships.

Factitious disorder is the name for any self-induced disease. The symptoms are voluntarily controlled. There is a conscious awareness on the part of the deceiver. There is evidence of internal compulsion. The person appears to be unable to control the urge to adopt the symptoms. Additionally, the person seems to maintain the illness because of psychological stressors. The person with factitious disorder needs help from a mental health professional because the feigned illness can do considerable, even irreparable damage to the health of the afflicted person. The three most common types of factitious disorder are Munchausen syndrome, Munchausen by proxy, and Ganssen syndrome.

Factitious disorder is a continuum based on the seriousness of the symptoms and the intensity with which the afflicted person is looking for medical attention. However, nowhere on this continuum is there any observable extrinsic incentive for the behavior. It is important to note that people afflicted with factitious disorder have the goal of being sick; they want to be sick even when there is no one around to impress.

Depending on the persistence, strength, and danger of the deceit, individual cases of the syndrome may be considered mild to severe. If the symptoms and the portrayal of the afflicted do not change their life much, then the disorder is considered mild. However, if the afflicted people

are persistent to the point of enduring very painful symptoms, financial difficulties, and lifestyle disruptions, then the disorder is considered severe. On the severe end of the continuum is Munchausen syndrome named in 1951 by British doctor Richard Asher based on the popular perception of Baron Freiherr von Münchhausen, who exaggerated his exploits in the Russian-Turkish war. Munchausen syndrome involves reporting the symptoms of physical illnesses. Another less common disorder is Ganssen syndrome, which involves reporting the symptoms of psychological illnesses.

Munchausen syndrome Munchausen syndrome is the most common factitious disorder. The symptoms reported are from physical maladies. These symptoms may be naturally occurring, but they are exaggerated or made worse by the afflicted. However, the symptoms may also be self-inflicted. The afflicted is willing to receive treatments for the feigned physical ailments but is usually resistant to treatment for the psychological disorder.

Ganssen syndrome Ganssen syndrome is the factitious disorder in which symptoms of psychological disorders such as dementia* or schizophrenia* are mimicked. Ganssen syndrome is very rare and has mostly been reported in prison populations. One of the characteristics of Ganssen syndrome is the response of “approximate answers.” The patient gives logically ridiculous answers to simple questions but responds with a number to a question requiring a number answer or with a color to a question requiring a color answer. It is listed in the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (*DSM-IV*) as a dissociative disorder; however, it is so rare that the true cause, whether dissociative or factitious, may not be known.

Munchausen by proxy Munchausen by proxy was named in 1977 by British pediatrician Roy Meadows, who is credited with its discovery. It is a form of caregiver abuse of children or dependent others. Munchausen by proxy most often occurs in a mother seeking medical treatment for a child with a feigned illness. In this case, the mother has the disorder and tries to receive attention for being the mother of a sick child. Although the mother faking illness in her child is the most common scenario, Munchausen by proxy could affect a father faking illness in his child or any individual in the position of caregiver who seeks medical help for the person in their care when the illness is feigned. In any scenario, Munchausen by proxy is purposeful, abusive behavior toward the individual receiving care by the caregiver. The only cause for it is the mental disturbance of the perpetrator.

The characteristics include the parent constantly seeking medical attention for the child, always presenting the child to the doctors as weak and sickly, vulnerable to a number of ailments. The parent with this disorder will allow the child to go through any number of physical examinations, even the most intrusive and uncomfortable. If the parent

* **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

* **schizophrenia** (skit-so-FREE-nee-ah) is a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors, which distort their view of reality.

gets hold of the laboratory reports, the parent will tend to reach separate judgments from them. If the doctor tells the parent that there is nothing wrong with the child, the parent will not accept the doctor's conclusion. The typical behavior of the parent in receiving the doctor's conclusion is to selectively hear the doctor's report, focusing on the small phrases that could support the parent's contention that the child is seriously ill. Otherwise, the parent might argue with the doctor, find another doctor, or not acknowledge hearing anything that the doctor said. Always the parent acts like a responsible, caring parent.

As with the other factitious disorders, there is no extrinsic incentive for this pretense to either the afflicted caregiver or the person in his or her care. Also, as with the other factitious disorders, Munchausen by proxy can range in the degree of severity. On the mild end, a mother may be only exaggerating symptoms that currently naturally exist in the child. On the severe end, a parent may be actually causing the child to be sick or injured. This may be done by giving the child something toxic to eat or by ignoring the treatment prescribed by the doctor.

The motivations for Munchausen by proxy vary. While the most common motivations are pathological, there are cases in which the mother is extremely stressed by her responsibilities, and her deceit is her way of making a desperate plea for help. When this is the motivation, she is relieved to be discovered, and therapy involves education in the areas in which she feels most vulnerable. There are also parents who are micromanagers of their children's health. These individuals might try to second-guess the doctor's advice, seek out the opinions of other doctors, and meticulously monitor the child's progress. While this behavior may be extreme and obstructive to the child's therapeutic relationship with the doctor, it is not factitious or pathological.

There are two general pathological motivations for this behavior. The first is an obsession with obtaining medical treatment, which is commonly referred to as a "doctor addiction". The perpetrator is more likely to exaggerate an existing illness than to actually bring on some malady in the child.

The second pathological motivation is more common and more dangerous. The parent is trying to gain a sense of power by deceiving the doctors who are perceived as highly trained and intelligent. The parent also finds a sense of esteem in the role of a parent of a sick child. These parents are more likely to actively induce sickness in their children. This is the most serious level of Munchausen by proxy. When a physician in good faith suspects a case of Munchausen by proxy towards a child, the doctor is obligated to contact child protection authorities, since the health of that child may be in danger. This behavior of the parent may be life-threatening to the child. However, such accusations are hard to prove and require constant monitoring. When the perpetrator of Munchausen by proxy is found out, psychological interventions have limited success.

What Characterizes People Who Have Factitious Disorders?

It is difficult to develop a typical profile for someone with a factitious disorder because the reported cases are so few. An early study of Munchausen syndrome found more women than men tended to have the disorder. The afflicted was usually a young woman with poor psychosocial development. For most of her life, she had been dependent on her mother, but her dependency needs remained unfulfilled. She tended to have very little emotional support from her father and her verbal skills were poor. This pattern implies that she is looking to fulfill unmet needs but does not have the social skills necessary to seek them in direct, adaptive manners. Ganssen syndrome mostly afflicts men, but this finding may be based on the prison context of most studies. Most of those afflicted with Munchausen by proxy are young mothers.

How Do Doctors Diagnose and Treat Factitious Disorder?

Factitious disorders are very difficult to diagnose and treat. Because of the persistent deceit on the part of the afflicted, it is not easy for the doctor to determine what the problem actually is. The doctor must first rule out the possibility that the symptoms are real. If a factitious disorder is suspected, the doctor must determine how well the patient is familiar with the disease being faked. The patient may know the symptoms but not their proper order. If the patient then reports something unusual, such as the symptoms appearing in the wrong sequence, then the doctor may be cued that the patient does not really have the illness.

A complete diagnosis should involve a careful reading of the medical records for any inconsistencies or abnormalities. The doctor should also interview friends and family. Because the factitious disorder patient is not trying to get well, there should be some system of monitoring the patient's compliance with treatment.

Treatment is not easy because the causes of these disorders usually signify deep psychological problems, likely an underlying personality disorder. The mental health professional offering therapy has to be careful at first to develop a supportive relationship with the afflicted. There should be no early confrontation regarding the patient's lies except in a crisis situation. Therapy can follow a conventional pattern after the rapport has been established. However, the therapist has to be constantly aware that the patient has a weak ego and low self esteem.

Can Factitious Disorder Be Prevented?

As of 2009, there were no preventative measures. In most mental health issues, the person's family should be able to notice behavioral irregularities and provide the necessary support. However, if early studies of Munchausen syndrome are correct, afflicted individuals often do not have family support. Ganssen syndrome did not appear to be preventable either.

▶ See also **Conversion Disorder**

Resources

Books and Articles

Feldman, Marc D. *Playing Sick? Untangling the Web of Munchausen Syndrome, Munchausen by Proxy, Malingering, and Factitious Disorder*. New York: Brunner-Routledge, 2004.

Phillips, Katharine A., ed. *Somatoform and Factitious Disorders (Review of Psychiatry)*. Arlington, VA: American Psychiatric, 2001.

Organization

Cleveland Clinic. 9500 Euclid Avenue, Cleveland, OH, 44195.
Toll free: 800-223-2273. Web site: http://my.clevelandclinic.org/disorders/Factitious_Disorders/hic_An_Overview_of_Factitious_Disorders.aspx.

Fainting (Syncope)

Fainting is a brief loss of consciousness caused by a temporary drop in blood flow to the brain.

Marie Osmond Passes Out

One minute, Marie Osmond was finishing a performance with her partner on the television show *Dancing with the Stars* and waiting for their scores from the judges. The next minute, she was peering up at the concerned faces of her dance partner and the show's host. She had just had a fainting spell, and this was not her first. The 2007 incident made the news because it happened on live TV to a famous person, but fainting is common. As often happens with people who experience fainting spells, Osmond recovered within minutes and had no lasting effects from the incident.

What Is Fainting?

Fainting, also known as syncope (SING-ko-pee), is a brief loss of consciousness caused by a temporary drop in the flow of oxygen-carrying blood to the brain. Without enough oxygen, brain processes slow down, and the person may pass out briefly. The sudden drop in blood flow can occur for several reasons, including an irregular heart rate or rhythm, a dip in blood pressure, or the pooling of blood in the legs usually after a prolonged period of standing. Although fainting can be scary and embarrassing, it usually is not a cause for panic. Healthy people sometimes faint

BLACKING OUT IN BLUE SKIES

In World War II, fighter pilots sometimes lost their lives because of fainting.

During high-speed flight, very rapid changes in speed create a force that is expressed as a unit of gravity (g). A force of 4 to 6 g makes blood become very heavy and pool in the lower part of the body, robbing the brain of its blood supply. Many high-speed moves create a force this great. For example, pulling out of a dive can produce a force up to 9 g. When this happened to the pilots, they sometimes fainted and crashed.

Scientist Wilbur R. Franks (1901–1986) had the job of finding a solution to this problem. In 1942, he invented the first anti-gravity suit, a flight suit with special pants that apply pressure to the legs and belly, forcing blood back into the upper part of the body. Franks's invention gave Allied pilots a competitive edge during the war. The suits later worn by jet pilots and astronauts were based on his design.

when they are extremely tired, get bad news, or see something upsetting. In other cases, however, fainting may be a sign of a more serious medical condition.

What Causes Fainting?

One in three people faint occasionally. The problem occurs in people of all ages, although it is most common in people over 65 years of age. Fainting has many possible causes. Some of the more frequent ones are described below.

Heart disorders The most serious causes of fainting usually involve the heart or blood vessels. In some cases, the heart beats too fast or with an irregular rhythm, reducing the amount of blood it pumps. In other cases, individuals may have a narrowing of the valve that lets blood out of the heart or a partial blockage of the blood vessels that carry blood to the head, limiting blood flow to the brain.

Emotional stress Stress, fright, or sudden pain can arouse the nervous system, which, in turn, can signal the heart to slow down or the blood vessels to widen. If such changes happen too quickly a person's blood pressure can drop suddenly, which reduces blood flow to the brain, and the person may faint.

Heavy sweating Sweat contains sodium, a mineral that plays a key role in blood pressure control. Heavy sweating is another possible cause of a sudden dip in blood pressure. People who take part in strenuous physical activities under hot, humid conditions may experience this problem.

* **nervous system** is a network of specialized tissue made of nerve cells, or neurons, that processes messages to and from different parts of the human body.

DANCING MANIA AND MASS FAINTING

The phenomenon of mass fainting was reported to have occurred in the Middle Ages as a result of what was known as dancing mania.

Minstrels who played intoxicating music at medieval festivals reportedly induced dancing mania. The music stimulated fits of wild dancing, leaping, hopping, and clapping that led to hyperventilation, heart palpitations, and other symptoms.

Dancing mania curiously parallels the fainting that sometimes occurs at present-day rock concerts.

Standing up quickly When most people stand up, the nervous system* triggers a reflex response that increases the heart rate and blood pressure. This response insures that enough blood gets to the brain. In some people, particularly the elderly, these responses may not occur fast enough. Blood may pool in the legs. When too little blood reaches the brain, the person may faint.

What Happens When People Faint?

Symptoms Some people simply lose consciousness and slump down without warning. However, many people feel dizzy, lightheaded, or sick to their stomach just before they faint. They may become sweaty and pale, and they may have a graying out of vision. By definition, a faint does not last long. Falling down locates the head at the same level as the heart. This position helps restore blood flow to the brain. The person soon regains consciousness, usually within a minute or so.

Treatment A person who is feeling faint should lie down immediately and not try to stand or walk. If the person who faints does not regain consciousness within a minute or two, someone must get emergency medical help for that person. While awaiting emergency help, adult bystanders probably will elevate the legs of the person who has fainted; loosen belts, collars, or tight clothing; and check that the person's airway remains open, as people who faint may vomit as well. They will not move the person who has fainted until medical help arrives, because the fall may have injured the person.

The person who has fainted probably will regain consciousness quickly but may continue to feel a bit weak for a little while. To prevent fainting again, the person should continue lying down for a few minutes.

Even when people recover promptly, they should contact their doctors about a first fainting attack, about repeated fainting spells, or about other

possible symptoms, including irregular heartbeat, chest pain, shortness of breath, blurred vision, confusion, or trouble talking.

▶ See also **Heart Disease • Hypertension • Stress and Stress-Related Illness**

Resources

Books and Articles

Grubb, Blair P. *The Fainting Phenomenon: Understanding Why People Faint and What to Do about It*, 2nd ed. Malden, MA: Blackwell, 2007.

Organization

American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org>.

Familial Mediterranean Fever

Familial Mediterranean fever is an inherited inflammatory disorder that causes repeated episodes of fever, inflammation, and pain.

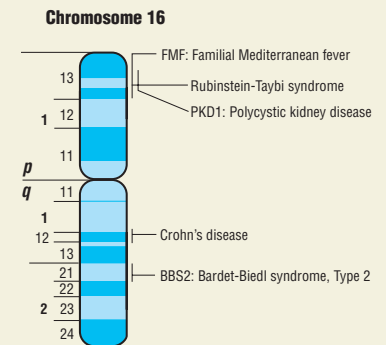
What is Familial Mediterranean Fever?

Familial Mediterranean fever (FMF) is an inherited inflammatory disorder that causes repeated episodes of fever, inflammation, and pain. The episodes develop over two to four hours and may last from several hours to several days. The periods of illness usually resolve without treatment but may damage body organs over time.

The gene* associated with FMF is called the Mediterranean fever gene (MEFV). FMF is inherited and develops in individuals who get two copies of the recessive* MEFV gene from their parents. Individuals with one copy of the gene are considered carriers of the disease. The children of two carriers have a 25 percent chance of having the disease, the children of a carrier and someone with FMF have a 50 percent chance of having the disease, and children of two FMF individuals are certain to have the disease. FMF is seen among only certain ethnic populations, and it is not as widely known in the United States. The symptoms associated with FMF may resemble symptoms of other more common medical disorders and be misdiagnosed.

Who Gets Familial Mediterranean Fever?

FMF occurs among people who live in areas around the Mediterranean Sea. Among Ashkenazi Jewish people, who make up a large portion of the Eastern European and American Jewish population, the FMF incidence* is one case per 73,000 people. Sephardic Jewish people, who are descended



ABCC6: Pseudoaxanthoma elasticum (16)

▲ Chromosome 16 controls familial Mediterranean fever. *Illustration by Argosy. Reproduced by permission of Gale, a part of Cengage Learning.*

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **recessive** describes a gene that is not dominant, one that requires a second identical recessive gene in order for the trait to show in the individual. When a recessive gene is paired with a dominant one, the individual is said to be a carrier of the trait.

* **incidence** means rate of occurrence.

- * **appendicitis** (ah-pen-dih-SY-tis) is an inflammation of the appendix, the narrow, finger-shaped organ that branches off the part of the large intestine in the lower right side of the abdomen.
- * **appendectomy** a surgical procedure in which the appendix is removed.
- * **gout** occurs when deposits of uric acid in the joints cause inflammation and pain.
- * **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.
- * **amyloidosis** a condition in which excessive amounts of a protein known as amyloid are created by the body and deposited in tissues causing damage.

from Jewish populations in Spain, have a rate of one FMF case per 250 to 1,000 people. Some studies have shown that Arabic populations have a rate of one case per 2,600 people for FMF, and Turkish populations have a rate of one case per 1,000. Studies done on Armenian populations have shown a rate of one case per 500 people, although some studies have shown even higher rates for Armenians. FMF occurs more often in adult men than women and is usually seen in individuals younger than 40 years of age.

What Are the Symptoms of Familial Mediterranean Fever?

FMF symptoms include fever, which may range from 100 to 104 degrees Fahrenheit. If an episode is a mild one, the fever may be the only symptom. Most people with FMF experience episodes of abdominal pain and inflammation, which may be misinterpreted as appendicitis*. Consequently, people with FMF sometimes have procedures they do not really need, such as appendectomies*.

FMF sometimes causes inflammation of the tissue surrounding the lungs and heart. Inflammation of the joints is more common and usually involves the wrists, knees, and ankles. Joint symptoms may resemble those of more common medical problems such as gout*. FMF sufferers may experience skin rashes, especially on the lower extremities. Muscle pain may be confused with other muscle disorders. Male FMF sufferers may have painful inflammation of the scrotum, while females may experience pelvic inflammation. One-third of females with FMF are infertile, and FMF causes a higher rate of miscarriage*.

FMF sufferers sometimes develop amyloidosis* where a protein called amyloid is deposited in body tissues, which can damage both the tissues and the kidneys that filter excess proteins from the blood. Kidney failure can occur in some patients who are not treated with medicine.

How is Familial Mediterranean Fever Treated?

Individual bouts of FMF usually end without medical help, but repeated inflammation can damage body organs and cause other medical complications. Therefore, doctors try to reduce the number of attacks and decrease the inflammation during attacks. The drug colchicine is commonly prescribed. People who take this drug usually have fewer complications and a longer lifespan. An additional benefit is that colchicine treatment may improve the chances of women having a successful full-term pregnancy. However, as of the early 2000s, colchicine had not been proven safe for use by pregnant women. The potential benefits need to be weighed against the potential risk.

Do People with Familial Mediterranean Fever Get Better?

FMF is a difficult disease to live with due to its recurrent, painful, and disruptive nature. Patients who are not receiving colchicine therapy may develop kidney failure and die before the age of 50. If amyloidosis is a

complication, the risk for renal failure is greater and death by the age of 50 is more likely. Daily therapy with colchicine greatly improves the chance of survival. Individuals with FMF on colchicine may have a normal lifespan if therapy is initiated before the development of excessive protein for the kidneys to filter and before kidney damage occurs.

▶ See also **Genetic Diseases**

Resources

Organizations

Chicago Center for Jewish Genetic Disorders. Ben Gurion Way, 30 South Wells Street, Chicago, IL, 60606. Telephone: 312-357-4718. Web site: <http://www.jewishgeneticscenter.org/what/sephardi/familial.asp>.

National Organization for Rare Disorders. 55 Kenosia Avenue, P.O. Box 1968, Danbury, CT, 06813-1968. Toll free: 800-999-6673. Web site: http://www.rarediseases.org/search/rdbdetail_abstract.html?disname=Mediterranean+Fever,+Familial.

- * **bone marrow** is the soft tissue inside bones where blood cells are made.
- * **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.
- * **pre malignant** medical term used to describe a disease or condition considered highly associated with future cancer.
- * **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.
- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

Fanconi Anemia

Fanconi anemia is a rare genetic syndrome, involving failure of the bone marrow to produce blood cells.*

What Is Fanconi Anemia?

Fanconi anemia (FA) is a rare genetic* syndrome, involving failure of the bone marrow to produce blood cells. FA is a premalignant* medical disorder, which means that individuals with FA often eventually develop some form of cancer. However, the most common cause of death among people with FA is bone marrow failure leading to a life-threatening anemia*. FA patients often have various characteristic birth defects and other medical problems in addition to the anemia and cancer.

What Is the Connection Between Fanconi Anemia and Blood Production?

The cells that make up blood include red blood cells that carry oxygen to body tissues, white blood cells that function as part of the immune system* to fight off infections, and platelets, which are necessary for blood clotting and wound closure. Each blood component is critical to maintaining life. Bone marrow has an essential role in the production

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.

of mature blood cells. FA involves a type of anemia known as aplastic anemia, in which all three types of blood cells are deficient due to bone marrow failure. Having such critical body components deficient leads to many different medical problems that can be life threatening.

How Is Fanconi Anemia Inherited?

FA is an autosomal recessive genetic disorder. Autosomal recessive disorders are diseases in which both parents must be carriers of the gene in order for their child to inherit the condition. If both parents are carriers, there is a 25 percent risk for the child to be affected by the disease. There are at least 13 known genes* that can be mutated (changed) and cause FA. Only one of these 13 is needed to cause the disease. The proteins expressed by these genes may cause DNA* damage that affect bodily processes such as blood production by the bone marrow and the start of cancer. However, the exact mechanism by which these gene mutations cause birth defects, bone marrow failure, and cancer was not known as of 2009.

Who Inherits Fanconi Anemia?

In the United States, one in 300 individuals carry the mutated genes that can cause FA. About one in 360,000 people in the United States are born with the disease. In the United States, the Ashkenazi Jewish population has a higher rate of one carrier per 90 people and one case per 30,000 people. In other countries, FA occurs at similar rates. Certain ethnic groups have higher rates of carrying the FA genes. These groups include sub-Saharan Black people and Spanish gypsies.

What Causes Fanconi Anemia?

FA is a genetic disorder caused by mutations in one of 13 different genes, but how this mutation happens was not known as of 2009. The cells affected by these mutated genes may be more susceptible to environmental factors that cause cancers or the cells may not have the self-protective mechanism that healthy cells have.

What Signs and Symptoms Are Typical in Fanconi Anemia?

Babies born with FA typically have low birth weight. Three-fourths of all people with FA have visible birth defects, too. Altered skin pigment known as café au lait spots for their light brown color is characteristic. Many children with FA are short and have small heads. They may also have abnormal thumbs, eyes, and ears, along with impaired sight and hearing. Multiple internal organs may also be defective, such as the kidneys, gastrointestinal tract (often esophagus, small intestine, or anus), heart, or lungs.

As children with FA continue to grow, bruises and small blood hemorrhages under the skin may be the first sign of blood problems associated with aplastic anemia and suggest platelets* deficiency. These individuals

have pale skin and tire easily, which is caused by red blood cell deficiency and decreased oxygen delivery to tissues. Frequent infections are caused by white blood cell deficiency.

How Is Fanconi Anemia Diagnosed and Treated?

The combination of obvious birth defects and blood disorders indicate FA. In one-fourth of FA patients, however, a diagnosis of FA only occurs after leukemia* or some other form of cancer is discovered. DNA tests can detect mutations in the known FA genes.

FA patients are often treated by a team of physicians, each of whom may address a different aspect of the disease. Treating the aplastic anemia may call for a bone marrow transplant. If appropriate bone marrow is not available, blood transfusions* may be performed to replenish blood cells needed by the body. Specific drugs that enhance blood cell production may also be prescribed. These drugs cannot correct the problem, but they may help reduce symptoms. For example, some drugs can help reduce bleeding. Blood counts are performed at least every three months, and bone marrow examination is necessary at least once per year. Sometimes surgery can help correct certain birth defects.

How Does Fanconi Anemia Cause Cancer?

Having FA makes a person likely to develop many kinds of cancer, even after bone marrow transplantation. People with FA often develop leukemia, a cancer originating in blood cells. The type of leukemia most often associated with FA is called acute myelogenous leukemia (AML), which is characterized by a rapid and unhealthy increase in immature white blood cells that cannot be used by the body to fight infection. The accumulating immature cells replace the normal bone marrow as well as the normal blood cells and are cancerous. This condition is life threatening. AML progresses rapidly and is typically fatal within weeks or months if left untreated. Other types of cancer associated with FA are characterized by tumors of the head and neck or tumors of the esophagus, reproductive tract, brain, liver, kidney, and lung.

What Can People with Fanconi Anemia Expect?

FA is a fatal disorder if left untreated and is sometimes fatal at an early age even with treatment. If a patient undergoes a bone marrow transplant along with other supportive treatments and has any severe birth defects corrected in a manner that sustains the person's life, then the prognosis is improved. With the best medical care and circumstances, a person with FA may live about 30 years. Making a diagnosis of FA early in the course of the disease improves the prognosis, as well as early cancer detection. However, the quality of life may be severely affected by frequent medical tests and procedures, complications such as birth defects or cancer, and various possible physical limitations.

* **leukemia** (loo-KEE-me-uh) is a form of cancer characterized by the body's uncontrolled production of abnormal white blood cells.

* **blood transfusions** (trans-FYOO-zhunz) are procedures in which blood or certain parts of blood (such as specific cells) are given to a person who needs them due to illness or blood loss.

▶ See also **Anemia, Bleeding, and Clotting • Genetic Diseases**

* **photosensitive** means responsive to light.

* **optic nerve** is the nerve that sends messages, or conducts impulses, from the eyes to the brain, making it possible to see. The optic nerve is also referred to as the second cranial nerve.

Resources

Organizations

Fanconi Anemia Research Fund. 1801 Willamette Street, Suite 200, Eugene, OR, 97401. Toll free: 888-326-2664. Web site: <http://www.fanconi.org/index.htm>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: http://www.nhlbi.nih.gov/health/dci/Diseases/fanconi/fanconi_what.html.

Farsightedness

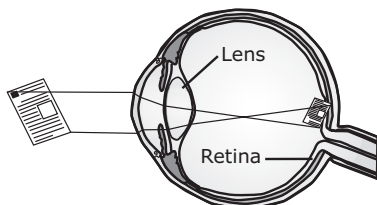
Farsightedness is an eye disorder that causes objects that are close to a person to appear out of focus or blurry, while objects at a distance appear clear.

What Happens If You Are Farsighted?

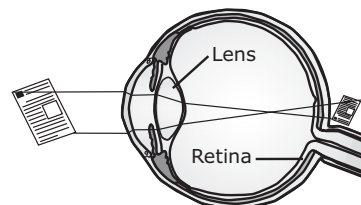
To people with farsightedness, the words on this page would seem blurry, unless they were wearing prescription (pre-SKRIP-shun) eyeglasses or contact lenses designed to correct the problem. But if they looked up from the page to read a sign across the room, they probably could read it easily.

What Is Farsightedness?

In most cases, farsightedness occurs when the eyeball is shorter than normal. For an object to appear clear, the light passing through the eye must focus on the retina, a layer of photosensitive* cells on the back of the eye. The retina is like the film in a camera. It is where the image passing through the eye is projected and then sent along the optic nerve* to the brain. In the brain, the image is developed into what we see. If the eyeball is too short, the image that is projected onto the retina by close objects is blurred, and the person is said to be farsighted.



Normal vision: near object is focused on the retina



Farsightedness: near object is focused behind the retina

Anatomy of the eye showing normal and farsighted focus. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

People with farsightedness usually have the disorder from birth. It is probably inherited from parents; however, just because a parent is farsighted does not mean the child necessarily will develop the problem too. Babies and younger children often are able to adapt to the problem. Muscles around the eyeball can change its shape, making it longer and allowing the image to be focused properly on the retina. As a child gets older, however, the muscles cannot do as good a job changing the eyeball's shape, and images close up are out of focus.

How Do Doctors Diagnose and Treat Farsightedness?

It can take many years for the symptoms of farsightedness to become noticeable. Eventually, people with farsightedness notice problems while reading or seeing objects that are close, whereas objects that are farther away remain clear. They also may start to get headaches after reading or doing other close work, and they may feel as if their eyes are tired.

An ophthalmologist* can diagnose farsightedness and correct it easily with prescription eyeglasses or contact lenses. These lenses change the focus of the images passing into the eye so they are projected properly onto the retina. Surgery to correct the problem is available, but it is not as widely used as surgery to correct nearsightedness.

Presbyopia Many people become more farsighted as they age. They develop a condition known as presbyopia (pres-be-O-pe-a), which is Latin for “old eyes,” that causes close objects to appear out of focus. Presbyopia results because the lens at the front of the eyeball becomes thicker and less flexible as a person ages. This change causes the eye to have trouble focusing the images passing through the lens. The first sign of presbyopia may be noticed when adults pass age 40. They start to find they cannot read the newspaper as well. People joke that their arms are too short because they try holding the paper or book farther away so they can see it clearly. People with farsightedness may need stronger prescription eyeglasses once they pass age 40. People with nearsightedness may need bifocals*.

▶ See also **Nearsightedness** • **Presbyopia**

Resources

Organizations

American Optometric Association. 243 N. Lindbergh Boulevard, St. Louis, MO, 63141. Toll free: 800-365-2219. Web site: <http://www.aoa.org/hyperopia.xml>.

National Eye Institute. 2020 Vision Place, Bethesda, MD, 20892-3655. Telephone: 301-496-5248. Web site: <http://www.nei.nih.gov>.

* **ophthalmologist** (off-thal-MOLL-o-jist) is a medical doctor who specializes in treating diseases of the eye.

* **bifocals** or multifocal (progressive) lenses are prescription eyeglasses that have lenses divided into two or more sections. The bottom section allows a person to see things clearly that are close, and the top section allows a person to see things clearly that are far away.

- * **panic attack** is a period of intense fear or discomfort with a feeling of doom and a desire to escape. The person may shake, sweat, be short of breath, and experience chest pain.
- * **behavioral** means related to the way a person acts.
- * **nervous system** is a network of specialized tissue made of nerve cells, or neurons, that processes messages to and from different parts of the human body.

FASD See *Fetal Alcohol Spectrum Disorders (FASD)*.

Fears and Phobias

Fear is a normal emotion, experienced when a person senses danger. Fear includes physical, mental, and behavioral (bee-HAY-vyor-al) reactions. Certain childhood fears are common and normal.

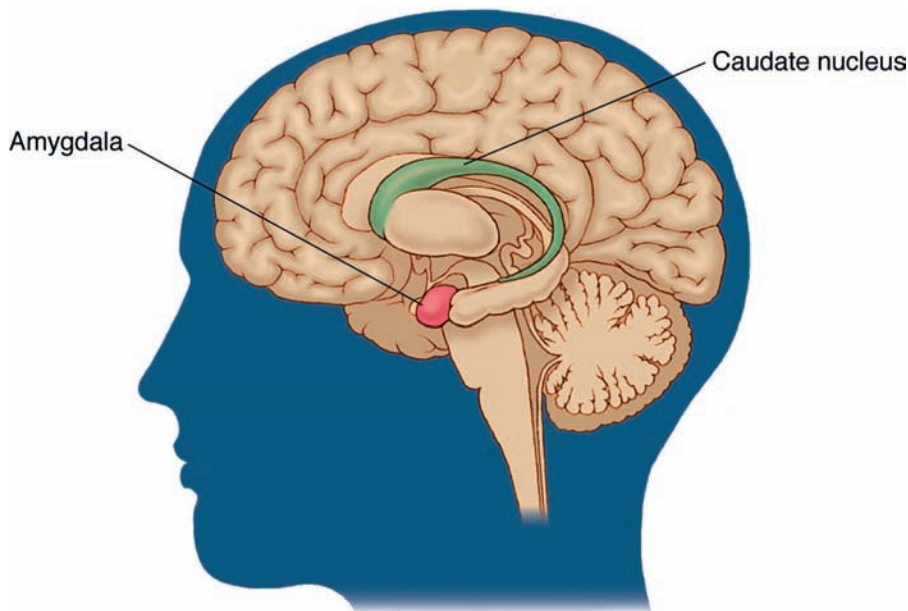
A phobia is an intense, persistent fear of a particular object or situation. Phobias can be narrowly focused or more general in nature. A broad spectrum of phobias have been reported. Social phobia is an intense, persistent fear of being painfully embarrassed in a social setting. Agoraphobia is fear of being in any situation that might provoke a panic attack* or from which escape might be difficult.

What Is Fear?

Fear is the emotion that people feel when they sense that they are in danger. It is a protective emotion, which signals danger and helps a person to prepare for and cope with it. Fear includes physical, mental, and behavioral* reactions.

The physical reaction to fear is called the “fight or flight” response. Fight or flight is an involuntary response, a response that a person cannot control consciously but that is controlled by the body’s nervous system*. It is the body’s way of preparing to run from danger or to fight. The heart

► Cross-section of a brain showing the amygdala and caudate nucleus—the structures believed to be linked to negative emotions such as fear and anger. The amygdala is believed to be fully developed by the time a baby is born. The prefrontal cortex (the front of the brain) where thinking and planning take place, takes longer to mature. This may explain why it takes time for children to learn how to control their fears. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



beats faster, and the blood pressure and breathing rate increase. Oxygen-rich blood rushes to the large muscles of the body, which are tensing to prepare to fight. The pupils of the eyes grow larger to help the eyes scan for danger. Epinephrine*, also called adrenaline*, is released to prepare the body for quick action. Sweat is produced to cool the body.

Mentally, fear triggers thoughts about the danger or threat that the person senses. These thoughts may size up the danger, anticipate what might happen, or imagine ways to avoid harm. Behaviorally, the person may startle or jump and then run, freeze, or get ready to fight.

Different Kinds of Fear

Fear and anxiety Fear and anxiety (ang-ZY-e-tee) are similar emotions but with an important difference. Fear is the emotion that people feel when a danger is actually present, while anxiety is the fear connected with worrying about danger that might happen.

Childhood fears Certain fears are common and normal during childhood. In fact, all children have fears at times during their lives. Because so much of the world is new to children, they may fear certain things until they understand them better or are better able to cope. Fear serves a protective purpose, keeping children appropriately cautious while they learn about what is safe and what is dangerous.

Fears of animals, loud noises, or being in water are common in very young children, who are still learning to understand the information their senses are gathering. Babies as young as eight months old may fear strangers, and this is a sign that the baby is able to recognize his parents and to tell them apart from strangers.

Young children often fear imaginary creatures such as monsters, ghosts, and witches. Because imagination is developing at a rapid pace but the young child has not yet developed the ability to tell the difference between what is real and what is make-believe, these imaginary things can seem dangerous. Children tend to outgrow fears of imaginary creatures as soon as they are able to understand the difference between real and pretend.

Older children are more likely to fear real-life things such as burglars, being hurt or lost, or natural disasters such as earthquakes and extreme weather like hurricanes. These children may need reassurance and support from parents while they learn to cope with worry and fear and gain confidence in dealing with life's challenges.

Learned fears Fearful parents tend to have fearful children. Without realizing it, parents may teach children to be too fearful or cautious of certain things, not so much by what they say but by how they act. If a mother always crosses the street to avoid dogs and gets a little pale when a dog is nearby, chances are the child will learn to be afraid of dogs. Research has found that fears or worries can run in families. It may be that certain fear reactions are inherited, but people do not have to live with them just because they may be inherited.

What Is So Scary to Children?

Most school-age children report that they have between five and seven fears at any one time. Here are some of the most common childhood fears and the age they usually occur:

- **infants (up to 2 years old):** fear of falling, loud noises, strangers
- **toddlers (2–3 years old):** fear of loud noises, flushing the toilet, dogs and other animals
- **preschoolers (3–5 years old):** fear of monsters, imaginary creatures, getting lost, the dark, insects, thunder and lightning, injury, shots
- **early-school-age children (6–10 years old):** fear of burglars, divorce, tornadoes, hurricanes, injury, being bullied, losing a parent.

* **epinephrine** (eh-pih-NEH-frin) is a chemical substance produced by the body that can also be given as a medication to constrict, or narrow, small blood vessels, stimulate the heart, and cause other effects, such as helping to open narrowed airways in conditions like asthma and croup.

* **adrenaline** (a-DREN-a-lin), also called epinephrine, (ep-e-NEF-rin), is a hormone, or chemical messenger, that is released in response to fear, anger, panic, and other emotions. It readies the body to respond to threat by increasing heart rate, breathing rate, and blood flow to the arms and legs. These and other effects prepare the body to run away or fight.

Fear + Distress or Fear + Excitement?

The feelings and sensations people get when they are afraid or anxious are similar to the excited thrill people feel when they go on a scary ride at an amusement park or see a scary movie. Some people actually like the feeling, while others do not. Research psychologists (sy-KOL-o-jists) have described anxiety as a complex emotion that is made up of fear plus one or more other emotions, such as distress, anger, excitement, shyness, or guilt. Anxiety that is made up of fear plus excitement will be experienced differently from anxiety that is made up of fear plus distress, for example.

* **cognitive behavioral therapy** (KOG-nih-tiv be-HAY-vyuh-rul THAIR-uh-pee) is treatment that helps people identify negative ways of thinking and behaving and change them to more positive approaches.

Fears can be “unlearned.” If the fearful child watches another child calmly approach and pat a dog, she is learning that petting a dog can be safe and pleasant. By watching and then learning to go toward the dog slowly herself, with the right adult support, she can learn to overcome her fear of dogs. When leaving home, even to go to school, is too scary or when people avoid important activities because of fearfulness, professional help may be needed to help “unlearn” fears.

Are All Fears Outgrown?

Most childhood fears pass with time, maturing, and support from caring adults. Childhood fears do not get better by teasing, threatening, or forcing the child to meet the feared object or situation. Such remedies are likely to produce shame and lower self-esteem, and they may even worsen fear. The protective emotion of fear is not outgrown. People feel fear throughout life whenever they sense danger.

When to Get Help for Fears

Sometimes a normal childhood fear can become intense or last well beyond the age when a child usually outgrows it. If this happens, or if fears cause so much distress that they interfere with everyday life, professional help may be needed to help get over their fears.

Cognitive-behavioral therapy* is often helpful. It may involve teaching coping skills, supporting the child’s gradual approach to the feared situation, and coaching parents to provide needed reinforcement and support.

Hannah’s Story

Whenever 15-year-old Hannah entered a building with more than two stories, she checked to see if the building had stairs. Hannah was intensely afraid of riding in elevators. Her friends teased her, and she readily admitted that her fears were “silly.” But when an elevator door closed, Hannah began to sweat and her heart started to beat faster. “It’s like I’m trapped,” she told her friends. “As if I’ll never, ever escape.”

What Are Phobias?

A phobia (FO-bee-a) is an intense fear of a specific thing, such as dogs or spiders or riding in elevators. With a phobia, the fear a person feels is out of proportion to the real danger. The person with a phobia is very worried about the possibility of seeing the feared object or experiencing the feared situation. People with phobias may go to great lengths to avoid any situation that might bring them face to face with the object of their fear. Because of all the worry and avoidance, a phobia can interfere with a person’s everyday life.

Social phobias At some time in their lives, people find themselves in a social situation that makes them uncomfortable. But phobias involve more than social discomfort, and they take several forms. For

individuals with a social phobia, the exposure to a particular event provokes such enormous anxiety that it can trigger a panic attack*. A person with a social phobia will do almost anything to avoid similar social situations.

Social phobias are often associated with persistent fears of humiliation or embarrassment. These occur commonly in situations such as walking into a classroom or even leaving one's home. Individuals may feel as if everyone is looking at them. This phobia often persists. It may intensify with the result that when affected people venture into social situations, they spend all of their time alone, attempting to avoid other people.

Triggers When exposed to the trigger for a specific phobia, individuals may experience elevated levels of anxiety, including a panic attack. People with specific fears, such as Hannah with her fear of elevators, may know that their fear might be seen as “silly” or “irrational,” by others, but the fear still produces significant distress for them. Sometimes, particularly with children, affected individuals may not understand that their fears are excessive or unwarranted.

Trauma Traumatic events often contribute to the development of specific phobias. Social phobias often begin in mid-teens, with the average onset between the ages of 15 and 20, although some social phobias can begin in childhood. However, phobias can start at any age. Phobias may begin when two unrelated events are associated in someone's mind. Research has shown that social phobias may have a hereditary component.

What Are Common Types of Phobias?

The most common variety of phobia involves social situations. Social phobia is a persistent fear of humiliation or embarrassment in social settings. Closely related to social phobia is agoraphobia (literally “fear of the market place”), which is a fear of being in locations or situations from which escape might be difficult or embarrassing. People suffering from agoraphobia believe that they may suddenly develop a panic attack. To cope, people with agoraphobia avoid crowds or situations they find threatening. When they cannot do so, they are often filled with anxiety.

Other specific phobias such as arachnophobia (fear of spiders) or hydrophobia (fear of water) can cause people to avoid specific situations in which they might confront what frightens them.

How Are Phobias Treated?

Several prescription medications are used to treat social phobias. People with specific phobias may also benefit from psychotherapy* that uses systematic or progressive desensitization. In this form of therapy, affected persons work with a therapist in a safe environment. They are gradually exposed to the situations or objects that cause fear. They learn techniques

Examples of Phobias

The specific phobias that affect people are numerous and varied. Ablutophobia, is a fear of washing or bathing; zoo-phobia is an unrealistic fear of animals. Other common (and uncommon) phobias include the following:

- Arachibutyrophobia: fear of peanut butter sticking to the roof of the mouth
- Arithmophobia: fear of numbers
- Genuphobia: fear of knees
- Ichthyophobia: fear of fish
- Melissophobia: fear of bees but not other insects
- Pupaphobia: fear of puppets
- Pteromerhanophobia: fear of flying
- Testophobia: fear of taking tests
- Triskaidekaphobia: fear of the number 13

* **panic attack** is a period of intense fear or discomfort with a feeling of doom and a desire to escape. The person may shake, sweat, be short of breath, or have chest pain.

* **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.

involving relaxation, guided imagery, and deep breathing that allow them to work through their fears in a gradual manner.

▶ See also **Anxiety and Anxiety Disorders • Panic Disorder**

Resources

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Peurifoy, Reneau Z. *Anxiety, Phobias, and Panic*, rev. and updated. New York: Warner Books, 2005.

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org>.

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.psych.org>.

American Psychological Association. 750 First Street NE, Washington, DC, 20002. Toll free: 800-374-2721. Web site: <http://www.apa.org>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov/health/publications/anxiety-disorders/complete-publication.shtml>.

Feeding Disorders of Infancy and Early Childhood

Feeding disorders of infancy and early childhood occur when a child fails to consume enough to gain weight and grow normally. Unlike children who are finicky but otherwise get sufficient nutrients, children with feeding disorders miss out on some nutrients their bodies need.

The Growing Child: What is Normal?

During the first year, babies grow more than they grow at any other stage of life. Parents give their babies breast milk or formula* until they are at least four months old, and then slowly start adding solid foods, first infant cereal and then baby food. Younger babies drink more often but in smaller doses than older babies. A one-month-old baby, for instance, usually drink two to four ounces of breast milk or formula six to eight times a day, whereas a five-month-old may drink six to seven ounces five to six times a day. During the first year on a healthy diet, a baby gains about one to two pounds per month and about an inch in length for each of the first six months, about a pound and 0.5 inches per month from the age of six to 12 months old.

Throughout infancy and as the child grows up, the doctor continues monitoring the youngster's height and weight. The doctor uses these measurements and other tools to ensure that each child is healthy and developing well. Sometimes, doctors find that certain children are not developing well, and one of the reasons may be a feeding disorder.

What Are Feeding Disorders?

Infants and children with feeding disorders do not eat or drink enough, or do not consume a wide enough range of foods to get a sufficient amount of the nutrients they need to grow up healthy. This pattern often becomes evident when children gain too little weight or even lose weight and show signs that they are not developing properly. Medical professionals often call this "failure to thrive." Besides a slowing of or a stop in physical growth, children with feeding disorders sometimes also develop other problems, including difficulties with cognition, which includes learning, reasoning, analyzing, and other thought processes.

Feeding disorders often are the result of difficulties in one of a number of different areas of the digestive system that process food. These areas include the following:

- Mouth
- Pharynx (FARE-inx; a short tube that extends from the mouth to the esophagus)
- Esophagus (a tube that connects the pharynx to the stomach)
- Stomach, including the pylorus (portion of the stomach that attaches to the duodenum, the first part of the small intestine)
- Small intestine (a long tube that completes digestion and moves waste matter to the large intestine for elimination)

A variety of feeding disorders occur in each of these parts of the digestive system. Examples are listed below.

Mouth-related feeding disorders While many feeding disorders are noticeable only after a baby begins to lose weight, cleft palate* and lip are evident immediately at birth. Cleft palate and cleft lip are birth

* **formula** is a prepared, nutritious drink or a dry drink mix designed specifically for infants.

* **cleft palate** is a gap or split in the roof of the mouth (the palate). It occurs when the palate of a fetus does not develop properly during the first months of pregnancy.

defects in which the two halves of the roof of the mouth, called the palate (PAL-ut), did not join. The result ranges from a notch in the upper lip to a large gap in the front of the face that runs from the upper lip to the nose. Clefts are fairly common, affecting one in every 600 to 800 newborns. A child may inherit the condition as a result from a genetic mutation, or it may occur from other causes, such as the mother's diet or use of drugs during the pregnancy. Infants with a cleft palate and/or lip usually have trouble eating, because they cannot make a good seal with their lips and therefore have difficulty getting the suction necessary to draw milk from a mother's breast or from a bottle. The treatment for these problems is surgery. Children who receive the surgery early in their lives usually do well. Unfortunately, some children's families, particularly those in developing countries, cannot afford surgery, and these individuals must go through their lives with the obvious facial defect. These children typically have difficulties speaking and may become withdrawn, sometimes developing behavioral problems.

Children may have other feeding disorders related to abnormalities in the mouth. For instance, a child may have ankyloglossia (an-kih-lo-GLOSS-ee-uh) (be tongue-tied). In this condition, the child's tongue cannot move normally because the piece of tissue (called a lingual frenulum) that anchors it to the floor of the mouth holds the tongue down. Because of this condition, the child may not be able to lift his or her tongue very much. In infants, this can affect their ability to suck from a mother's breast or from a bottle. The condition affects from 4 to 10 percent of all newborns. Sometimes children "grow out of it" because the anchoring tissue may begin to allow more movement by the time the child reaches six years of age. In other cases, the child can learn to live with the condition. Sometimes when the tongue continues to be severely restricted in its movement, however, surgery is necessary.

Pharynx- and esophagus-related feeding disorders From the mouth, food moves into the pharynx and toward the esophagus. A ring of muscle at the top of the esophagus opens long enough for the food to enter. The food travels down to the bottom the esophagus, where another ring of muscle opens temporarily to allow the food to enter the stomach.

In some children, this process does not go smoothly. For example, the ring of muscle at the top of the esophagus—known as the cricopharyngeus (KRY-ko-fare-in-GEE-us) muscle—may not open enough for food to move from the pharynx into the esophagus. This very rare birth defect is called cricopharyngeal achalasia. Doctors sometimes prescribe drugs to relax the muscles, and studies as of 2009 were under way on possible other treatments.

A different feeding disorder may result from another birth defect: the esophagus ends in a pouch instead of connecting to the stomach as it should. This condition, called esophageal atresia (uh-TREE-zee-uh), affects about one in 4,500 newborns. A telltale symptom of this disorder is excessive drooling, sometimes accompanied by choking, coughing,

sneezing, and/or a bluish tint to the skin. The treatment for esophageal atresia is surgery to connect the esophagus and stomach.

Disorders related to the stomach and intestines Experienced parents often slip a towel over their shoulder before laying their infant's head there, because they are so used to their infants spitting up. This frequent regurgitation, which doctors call gastroesophageal reflux, is normal among healthy babies. It occurs because the ring of muscle at the bottom of the esophagus opens up after a baby has eaten so that gas in the stomach can exit up through the esophagus and out of the mouth as a burp. In infants, food in the stomach may also come up with the gas, which results in regurgitation.

Sometimes, however, the regurgitation can become severe and is a sign of a feeding disorder called pyloric stenosis (py-LOR-ik sten-O-sis), which affects about three of every 1,000 babies born in the United States. In this disorder, the infant not only vomits often but begins projectile vomiting, which means that the vomit shoots out of the mouth, sometimes for a distance of two or more feet. Other symptoms, all of which typically begin when the baby is about three weeks old, may include a noticeable decrease in the number and the size of stools, which occurs because too little food is remaining in and being processed by the baby's digestive system; a decrease in the number of wet diapers; no weight gain or an actual loss of weight; tiredness; noticeable rippling movements after a feeding (resulting from contractions of the stomach); a dip or "soft spot" on their heads; and wrinkly skin on the stomach, upper arms, and upper legs.

Pyloric stenosis occurs when the muscles of the pylorus become thickened. This condition results in a smaller opening between the stomach and small intestine. Because of this narrower opening, food can no longer easily progress through the digestive system, and the baby's system ejects it. As of 2009 medical experts were unsure of the cause of this disorder. To diagnose the condition, a doctor asks the parent about the vomiting, checks the baby's weight history, and may press on the baby's stomach to feel for a small bump. The doctor also may order an ultrasound* or blood tests. The treatment is surgery that widens the opening through the pylorus. After successful surgery, babies recover quickly, often returning home within two days.

One especially dangerous condition involving the large intestine is necrotizing enteritis (NEK-ro-ty-zing en-ter-I-tis), which can also cause an infant to stop feeding. It occurs in fewer than five out of every 2,000 newborns, and the vast majority of its victims are premature babies. In this condition, the tissue of the large intestine dies. The treatment typically involves antibiotics and other medical care and sometimes includes surgery. As of 2009 medical professionals were unsure what causes necrotizing enteritis, but the occurrence of occasional outbreaks in the neonatal* intensive care units at hospitals suggests that an infectious agent, such as a bacteria or virus, may be involved.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **neonatal** (ne-o-NAY-tal) means pertaining to the first 4 weeks after birth.

- * **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **cerebral palsy** (se-RE-bral PAL-zee) is a group of conditions, all of which affect a person's ability to move. They are usually caused by injury to the brain before or soon after birth.
- * **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.
- * **hypothyroidism** (hi-po-THY-royd-ih-zum) is an impairment of the functioning of the thyroid gland that causes too little thyroid hormone to be produced by the body. Symptoms of hypothyroidism can include tiredness, paleness, dry skin, and in children, delayed growth and mental and sexual development.

Are Other Systems Involved in Feeding Disorders?

Disorders involving other bodily systems, such as the cardiovascular (heart and blood), endocrine (relating to hormones*), and central nervous system (including the brain), also may interfere with food intake or nutrition and have an adverse effect on a child's growth and development. For instance, some nervous system disorders, such as cerebral palsy* or meningitis*, can cause swallowing problems. In hypothyroidism* (hi-po-THY-roid-izm), symptoms may include choking and a large, protruding tongue, which can make feeding difficult. In this condition, which sometimes occurs in infants and children, a hormone-producing gland called the thyroid gland does not produce a sufficient amount of certain important hormones. Many other examples exist. Some diseases do not cause feeding problems but affect the body's ability to break down or use the nutrients that have already made their way into the stomach and small intestine.

In addition, some children have digestive systems that work fine but have other medical disorders that can affect their feeding behaviors. An example is pica. In this condition, children eat inappropriate items over a period lasting a month or more. For instance, a child who is old enough to know better, may eat dirt, paper, chalk, or other non-food items, or

MOTHER'S MILK IS BEST

The milk that infants receive from their mothers is one of the most important meals they will ever have. Breast milk is important in the baby's growth and development. In addition, the first few days of mother's milk is particularly important. This first milk, called colostrum (ko-LAH-strum), is different from any other milk the mother's breasts will produce. It contains only a little fat, but a high concentration of carbohydrates and protein, as well as antibodies. These antibodies help protect the baby from diseases.

While the research is very clear on the benefits of breast milk, not all babies get it. Women in some cultures around the world do not breastfeed their babies at all, or stop breastfeeding them long before 12 months or more, as many experts recommend.

For instance, in the Asia-Pacific region overall, the breastfeeding rate for the first six months of a child's life is about 35 percent, but in the Philippines, it is just 16 percent and in Hong Kong, only 12 percent. Experts differ on the reasons for the low numbers, but some believe that aggressive marketing by formula-making companies or the belief that formula is some sort of status symbol might be to blame in some instances. By comparison, about 74 percent of U.S. mothers breastfeed newborns, according to the Centers for Disease Control and Prevention. That number drops to about 43 percent by the time the baby reaches six months old, and to 21 percent for 12-month-olds.

large amounts of foods, such as flour or salt, that are typically used as ingredients rather than eaten right out of the box or bag. Medical experts are unsure what causes pica, but some believe it may be caused by an iron deficiency, a psychological or developmental problem, or malnutrition. To treat pica, experts typically recommend that parents work with their doctor, in addition to a psychologist and social worker.

A Mother's Role

Breast milk is very important to the growth and development of healthy babies. It not only provides them with all the nutrients they need to thrive but also helps to protect them from illness because it transfers disease-fighting antibodies* from the mother to the baby. In some cases, however, infants may not take in adequate nutrition because they do not receive enough milk from their mothers. This can happen for several reasons.

One reason is mastitis (mas-TITE-is), which is an inflammation (and sometimes an infection) of the breast tissue that can cause it to redden, swell, and become painful. Although mastitis usually only affects one breast, it still may cause women to cut back on or stop breastfeeding their babies. In the United States, mastitis affects about 10 percent of breastfeeding women. Another quite common problem may also occur. About two to five days after women give birth, their breasts normally swell as they begin to produce milk for the nursing baby. Sometimes, the breasts become very swollen, hard, and painful. The mother may also develop a fever. This condition, called engorgement, may happen if the baby is not nursing frequently enough or is not drinking enough when nursing. When breasts are engorged, the baby may have a difficult time breastfeeding, and even if the baby is able to breastfeed, engorgement may cause the breasts to stop producing as much milk. Women can work with their physicians to help prevent both mastitis and engorgement and to treat these conditions should they occur.

While the majority of women produce enough milk for their babies, occasionally certain mothers do not. This may result because the woman does not feed her baby often enough (or alternately does not frequently enough use a breast pump to remove the milk, which will be fed to the baby later by bottle). Infrequent feeding can trigger the breast to slow its milk production. Low breast milk production can also stem from other factors. For instance, a mother who is taking certain drugs or herbal supplements or is a cigarette smoker may not make enough milk. Mothers with this problem should talk to a medical professional, who may be able to help them boost their milk production.

How Are Feeding Disorders Diagnosed and Treated?

Many feeding disorders are diagnosed when the parent or the doctor notices that the child is not growing at an expected rate. This is why doctors so frequently check a child's weight and height. Parents may also

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

alert a doctor to a possible feeding disorder by reporting any difficulties they may notice when their child is eating, such as excessive vomiting, or a refusal to eat an entire group of foods. Depending on the specific symptoms, a doctor may then order blood tests or other tests to help identify the particular feeding disorder and its cause.

For some feeding disorders, the doctor may simply tell the parent to carefully monitor the child because the condition often disappears on its own. For others, the doctor may prescribe antibiotics or other drugs, may recommend surgery, or may advise one of a variety of other treatments. The exact strategy is determined by the particular feeding disorder the child has and it takes into consider the child's age and overall health.

Resources

Books and Articles

American Academy of Pediatrics. *Your Baby's First Year*, 2nd ed. New York: Bantam Dell, 2005.

Organizations

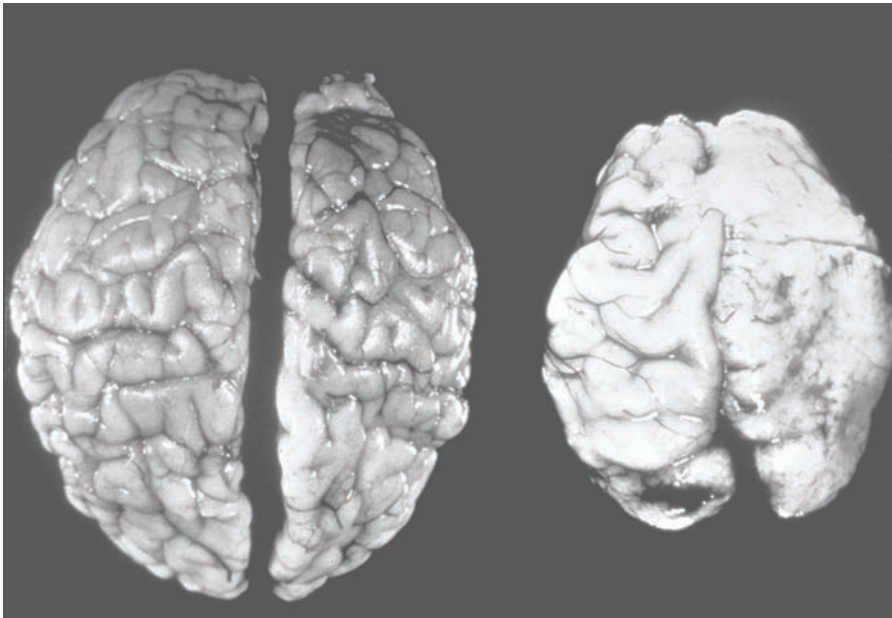
American Academy of Pediatrics. 141 Northwest Point Boulevard, Elk Grove Village, IL, 60007-1098. Telephone: 847-434-4000. Web site: <http://www.aap.org>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

World Health Organization. Avenue Appia 20, 1211 Geneva 27, Switzerland. Web site: http://www.who.int/topics/infant_nutrition/en.

Fetal Alcohol Spectrum Disorders

Fetal alcohol spectrum disorders (FASD) include such conditions as fetal alcohol syndrome (FAS), including partial FAS (pFAS); fetal alcohol effects (FAE); alcohol-related neurodevelopmental disorder (ARND); and alcohol-related birth defects (ARBD). These conditions result in varying degrees of physical, mental and behavioral problems that may develop in a child whose mother drank alcohol during pregnancy. FASD are the most common, known cause of mental retardation in the United States. This entry focuses on fetal alcohol syndrome (FAS) and fetal alcohol effects (FAE).



The brain of a normal infant (left); the stunted brain of an infant with fetal alcohol syndrome (right). Fetal alcohol syndrome is caused by excessive drinking by the mother during pregnancy. *Sterling K. Clarren. Reproduced by permission.*

Sarah, Child of Alcohol

Sarah was quiet and never caused any trouble in elementary school, but she had few friends and never fit in. Although she got fair grades, the teachers never knew how difficult the lessons were for her. When Sarah got to high school, however, she stopped trying to learn the lessons that were difficult for her, and she just barely graduated. Sarah had fetal alcohol effects (FAE), which were the result of her mother's drinking alcohol during pregnancy.

A person with FAE has some of the symptoms of fetal alcohol syndrome (FAS), but not enough to be diagnosed with the full syndrome*. Many of Sarah's teenage friends outgrew their immaturity, forgetfulness, and learning problems, but Sarah did not. The effects of her mother's drinking while pregnant with Sarah continue to follow Sarah throughout her life.

Not everyone with FAS or FAE has been identified, and researchers estimate that as many as one in every 500 children may have FAE or FAS. FAE and FAS are not contagious.

What Causes Fetal Alcohol Syndrome?

Alcohol use during pregnancy can cause fetal alcohol syndrome. When a woman drinks alcohol during pregnancy, it can have a range of effects on the fetus*, from subtle symptoms, such as Sarah had, to full fetal alcohol syndrome. Fetal alcohol syndrome is a group of similar characteristics found in affected babies. These characteristics may include low birth weight, distinctive facial features, learning problems, and mental retardation.

Like most drugs, alcohol passes through the mother's placenta* directly into the fetal bloodstream. In the fetus, alcohol slows down the central

* **syndrome** is a group or pattern of symptoms or signs that occur together.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **placenta** (pluh-SEN-ta) is an organ that provides nutrients and oxygen to a developing baby; it is located within the womb during pregnancy.

* **cleft palate** is a gap or split in the roof of the mouth (the palate). It occurs when the palate of a fetus does not develop properly during the first months of pregnancy.

nervous system and is broken down by the immature liver of the fetus, which cannot handle this poisonous substance effectively. Alcohol stays in the fetus for a long period, even after it has left the mother's body.

The more the mother-to-be drinks the greater the danger to the unborn baby. Women who have three or more alcoholic drinks per day and women who are binge drinkers (drinking heavily but not every day) are likelier to have children with fetal alcohol syndrome. All types of alcohol can cause damage. The same amount of alcohol is found in one beer, one glass of wine, and one shot of hard liquor such as gin, whiskey, or vodka.

What Happens When Babies Have Fetal Alcohol Syndrome?

Babies show signs of fetal alcohol syndrome in various ways.

Facial characteristics Babies with fetal alcohol syndrome have a distinctive appearance. Characteristics may include:

- Small openings for the eyes, which appear widely spaced
- Flat cheekbones
- Flatter ridges between the nose and upper lip
- Low and flat bridge of the nose
- Unusually thin upper lip
- cleft palate*
- Epicanthal (ep-i-KAN-thal) folds (folds of skin at the inner corner of the eye)
- Minor abnormalities in the shape and placement of ears
- Shorter nose and an elf-like appearance

Other characteristics The general characteristics associated with fetal alcohol syndrome include:

- Premature birth
- Low birth weight; babies with FAS are small at birth and may continue to grow slowly after birth as well
- Possible heart defects
- Possible skeletal problems or differences in the hands
- Misaligned or misshapen teeth
- Central nervous system problems, which may include microcephaly (my-kro-SEPH-a-lee) (an abnormally small head) and varying degrees of brain damage
- Mental retardation, ranging from mild to severe
- Problems concentrating and understanding concepts such as time, money, and cause and effect
- Difficulty making friends and controlling impulses, along with tendency to get into trouble at home and at school

2,500 YEARS OF WARNINGS ABOUT ALCOHOL AND PREGNANCY

In 1973 researchers at the University of Washington named the group of symptoms that can result from alcohol use during pregnancy “fetal alcohol syndrome.” In 1987 the U.S. Surgeon General said that no known safe level of alcohol use during pregnancy exists. Among those who issued earlier warnings were:

- Hebrew Bible and Talmud
- Plato (c. 428–348 B.C.E.), Greek philosopher
- Aristotle (384–322 B.C.E.), Greek philosopher
- Plutarch (c. 46–119), Greek biographer
- Francis Bacon (1561–1626), English philosopher
- William Sullivan, a U.S. doctor who conducted the first scientific study of the fetal effects of alcohol (1899)
- Taav Laitenen, a Finnish doctor who observed the low birth weight of babies born to mothers who drank alcohol during pregnancy (1910)
- Paul Lemoine, a French pediatrician who described facial features, growth retardation, and central nervous system problems resulting from alcohol use during pregnancy (1968).

Fetal alcohol effects Children with fetal alcohol effects may not have the facial and physical characteristics of children with fetal alcohol syndrome, but they do have many of the same behavior and learning problems caused by prenatal alcohol exposure.

How Can Fetal Alcohol Syndrome Be Prevented?

Fetal alcohol syndrome is 100 percent preventable. A pregnant woman should not drink at all. Because there is no amount of alcohol that has been proven safe to drink, the best choice for the mother-to-be is not to drink alcohol at all.

▶ See also **Alcoholism • Birth Defects and Brain Development • Cleft Palate • Intellectual Disability • Prematurity**

Resources

Books and Articles

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Golden, Janet. *Message in a Bottle: The Making of Fetal Alcohol Syndrome*. Cambridge, MA: Harvard University Press, 2005.

Stewart, Gail B. *Fetal Alcohol Syndrome*. Detroit, MI: Lucent Books, 2005.

Organizations

Connecticut Clearinghouse. 334 Farmington Avenue, Plainville, CT, 06062. Toll free: 800-232-4424. Web site: <http://www.ctclearinghouse.org/Topics/topicView.asp?TopicID=87>.

March of Dimes. 1275 Mamaroneck Avenue, White Plains, NY, 10605. Telephone: 914-997-4488. Web site: http://www.marchofdimes.com/professionals/14332_1170.asp.

National Institute on Alcohol Abuse and Alcoholism. 5635 Fishers Lane, MSC, 9304, Bethesda, MD 20892-9304. Telephone: 301-443-3860. Web site: <http://www.niaaa.nih.gov>.

National Organization on Fetal Alcohol Syndrome. 900 Seventeenth Street NW, Suite 910, Washington, DC, 20006. Toll free: 800-66-NOFAS. Web site: <http://www.nofas.org>.

Fetishism

Fetishism involves assigning increased value or power to an inanimate object or non-sexual body part.

What Is Fetishism?

Fetishism involves being fixated on inanimate objects or non-sexual body parts. The person assigns special significance or power to the object for the purpose of mental or sexual stimulation. Fetishes are considered a common part of human sexuality. Fetish objects may play a role in masturbation or sexual fantasies. Fetishism is more common among men than women.

LARS AND THE REAL GIRL (2007)

The award-winning movie, *Lars and the Real Girl* explores the phenomena of fixation and fetish and shows how these psychological conditions can develop from early childhood loss. Lars is fixated on a baby blanket his mother made for him. She died giving birth to him, and as he grew up he became convinced that he was responsible for her death. As an adult Lars wants to connect with others, but the fear of loss isolates him, and he turns instead to a substitute love object, a blowup doll, which he believes is a living female with a disability. Through the support of family, community members, and a sensitive physician, Lars comes to understand that loss happens and people can still take the risk of engaging in human relationships.

Are There Different Types of Fetishism?

There are two different categories for fetishes.

Form fetishes are those that focus on the shape and appearance of concrete objects such as high heeled shoes, lingerie, lipstick, or gloves.

Media fetishes tend to be more focused on the texture or feel of certain objects. These might include leather, rubber, or silk.

Fetishists use the items that they desire during masturbation or during sexual activity with their partners to achieve sexual satisfaction. Often, they need these items to become aroused. In many cases, fetishists simply need to see the object to become aroused, but more often, they prefer to touch, rub, and smell the object. Many fetishists prefer objects that have been worn or used, although they have no interest in the person who has used the object, only the object itself.

What Are the Most Common Fetishes?

Various items may be the desire of fetishists. Common fetishes include the following:

- shoe
- foot
- doll
- leather
- lingerie
- rubber
- glove

What Are the Symptoms of Fetishism?

Some people find certain objects or body parts sexually stimulating and even use them as a part of their sexual fantasies or sexual activity. However, as long as these people do not become fixated on the objects or body parts, they probably do not have a fetish. A fixation is an unhealthy preoccupation with or attachment to an object, and the fixated person invests the object with sexual meaning or value.

When people become fixated to the point that they can only become minimally aroused without a certain object or they can no longer become sexually aroused without it, they are considered fetishists. When an object is not available, the fetishist may fantasize about it as the only way to satisfy the desire.

Fetishists exhibit certain characteristics and behaviors. First, these individuals have fantasies involving the item of choice for at least six months. These are fairly common. More serious fetishes may cause disturbances in a person's ability to relate to others. Some people may find a line of work that helps satisfy their fantasies. For instance, a person with a panty fetish may find work in a lingerie store.

Just a Figure of Speech

A figure of speech, or locution (low-Q-shun), is a word or phrase that is used for effect and is not meant to be taken literally. The word "fetish" can be used loosely to mean "particular liking for." For instance, when Jenny tells her friend that she has a shoe fetish, she probably means that she really likes to shop for new footwear, not that she has a true fetish for shoes.

* **psychological** (SI-ko-LOJ-i-kal) refers to mental processes, including thoughts, feelings, and emotions.

* **psychoanalysis** (sy-ko-a-NAL-i-sis) is a method of treating a person with psychological problems, based on the theories of Sigmund Freud. It involves sessions in which a therapist encourages a person to talk freely about personal experiences, and the psychoanalyst interprets the patient's ideas and dreams.

What Causes Fetishism?

Fetishism is a complicated psychological* condition that is not fully understood. Many experts believe that fetishism results from difficult physical or emotional experiences during childhood, adolescence, or young adulthood.

Can Fetishism Be Cured?

Fetishism is not a condition that requires treatment or cure, unless the person finds it prevents or blocks some aspect of human experience or relationship. If the person with the fetish wishes to seek out treatment, however, there are resources available. These include psychoanalysis*, cognitive and behavioral therapies, hypnosis, and sometimes, medication. The primary focus tends to be counseling and understanding what caused the fetish to develop.

Resources

Books and Articles

Bramwell, David. *Fetish*. London: DK Adult, 2007.

Organization

Livestrong.com. 15801 NE Twenty-fourth St., Bellevue, WA, 98008.
Web site: <http://www.livestrong.com>.

Fever

Fever is an abnormally elevated body temperature that usually occurs during an infection, inflammation, or some other kind of illness. Fever is not a disease itself, but it is one of the most common signs of illness, especially among children.

How Is Body Temperature Controlled?

The body adjusts its temperature in much the same way that the thermostat in a house works. With a thermostat, people set the temperature they want, and the heating or cooling system clicks on until the inside of the house reaches the right temperature. After that, the heater or air conditioner clicks on and off automatically to keep the temperature in the house hovering around the desired temperature.

The body's thermostat is located in the hypothalamus (hy-po-THAL-a-mus), a small part of the brain that also helps to regulate hunger, thirst, awareness of pleasure, and awareness of pain. The thermostat region of the hypothalamus, called the thermoregulatory (ther-mo-REG-u-la-tor-ee)

center, normally keeps the body's temperature hovering at around 98.6 degrees Fahrenheit (F) (36.8 degrees Centigrade [C]).

Like a house, the body has sensors that tell the thermostat if the temperature inside is rising or falling. In the body, these sensors are cells located in the skin and in the brain itself. If the sensors report that the body's temperature is rising, the body's cooling system clicks on, telling the cells to burn less fuel and produce less heat. The blood vessels expand to let heat escape from the skin (the evaporating sweat draws heat away from blood vessels), sweat pours out to cool the body as it evaporates, and the brain may get a bright idea: "Let's go into the shade and have a cold drink."

Fever With fever, the thermostat in the brain is reset to a higher temperature. Instead of keeping the body's temperature hovering at around 98.6 degrees F, the body's heating and cooling systems may keep the temperature at 100 to 102 degrees F or even higher.

Normal temperature varies a bit from person to person and from morning to evening, making it hard to state precisely where normal ends and fever begins. In fact, temperature measured at different places in the body can also be different. Temperature measured at the mouth can be one whole degree Fahrenheit lower than the actual core body temperature. For this reason, core body temperature is best measured at the rectum or at the ear. Most doctors say that a core body temperature at or above 100.4 degrees F (38 degrees C) should be considered a fever. Core body temperature above 104 degrees F (40 degrees C) is generally considered a high fever.

Hyperthermia Sometimes a person's temperature can rise for a different reason. Hyperthermia (hy-per-THER-me-a), quite different from fever, occurs when the heat outside is too much for the body's cooling system to handle, making body temperature (and the set point) rise. The most severe cases of hyperthermia tend to occur in people who cannot sweat as much as others, such as elderly people or those taking certain medications.

How Does Illness Cause Fever?

Bacteria and viruses themselves, as well as toxins (poisonous waste products) produced by some bacteria, cause fever. In some cases, they work directly on the brain to raise the thermostat. More commonly, they cause the body's immune system* to produce proteins called cytokines (SY-to-kines). The cytokines help fight the infection, but they also reset the brain's thermostat, causing fever.

Any substance that causes fever is called a pyrogen (PY-ro-jen), from the Greek word for "fire-causer." If the substance comes from outside the body, such as a toxin from bacteria, it is called an exogenous (ek-SOJ-e-nus) pyrogen. The prefix "exo-" means "outside" in Greek. If the substance comes from inside the body, such as a cytokine, it is called an endogenous (en-DOJ-e-nus) pyrogen. The prefix "endo-" means "inside" in Greek.

Ups and Downs

A person's temperature normally varies in the course of a day by about 1 degree F (0.6 degree C). It is lowest in the early morning and highest in the late afternoon. This daily variation is called the circadian (sir-KADE-ee-an) rhythm. When a person has a fever, it usually follows the same daily pattern.

Other factors also can affect what is a normal body temperature. In women of childbearing age, for instance, the early morning temperature usually goes up each month just before ovulation (ov-u-LA-shun), the release of an egg from the ovary. It stays elevated briefly and then returns to the lower level.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

- * **autoimmune disease** (aw-toh-ih-MYOON) is a disease in which the body's immune system attacks some of the body's own normal tissues and cells.
- * **rheumatoid arthritis** (ROO-mah-toyd ar-THRY-tis) is a chronic disease characterized by painful swelling, stiffness, and deformity of the joints.
- * **lupus** (LOO-pus) is a chronic, or long-lasting, disease that causes inflammation of connective tissue, the material that holds together the various structures of the body.
- * **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.
- * **leukemia** (loo-KEE-me-uh) is a form of cancer characterized by the body's uncontrolled production of abnormal white blood cells.
- * **lymphoma** (lim-FO-muh) refers to a cancerous tumor of lymphocytes, cells that normally help the body fight infection.
- * **transfusion** (trans-FYOO-zhun) is a procedure in which blood or certain parts of blood, such as specific cells, is given to a person who needs it due to illness or blood loss.

Sometimes the immune system produces pyrogens even without an infection. For instance, this may happen if a person has the following:

- an autoimmune disease*, such as rheumatoid arthritis* or lupus*
- inflammation* anywhere in the body
- cancer, such as leukemia* or lymphoma*
- received a blood transfusion* that is not compatible with his or her own blood type
- has a reaction to a medication

THE NAME IS FAMILIAR

Many infectious diseases are named for the major symptom of fever. Most of those listed below lead to fevers of about 102 to 104 degrees F (39 to 40 degrees C). Dengue fever, Lassa fever, and yellow fever are caused by viruses. The others are caused by bacteria.

- Dengue (DEN-gay) fever causes sudden high fever, headache, extreme tiredness, severe joint and muscle pain, swollen lymph nodes, and a rash. It is spread by mosquitoes.
- Lassa (LAH-sa) fever causes fever, headache, dry cough, back pain, vomiting, diarrhea, sore throat, and facial swelling. It is spread by rats and from person to person.
- Q fever causes sudden high fever, severe headache, and chills. It is spread by farm animals and insects.
- Rheumatic (roo-MAT-ik) fever causes painful, swollen joints, fever, and heart murmurs (abnormal heart sounds). It can follow an infection with the same bacterium that causes strep throat.
- Rat-bite fever causes sudden chills, fever, headache, vomiting, back pain, a rash on the hands and feet, and temporary arthritis (joint inflammation). It is spread by rats and mice.
- Relapsing (re-LAPS-ing) fever causes sudden chills and high fever, fast heartbeat, severe headache, vomiting, muscle pain, and sometimes mental confusion. Symptoms can recur several times. It is spread by ticks and lice.
- Rocky Mountain spotted fever causes fever, headache, skin ulcers (open sores), and a rash. It is spread by ticks.
- Scarlet fever causes high fever, sore throat, flushed cheeks, and a rash, especially in children. It is caused by the same bacterium that causes strep throat.
- Typhoid (TY-foid) fever causes fever along with abdominal pain, headache, and extreme fatigue. It is spread by food and water that contain salmonella bacteria.
- Yellow fever causes sudden fever, slow pulse, nausea, vomiting, constipation, muscle pains, liver failure, and severe fatigue. It is spread by mosquitoes.

People sometimes say that fever is a sign that the immune system is active, working to protect the body from illness. That may be true in some cases, but it is not always so. People often get fevers, for instance, if their immune system is weak or damaged. Scientists are not sure exactly what, if anything, fever indicates about the state of the immune system.

Who Gets Fever?

Fever is caused by so many common illnesses, including colds and flu, that it happens to everyone many times in the course of a lifetime. Young children are particularly likely to get bacterial and viral infections, such as strep throat and ear infections, that cause fever. Sometimes minor viral infections cause high fevers in children, whereas illnesses that are more serious cause milder fevers. People of all ages get fever.

Helpful fever Some evidence suggests that an elevated body temperature can make the immune system more effective and weaken certain bacteria. However, most of this evidence comes from animals or experiments on human cells in test tubes. Scientists really do not know whether fever actually helps people fight off infections. It may be that fever helps in certain cases but not in others.

Fever often can be helpful in another way. It can be an important sign that a person is sick. The movements of temperature up and down can indicate whether a person is getting better or worse.

Harmful fever Fever often makes an illness more unpleasant. In addition, a feverish body needs more oxygen, which means that the heart and lungs have to work harder as the fever rises, which can be a problem for people who already have heart or lung problems.

Fever can make mental problems worse for elderly people who have dementia (de-MEN-sha), which is a form of mental confusion and loss of memory that can develop gradually as people age. High fever also can cause temporary mental confusion, called delirium (de-LEER-e-um), even in healthy people.

Febrile convulsion Children under five years of age can have a different problem if their temperature rises quickly. They may experience a kind of seizure* called a febrile convulsion (FEB-ryl kon-VUL-shun). Their muscles may twitch, and they may lose consciousness for several minutes. Usually, a febrile convulsion needs no treatment and may not recur. However, febrile convulsions can be frightening. They also can lead to injury; for example, if a child falls.

Extremely high temperatures of around 107 degrees F or higher can cause permanent brain damage at any age if they last for a long time. Temperatures that high usually result from hyperthermia, not from an illness-related fever.

Fever of Unknown Origin

Sometimes a person has a fever that lasts for two to three weeks, and the doctor cannot find a cause, despite performing the usual array of medical tests. This condition is referred to as fever of unknown origin.

In about 90 percent of cases, medical professionals eventually find a cause. The most common causes are infectious diseases. Fever of unknown origin is particularly common in people infected with HIV, the human immunodeficiency virus that causes AIDS.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

Fiery Language

Many medical terms dealing with fever start with the prefix “pyro-” or “pyr-,” from the Greek word for “fire.” Fever itself is called pyrexia (pi-RECKS-ee-a). Substances that cause fever are called pyrogens, and medicines that reduce fever are called antipyretics.

The same Greek root has given rise to words outside medicine. A funeral pyre is a consuming blaze used to cremate a body (turn it to ashes). Pyromania is a compulsion to set fires. Pyrotechnics are fireworks. Pyrex is the trade name for a kind of glass used as baking dishes because it can withstand high heat.

How Is Fever Diagnosed?

People with a fever often feel hot, tired, achy, and generally sick. They sometimes have shaking chills as their temperature rises. Shaking helps raise the temperature to the feverish level that has been set by the body’s thermostat. They may sweat heavily when the fever “breaks” (starts to go away) or if it falls temporarily as part of an up-and-down pattern. Sweating helps lower the temperature to the new, lower point set by the thermostat.

Although the classic way of checking for fever at home is to touch the person’s forehead to see how warm it feels, doing so often does not work. The only way to tell for sure if a person has a fever is by taking the temperature with a thermometer. Three kinds of thermometers are available: digital, mercury, or tympanic.

Digital thermometers, usually used in medical offices and hospitals as well as at home, are electronic. They can take an oral temperature when placed under the tongue, a rectal temperature when placed into the rectum, or an axillary (AK-si-lar-y) temperature when placed in the armpit. The measured rectal temperature is the closest to what the core of the body actually feels and thus is considered to be the most accurate.

Mercury thermometers, which used to be the only kind available, are made out of glass and contain liquid mercury. They come in oral or rectal versions. Either kind can be used in the armpit as well. They are cheaper than digital thermometers, but they take longer to use.

Tympanic (tim-PAN-ik) thermometers are a special kind of digital thermometer that is placed into the ear. While the other thermometers take several minutes to give a reading, the tympanic thermometer takes only a few seconds. However, tympanic thermometers are more expensive and can be inaccurate if placed improperly in the ear.

When Should a Doctor Be Consulted?

A doctor should be consulted if a fever is high, lasts longer than a few days, or is accompanied by other symptoms, such as a rash; pain in the joints, neck, or ears; unusual sleepiness; or a dazed or very sick feeling. For babies under about three months of age, a doctor should be consulted about any fever.

The doctor will try to find and treat the underlying cause of the fever. Antibiotics can cure many bacterial infections, such as those that cause many earaches and sore throats. No medications are available to treat most viral infections.

How Is Fever Treated?

In a basically healthy adult or older child, there usually is no medical reason to treat the fever itself unless it is very high. In fact, lowering the fever with drugs can make it harder to tell if a person is actually getting better or if the drugs are just keeping the fever down. In younger

children, though, doctors often treat fevers above 100 degrees F, in part to avoid febrile convulsions. Of course, if a person of any age is very uncomfortable or unable to sleep, even a low fever can be treated to provide relief.

Fever can be lowered by drugs called antipyretics (an-ti-py-RET-iks) that do not require prescriptions. The major ones are acetaminophen (a-seet-a-MIN-oh-fen), ibuprofen*, and aspirin. However, aspirin should not be given to children or teenagers with a fever. If children have a viral illness, such as influenza or chickenpox, aspirin makes it likelier that they may get a rare but dangerous illness called Reye's syndrome*. This possibility does not exist with their taking acetaminophen* or ibuprofen.

Antipyretic medicines are available in pills for adults, chewable tablets for children, and liquid drops for babies. Acetaminophen also comes in suppositories (su-POZ-i-tor-eez), waxy pellets that are inserted into the rectum. They are used for people who cannot take medicine by mouth for whatever reason.

A lukewarm bath can also help lower a high temperature. However, cold water or alcohol rubs can do more harm than good by causing the body to shiver, which just raises body temperature more. In addition to these treatments, it is important for a person with a fever to drink plenty of liquids to avoid dehydration*. In extreme cases, a person in the hospital with a very high fever may be wrapped in a special cooling blanket or immersed in ice water.

How Can Fever Be Prevented?

Many of the diseases that cause fever can be prevented by vaccination*. These include influenza, measles, mumps, rubella (German measles), chickenpox, diphtheria, and typhoid fever. A number of other diseases that cause widespread fever in poorer nations have been eradicated in the United States by good sanitation systems and access to clean water. Still other diseases, such as colds and strep infections, often can be prevented by washing the hands properly before eating and, if possible, by avoiding contact with people who already have these infections.

▶ See also **Bacterial Infections • Common Cold • Dengue Fever • Diphtheria • Heat-Related Injuries • Infection • Influenza • Lassa Fever • Measles (Rubeola) • Mumps • Reye's Syndrome • Rheumatic Fever • Rocky Mountain Spotted Fever • Rubella (German Measles) • Scarlet Fever • Seizures • Typhoid Fever • Varicella (Chicken Pox) and Herpes Zoster (Shingles) • Viral Infections • Yellow Fever**

Resources

Books and Articles

Calamandrei, Camilla. *Fever*. Tarrytown, NY: Marshall Cavendish Benchmark, 2009.

* **ibuprofen** (eye-bew-PRO-fin) is a nonsteroidal anti-inflammatory drug (NISAD) used to reduce fever and relieve pain or inflammation.

* **Reye's syndrome** (RYES SIN-drome) is a rare condition that involves inflammation of the liver and brain, and sometimes appears after illnesses such as chicken pox or influenza. It has also been associated with taking aspirin during certain viral infections.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

* **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.

* **menstruation** (men-stroo-AY-shun) is the discharge of the blood-enriched lining of the uterus. Menstruation normally occurs in females who are physically mature enough to bear children. Most girls have their first period between the age of 9 and 16. Menstruation ceases during pregnancy and with the onset of menopause. Because it usually occurs at about four-week intervals, it is often called the monthly period.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: <http://www.cdc.gov>.

Nemours Center for Children's Health Media, Alfred I. Dupont Hospital for Children. 1600 Rockland Road, Wilmington, DE, 19803. Web site: <http://kidshealth.org/parent/general/body/fever.html>.

Fever Blister See *Herpes Simplex Virus Infections*.

Fibrocystic Breast Disorder

Fibrocystic (fy-bro-SIS-tik) breast disorder is the general term used to describe noncancerous changes in the breast, such as the formation of fluid-filled sacs called cysts.

When Is a Breast Lump Not Breast Cancer?

It is estimated that more than half of all women experience the breast changes that are known as fibrocystic breast disorder at some time during their lives. The symptoms vary from person to person. Some women have no symptoms at all. Others notice a lump that feels like a smooth grape under the skin. These lumps, or cysts, are sometimes painful or tender to the touch.

What Causes Fibrocystic Breast Disorder?

The breast is made up of fatty tissue filled with pockets called lobes, each of which contains many smaller pockets called lobules. After a woman gives birth, these lobules produce milk. As a woman goes through her menstrual cycle*, the body releases hormones that cause the pockets in the breast to enlarge and hold extra fluid. At the end of the cycle, this swelling disappears, but fluid can sometimes get trapped in these openings. Over time, cysts can form.

Fibrocystic breast disorder usually affects women between the ages of 30 and 50. The lumps often are especially noticeable before and during menstruation*. When a woman reaches her 50s or 60s and stops menstruating, these symptoms usually disappear as well.

How Does the Doctor Know if the Lumps Are Not Cancer?

A doctor starts with a physical examination and mammogram, or x-ray of the breast, because benign* breast lumps often look and feel different from cancerous ones. If the lump turns out to be a cyst, the doctor may use a small needle to drain the fluid. If the fluid is bloody or appears unusual in any way, it may be sent to the laboratory for analysis. In most cases, no other treatment is needed.

If the lump is solid, a biopsy (BY-op-see) is performed. During this procedure, some or all of the tissue is removed and examined under a microscope for the abnormal cell shapes and growth patterns that indicate cancer. Researchers have investigated whether there is a connection between fibrocystic breast disorder and a woman's risk for breast cancer without reaching a conclusion as of the early 2000s.

▶ See also **Breast Cancer • Cyst • Tumor**

Resources

Organization

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/breastdiseases.html>.

Fibroid Tumors/Fibroids See *Menstruation and Menstrual Disorders*.

Fibromyalgia

Fibromyalgia (fi-bro-my-AL-ja) is a chronic disorder that causes generalized aching, stiffness, and fatigue in the muscles and joints.*

What Is Fibromyalgia?

Fibromyalgia is a later term for an old disorder that was once called fibrositis (fi-bro-SY-tis). Fibromyalgia means pain in the muscles and joints*. Three to six million Americans are thought to be affected by fibromyalgia. It occurs mostly in women aged 50 and older. Fibromyalgia is found throughout the world, among all ethnic groups. It is only rarely seen in children.

* **benign** (be-NINE) refers to a condition that is not cancerous or serious and will probably improve, go away, or not get worse.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **joints** are places in the body where two bones fit together, usually in such a way as to allow motion.

* **chronic fatigue syndrome** (KRON-ik fat-TEEG) a debilitating and complicated disorder in which individuals feel intense fatigue that lasts six months or longer. Symptoms may include insomnia, muscle pain, and impaired concentration. Because other illnesses have these symptoms, doctors must rule out a number of conditions in order to make a diagnosis.

* **antidepressant medications** are used for the treatment and prevention of depression.

What Causes Fibromyalgia?

As of the early 2000s, researchers had been unable to identify the cause of fibromyalgia, but they put forth several theories. One was that fibromyalgia is caused by injury to the central nervous system (the brain and spinal cord), which sends messages to the muscles. A second theory was that biochemical changes in muscle tissue cause fatigue and loss of strength. A third theory suggested that fibromyalgia may be caused by a virus. Some patients with fibromyalgia have psychological problems, but it is unclear whether there is any relationship between the psychological state and the physical condition.

How Do People Know If They Have Fibromyalgia?

Fibromyalgia begins gradually. The main symptom is pain in the muscles and joints. The pain moves around but is most common in the neck, chest, arms, legs, hips, and back. In addition, patients may complain of headaches, tiredness, sleep disorders, digestive disturbances, anxiety, or depression.

Fibromyalgia can be frustrating to diagnose for both the doctor and the patient. The muscles hurt, but they look normal. Blood and x-ray tests are also normal. The symptoms can resemble those of a variety of illnesses, including infections, and the doctor needs to rule out such possibilities. Fibromyalgia also shares similarities with chronic fatigue syndrome*. If no other explanation for a patient's symptoms is found, a doctor may diagnose fibromyalgia if the pain keeps coming back, occurs in many different muscles, and has lasted for more than three months.

How Is Fibromyalgia Treated?

A doctor who suspects fibromyalgia will reassure the patient that the condition does not harm the muscles. The most effective treatment is a combination of exercise, medication (sometimes including antidepressant medications*), physical therapy, and relaxation. Other approaches, such as massage and acupuncture, do not seem to be particularly helpful. There is no known way to prevent the condition.

Living with Fibromyalgia

Fibromyalgia is a chronic disorder, which means that the symptoms may get better or worse but can last for months or years. Many communities have support groups for patients with fibromyalgia.

What Progress Is Being Made in Treating Fibromyalgia?

Because fibromyalgia is a source of serious disability for many people, organizations such as the National Institute of Arthritis and Musculoskeletal and Skin Diseases sponsor research to help diagnose, treat, and prevent it. For example, researchers study how structures of the brain are involved in the painful symptoms of fibromyalgia. They also use sophisticated imaging technologies to study how the muscles perform.

▶ See also **Arthritis • Chronic Fatigue Syndrome**

Resources

Books and Articles

Bested, Alison C., and Alan C. Logan, with Russell Howe. *Hope and Help for Chronic Fatigue Syndrome and Fibromyalgia*, 2nd ed. Nashville, TN: Cumberland House, 2008.

Trock, David H., and Frances Chamberlain. *Living with Fibromyalgia*. Hoboken, NJ: Wiley, 2006.

Organizations

American College of Rheumatology. 1800 Century Place, Suite 250, Atlanta, GA, 30345-4300. Telephone: 404-633-3777. Web site: http://www.rheumatology.org/public/factsheets/fibromya_new.asp.

Arthritis Foundation. P.O. Box 7669, Atlanta, GA, 30357-0669. Toll free: 800-283-7800. Web site: <http://www.arthritis.org>.

Fifth Disease

Fifth disease, also known as erythema infectiosum (air-uh-THEE-muh in-fek-she-O-sum), is a common viral infection of infants and young children that causes a characteristic slapped-cheek rash.

What Is Fifth Disease?

Fifth disease, sometimes called slapped-cheek disease, is an infection caused by the virus human parvovirus B19. Its most characteristic feature is a bright red rash that begins on the face, making the cheeks look as if they have been slapped. After a few days, the rash may spread down the body and onto the arms and legs. As it spreads, the rash takes on a pink, lacy appearance.

Most people with fifth disease have mild symptoms and do not become seriously ill; some may not have any symptoms at all. However, the disease can be serious for people with certain blood disorders, such as sickle-cell disease*, because parvovirus B19 can temporarily cause or worsen existing anemia*. For most people, temporary anemia is not a problem, but for those who already have anemia, the condition can become severe, causing paleness, fatigue, and a fast pulse. People with weakened immune systems, such as those who have AIDS*, cancer, or who have had an organ transplant, can also develop severe anemia as a result of fifth disease.



▲ A few days after infection with the virus that causes fifth disease, the telltale “slapped cheek” rash appears on the face. S. Miller/Custom Medical Stock Photo, Inc. Reproduced by permission.

- * **sickle-cell disease** is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.
- * **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

- * **strains** are various subtypes of organisms, such as viruses or bacteria.
- * **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.
- * **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.
- * **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

Parvoviruses can infect animals, but these are not the same strains* that affect humans. Therefore, a person cannot catch fifth disease from a dog or cat, and a pet cannot catch it from an infected person.

How Common Is Fifth Disease?

Fifth disease occurs most commonly in children between the ages of 5 and 15 years, but adults can also get it. It often occurs in outbreaks (for example, among classmates at school or children in a child-care center) in the winter and spring, but people can get it throughout the year.

Fifth disease spreads quickly. At home, up to half of family members exposed to someone with fifth disease become infected. If an outbreak occurs in school, up to 60 percent of students may get the virus.

A person with fifth disease can spread the infection in the early part of the illness, before the rash develops. By the time the rash appears (about a week after being exposed to the virus), a person likely is no longer contagious. Once someone is infected with parvovirus B19, that person develops immunity* to it and will not usually become infected again.

Parvovirus B19 passes from one person to another through nose and mouth fluids, such as mucus and saliva. Any direct contact with the fluids of an infected person, whether through a cough or sneeze or by sharing drinking glasses or utensils, can spread the infection.

Fifth disease can also be passed from pregnant women to their unborn babies. Most of the time, the baby is not harmed. Occasionally the infection can cause severe anemia in the baby and lead to miscarriage*, especially if the baby was infected in the first half of pregnancy.

What Happens When People Get Fifth Disease?

Signs and symptoms The first symptoms of fifth disease are similar to those of a common cold and include low fever, a runny or stuffy nose, sore throat, cough, headache, diarrhea, and fatigue. During this early period fifth disease is most contagious. After a few days, especially in children, the slapped-cheek rash usually first appears on the face, and it soon begins to involve the rest of the body in a pink, lacy-looking pattern. Not everyone with fifth disease develops this rash, but it is much more likely to appear in children under 10 years of age. For some people the rash fades and reappears if triggered by heat, exercise, stress, or exposure to the sun. Sometimes the rash itches, and adults in particular may experience pain and swelling of the joints in the hands, or the wrists, knees, or ankles.

Diagnosis In children, doctors can usually diagnose fifth disease simply by looking for the telltale rash on the face and body. In cases in which there is no rash, blood tests can confirm the presence of parvovirus B19.

Treatment Most people with fifth disease do not require treatment. Antibiotics do not help because the illness is caused by a virus rather than bacteria. Symptoms such as fever or joint pain may be treated with acetaminophen*.

NAMING A DISEASE

Fifth disease was named in the late 1800s. It was the fifth classic childhood rash-associated disease to be named, following measles (first disease), scarlet fever (second disease), rubella or German measles (third disease), and a fourth condition with a rash that is unknown to doctors today (fourth disease). The name fifth disease probably stuck because it is a lot easier to say than erythema infectiosum.

The rash clears up on its own, often within one to three weeks. Joint pain and swelling can take longer to go away, sometimes up to several months. People with joint pain may need to rest and restrict their activities until they feel better.

People with blood disorders or immune deficiencies who develop severe anemia as a result of fifth disease may require blood transfusion* and other specialized medical care.

Complications The vast majority of people who are infected with parvovirus B19 recover completely without any complications. Severe anemia, the complication most often associated with fifth disease, usually affects people with weakened immune systems or blood disorders and, rarely, unborn babies who were infected during the first half of pregnancy.

In healthy people, parvovirus B19 infection can sometimes affect the ability of the bone marrow (the soft tissue inside bones where blood cells are made) to make new red blood cells, but this effect is usually temporary and does not cause significant anemia or other problems.

Can Fifth Disease Be Prevented?

There is no vaccine to prevent fifth disease. The best way to prevent the spread of infection is to practice good hygiene, including frequent hand washing and not sharing drinking glasses and eating utensils. Because the disease is most contagious before the telltale rash appears, it is difficult to keep the infection from spreading among family members or young children in school or day care. By the time the rash appears and the illness is diagnosed, the person is usually no longer contagious.

▶ See also **Measles (Rubeola) • Rubella (German Measles)**

Resources

Books and Articles

Laskey, Elizabeth. *Fifth Disease*. Chicago: Heinemann Library, 2003.

* **blood transfusion** is the process of giving blood (or certain cells or chemicals found in the blood) to a person who needs it due to illness or blood loss.



▲
Lymphatic filariasis can progress to elephantiasis, a swelling and thickening of body tissues from accumulation of fluid. The skin may look thick, pebbly, and dark. *C. James Webb/Phototakel/Reproduced by permission.*

* **parasitic** (pair-uh-SIH-tik) refers to organisms such as protozoa (one-celled animals), worms, or insects that can invade and live on or inside human beings and may cause illness. An animal or plant harboring a parasite is called its host.

* **strains** are various subtypes of organisms, such as viruses or bacteria.

* **cutaneous** (kyoo-TAY-nee-us) related to or affecting the skin.

* **lymphatic** (lim-FAH-tik) means relating to the system of vessels and other structures that carry lymph, a colorless fluid, throughout the body's tissues; the lymphatic system plays an important role in protecting the body from infections.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/dvrd/revb/respiratory/parvo_b19.htm.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/fifthdisease.html>.

Filariasis

Filariasis (fih-luh-RYE-uh-sis) is a tropical disease caused by tiny worms.

What Is Filariasis?

Filariasis is caused by different species of microscopic parasitic* roundworms that are passed to people through the bites of insects, most commonly mosquitoes. Several strains* of these worms, known as filariae (fih-LAIR-e-e), can infect humans, including *Wuchereria bancrofti* (voo-ker-E-re-ah ban-CROFT-e). There are also different types of filariasis itself, including cutaneous* or skin-related, body cavity, and lymphatic* infections. In the cutaneous disease, the worms live in the layers of the skin; in body cavity filariasis, they inhabit certain body openings and surrounding tissue; and in the lymphatic form of infection, they invade the vessels of the lymphatic system and the lymph nodes*.

Lymphatic filariasis, which can progress to a condition called elephantiasis*, is the most serious form of the disease. It begins when an infected female mosquito injects worm larvae* into a person's blood while feeding. The larvae travel to the lymphatic vessels, where they grow into adult worms. As adults, the worms can survive and reproduce for up to seven years. The gradual buildup of worms in the vessels hinders the lymphatic system's ability to fight infection and causes lymph fluid to collect—typically in the arms, legs, breasts, and male genitals—leading to swelling and disfigurement.

How Common Is the Infection?

Filariasis is most common in tropical and subtropical regions, including parts of Africa, the western Pacific, Asia (especially India), and Central and South America. In these areas, in the early 2000s, the number of cases of filariasis continued to rise. It was estimated that more than 120 million people worldwide had the lymphatic form of illness, and approximately 40 million of them were disabled or disfigured by the disease. Although contracting filariasis is not a risk in the United States, some immigrants may have it, and people who travel to other countries can contract the

disease as well. For example, missionaries and Peace Corps volunteers are considered to be at risk.

Is Filariasis Contagious?

The disease does not spread from direct person-to-person contact. Instead, it is transmitted by the bite of a mosquito. When one of these insects bites someone who is infected, it takes in the parasites along with its meal of blood. The mosquito then can pass those parasites on to the next person it bites. Usually, someone must be bitten many times, typically over a long period, to develop symptoms of filariasis.

What Are the Signs and Symptoms of the Disease?

The lymphatic form of filariasis usually produces fever, swollen or painful lymph nodes in the neck and groin, pain in the testicles*, and swelling in the limbs or genitals. Males and the male urinary and genital systems are particularly likely to be affected. In elephantiasis, a severe form of chronic* lymphatic filariasis, the blocked flow of lymph causes one or both legs to swell significantly. Over time, the skin on the leg can also change, taking on a rough texture so that it resembles the skin of an elephant. Although elephantiasis is unusual, up to half of all men with lymphatic filariasis may show serious symptoms, such as swelling of the scrotum*. In some cases people may have no obvious symptoms, but they still may have serious damage to the kidneys and lymphatic system.

Making the Diagnosis

Knowing that the person lives in or has spent time in a country where filariasis poses a risk can help a doctor diagnose the disease. The doctor may also take skin and blood samples from the patient to look for signs of the parasite.

What Is the Treatment for Filariasis?

Ideally, treatment begins as soon as possible after the patient becomes infected. Prompt treatment may not be possible, however, because the disease can be difficult to detect in its early stages. When the diagnosis is made, treatment may include:

- medication to kill the young worms in the bloodstream and stop the parasite's life cycle (although the medicine cannot kill adult worms)
- exercising and moving swollen limbs to improve lymph flow
- bed rest and compression bandages to treat swelling
- medications to lessen swelling and discomfort
- hospitalization and intravenous* (IV) antibiotics for secondary infections that might appear because the damaged lymphatic system is less able to assist in defending the body against infectious agents
- surgical treatment for deformities, such as enlarged limbs and scrotum, sometimes with several procedures and skin grafts* to correct cases of disfigurement

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **elephantiasis** (eh-luh-fan-TIE-uh-sis) is the significant enlargement and thickening of body tissues caused by an infestation of parasites known as filaria.

* **larvae** (LAR-vee) are the immature forms of an insect or worm that hatches from an egg.

* **testicles** (TES-tih-kulz) are the paired male reproductive glands that produce sperm.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **scrotum** (SKRO-tum) is the pouch on a male body that contains the testicles.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **grafts** are tissue or organ transplants.

* **stigma** is a mark of shame.

How Long Does the Disease Last and What Are the Complications?

Filariasis can last a lifetime, and without treatment it can worsen. The disease can lead to permanent disfigurement and damage to the lymphatic system and kidneys, secondary infections, hardening and thickening of the skin, and sexual and psychological problems. In countries in which the disease is common, a serious social stigma* often accompanies it, meaning that people in these countries look down on individuals who have symptoms of the disease.

Can Filariasis Be Prevented?

There is no vaccine to prevent filariasis, but controlling the populations of blood-sucking insects, especially mosquitoes, can limit the spread of the disease. In some areas where filariasis is common, people are treated yearly with preventive medicine to kill any immature worms in their blood. To protect themselves, people can also do the following:

- Stay inside as much as possible from dusk to dawn, when mosquitoes are most active.
- Sleep under mosquito netting.
- Place screens in all windows.
- Use insecticides around living areas.
- Apply insect repellent to exposed skin.

▶ See also **Skin Parasites • Travel-related Infections • West Nile Fever**

Resources

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/parasites/lymphaticfilariasis>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: 41-22-791-2111. Web site: <http://www.who.int/topics/filariasis>.

Flat Feet

Flat feet have flat inner arches and soles that completely touch the ground when the person is standing.

What Are Flat Feet?

Flat feet can happen at any age, and babies are born with them. Babies have fatty pads in the soles of the foot and in front of the heel, which fills the arch and gives feet their flat appearance. By three years of age, when children are walking properly, their feet no longer have a flat look. When children are between three to six years of age, the muscles of their feet become stronger, the fat disappears, and an arch develops. If the arches have not appeared by about age five or six—as happens with approximately one in every 10 children—a child is likely to have flat feet through adulthood.

Adults may have flat feet but still have good muscle tone and no pain. If feet are extremely flat, a doctor may recommend orthotics (arch supports) and a firm shoe to enable the person to walk without foot strain. Upwards of 75 percent of Americans have foot pain at some time, and flat feet may be the cause.

What Makes Feet Flat?

For some people, flat feet are the result of congenital bone malformation, evident if the doctor takes x-rays. For others, flat feet develop later. Each day as people walk, they take 8,000 to 10,000 steps on pavement, floor, tile, and other surfaces. With each step a person takes, gravity-induced pressure puts three to four times the body's weight on each foot. Over the years, the imbalance on the muscles of the feet may cause a disorder in the natural arch, weakening the posterior tibial tendon of the foot. Excessive weight or pounding stress may cause the longitudinal (lonj-i-TOO-di-nal) arch (which runs the length of the foot) or the metatarsal (met-a-TAR-sal) arch (which runs perpendicular to the longitudinal arch, from one side of the foot to the other) to fall, or flatten.

Other causes of flat feet are shoes that do not fit well, obesity*, rickets*, and metabolic disorders that may cause the arch muscles to weaken. In older adults, decreased exercise and increased weight can cause mechanical disturbances in the foot.

What Is Bad about Flat Feet?

Flat feet in themselves are not a problem. However, running on flat feet is almost like running on gelatin. Flat feet turn inward (pronation*), causing legs to turn inward, and contribute to such overuse injuries as shin splints* and back problems. Flat feet can also produce heel spurs*.

Correcting Flat Feet

Reducing pronation can help to prevent further problems. Experts recommend the following:

- Wearing shoes with arch support
- Wearing shoes that are motion controlled
- Avoiding shoes with lots of cushioning and little support
- Avoiding uneven running surfaces such as golf courses and trails.

Surgery is rarely recommended for flat feet alone.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

* **rickets** (RICK-kets) a condition of bones that causes them to soften and bend creating deformity. In the early twentieth century, rickets was caused by lack of sunlight and the lack of vitamin D, calcium, and phosphorus. As enriched foods and improved diets became more widespread, rickets practically disappeared in industrialized countries.

* **pronation** is the rotation of the foot inward and downward so that, in walking, the foot comes down on its inner edge.

* **shin splint** is inflammation in the front part of the tibia (the big bone below the knee), due to overuse, as in running too much on hard surfaces.

* **heel spur** is a bony growth under the heel that causes pain when a person walks.

* **ions** are positively or negatively charged elements or compounds, such as hydrogen, sodium, potassium, and phosphate, which are necessary for cellular metabolism.

▶ See also **Bunions**

Resources

Books and Articles

Langer, Paul. *Great Feet for Life: Footcare and Footwear for Healthy Aging*. Minneapolis, MN: Fairview Press, 2007.

Organizations

American Podiatric Medical Association. 9312 Old Georgetown Road, Bethesda, MD, 20814-1621. Web site: <http://www.apma.org>.

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905. Web site: <http://www.mayoclinic.com/health/flatfeet/DS00449>.

Flu See *Influenza*.

Fluid and Electrolyte Disorders

Fluid and electrolyte disorders are abnormalities in the distribution of water and ions in the body that result in health problems.*

What Are Electrolytes?

Electrolytes are charged particles (ions) that form when certain compounds are dissolved in water. Positively charged ions are called cations. Negatively charged ions are called anions. Some of the electrolytes that are important to maintaining health are sodium, potassium, calcium, magnesium, chloride, phosphate, bicarbonate, and sulfate.

Fluids and electrolytes are not evenly distributed in the body. About two-thirds of the fluid in the body is found inside cells and is called intracellular fluid (ICF). The remaining one-third is found in the spaces between cells, in the circulatory system, and in smaller amounts in the stomach, bladder, and a few other places. This fluid is called extracellular fluid (ECF). The distribution of fluid in the body is closely related to the distribution of electrolytes, particularly sodium and potassium. To understand this connection, it is necessary to understand what causes water to move in and out of cells.

Water follows electrolytes. Water passes easily across cell membranes. When fluid with two different concentrations of electrolytes is separated

by a cell membrane, there is pressure (called osmotic pressure) for water to flow across the membrane from fluid that contains fewer electrolytes (less concentrated) into fluid that contains more electrolytes (more concentrated). If osmotic pressure were the only factor affecting the movement of water, water and electrolytes would be evenly distributed inside and outside of cells. However, chemical reactions in the cell membrane actively prevent this from happening. Different types of cells have membranes that allow some electrolytes to pass across them while blocking others. The cell uses energy to drive this selection process and to maintain different concentrations of electrolytes on either side of the membrane.

The concentration of electrolytes in the body is highly dependent on how much water is in the body. The kidney is the main regulator of body fluids. As blood passes through the kidney, water, electrolytes, glucose (sugar), and wastes are filtered out of the blood into many tiny collecting tubules. If there is too little water in the body, the pituitary* secretes a hormone* called antidiuretic hormone (ADH). ADH signals the cells of the collecting tubules to allow water to pass back into the blood. If there is too much water in the body, little or no ADH is secreted, and instead of water returning to the blood, it is removed from the body in urine*. Other hormones help the kidney to regulate the amount of electrolytes that are returned to the blood. The filtering process helps rebalance the level of fluids and electrolytes in the body and maintain them within the narrow range needed for the body to function properly.

Maintaining the correct distribution of electrolytes inside and outside different types of cells is important because electrolytes play a role in most of the cellular activities that maintain life. For example, they perform the following:

- Help to control water balance and fluid distribution in the body
- Create an electrical difference across cell membranes that is necessary for muscle contraction and nerve transmission
- Regulate the acidity (pH) of the blood to keep it within the narrow limits that support life
- Help to regulate the level of oxygen in the blood
- Help move nutrients into cells and waste products out of cells

When the body is functioning correctly, it is able to perform the complex regulatory events that keep conditions within the body stable despite variations in the amount of food and water a person consumes. When there is an imbalance in electrolytes, many systems in the body are affected, and serious, even fatal, health problems, can result.

What Causes Fluid and Electrolyte Disorders?

Dehydration Dehydration is the most common cause of a fluid and electrolyte imbalance. Dehydration occurs when more water is lost from the body than is taken in through food and drink. This condition is often temporary; however, a 20 percent loss of water can be fatal. The average

Weighing In

The percentage of body weight that is made up of water changes as people age. Newborns have the most water—about 70 to 80 percent of their body weight. Older children and adults are about 60 percent water, while in elderly people only between 46 and 52 percent of body weight is water. Obese people's bodies contain a lower percentage of water than normal-weight people because fat cells do not store fluids. A woman's body contains less water than a man's body of the same weight because pound for pound, women have more fat cells.

* **pituitary** (pih-TOO-ih-tare-e) is a small oval-shaped gland at the base of the skull that produces several hormones—substances that affect various body functions, including growth.

* **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

Too Much Water

Flooding the body with water, just like its opposite severe dehydration, can be fatal, although the condition, called water intoxication, is much less common. In 2007, a Sacramento, California, woman died when she participated in a radio station contest that involved drinking large amounts of water in a short period. Water intoxication caused fatal swelling of her brain.

* **anorexia nervosa** (an-o-REK-se-a ner-VO-sa) is an emotional disorder characterized by dread of gaining weight, leading to self-starvation and dangerous loss of weight and malnutrition.

* **bulimia** (bu-LEE-me-a) is an eating disorder in which a person has episodes of out-of-control overeating, or binges, and then tries to make up for them by making themselves vomit, by taking laxatives, or by exercising to excess to avoid gaining weight.

* **endocrine system** is a system of ductless glands, including the thyroid and pituitary among others, that secrete hormones and control many bodily functions.

* **adrenal glands** (a-DREEN-al glands) are the pair of endocrine organs located near the kidneys.

* **corticosteroid** (KOR-ti-ko-STER-oid) is one of several medications that are prescribed to reduce inflammation and sometimes to suppress the body's immune response.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

adult man loses about 10 cups (2.5 L) of water daily through urine, bowel movements, sweating, and breathing out water vapor from the lungs, but many conditions increase the amount of water lost. The following are some examples:

- Heavy exercise in hot weather causes loss of sodium and water through sweating.
- Severe vomiting and diarrhea cause large amounts of water and many electrolytes that would normally be absorbed in the intestines to be lost. Small children with diarrhea can become seriously dehydrated in less than one day. Infants can become dehydrated within hours.
- High fever, especially in infants and young children, increases water loss through the skin.
- Severe burns cause water to be lost from the surface of the body when the skin is not there to prevent evaporation. In addition, as large numbers of damaged cells die, they release their electrolytes into interstitial fluid, upsetting electrolyte balance.
- Limited fluid intake is a particular problem with the elderly, especially those who are unable to walk or who are bedridden. In addition, the receptors that trigger the sense of thirst and the need to drink are less sensitive in the people over age 60.

Diseases and disorders A great many diseases can upset the balance of electrolytes and thus the functioning of the body. Often more than one electrolyte is affected. These diseases include the following:

- Any disease that damages the kidney and causes reduced kidney function or failure. This situation is a common cause of electrolyte imbalances in the elderly and can be fatal.
- The eating disorders anorexia nervosa* and binge-and-purge bulimia*
- Disorders of the endocrine system* in which too much or too little of any hormone that affects the kidneys is produced. An example is Conn's syndrome in which the adrenal glands* produce too much aldosterone, a hormone that affects potassium reabsorption.
- Certain cancer tumors that produce hormones
- Injury to or surgery on the pituitary gland

Drugs Some medications selectively increase the excretion of certain electrolytes, cause the body to retain excess water, or stimulate the kidneys to produce excess urine. Diuretic drugs (so-called water pills) are the most widely used drugs to affect fluid and electrolyte balance. These drugs rid the body of water, but at the same time often cause excess loss of electrolytes (most often potassium) in urine. By contrast, corticosteroid* drugs generally cause fluid retention (edema). Many chemotherapy* drugs also affect fluid and electrolyte balance as do some herbal supplements.

How Are Fluid and Electrolyte Imbalances Diagnosed and Treated?

Fluid and electrolyte imbalances may show with certain symptoms, including abnormal blood pressure, rapid pulse, abnormal breathing, and abnormal skin appearance, but none of these symptoms is specific to an electrolyte disorder. The definitive way of diagnosing an electrolyte imbalance is with urinalysis and blood tests. An electrolyte panel is a standard blood test that measures the concentrations of major electrolytes found in blood serum.

Treatment of dehydration involves replacement of fluids either intravenously* or by mouth with a fluid that contains a balance of electrolytes similar to that found in a healthy body. In mild cases of dehydration, young children can be given replacement pediatric rehydration fluids (e.g., Pedialyte), which are available at supermarkets and pharmacies without a prescription. Athletes frequently treat or prevent dehydration by using sports drinks that are formulated to replace electrolytes lost through sweating.

When the fluid and electrolyte imbalance is caused by an underlying disease, such as food poisoning that causes severe diarrhea, kidney failure, or an endocrine disease, that disease is treated. People with severe diarrhea and vomiting, cancer patients, people with hormonal imbalances, and other very ill people often need short-term fluid and electrolyte replacement therapy. Untreated electrolyte imbalances can cause health problems that range from chronic to rapidly fatal.

▶ See also **Diabetes • Kidney Disease**

Resources

Books and Articles

Hawkins, W. Rex. *Eat Right—Electrolyte: A Nutritional Guide to Minerals in Our Daily Diet*. Amherst, NY: Prometheus Books, 2006.

Organizations

American Academy of Pediatrics. 141 Northwest Point Boulevard, Elk Grove Village, IL, 60007-1098. Telephone: 847-434-4000. Web site: http://www.aap.org/publiced/BR_Diarrhea.htm.

American Association for Clinical Chemistry. 1850 K Street NW, Suite 625, Washington, DC, 20006. Toll free: 800-892-1400. Web site: <http://labtestsonline.org/understanding/analytes/electrolytes/test.html>.

American College of Sports Medicine. P.O. Box 1440, Indianapolis, IN, 46206-1440. Telephone: 317-637-9200. Web site: http://www.acsm.org/Content/NavigationMenu/Research/Roundtables_Specialty_Conf/PastRoundtables/Position_Stand_Fluid_Replacement.htm.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

Food Poisoning

Food poisoning results from eating food or drinking water that is the contaminated with a virus, bacterium, parasite, or chemical that causes illness. This condition can result when foods have not been properly prepared or stored or when water has not been adequately treated to remove contaminants. Food poisoning can also result from eating poisonous plants or animals.

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Robin's Story

Robin and her friends squeezed every pleasure they could into the early days of September before school started. The make-your-own-sundae

Microorganisms responsible for common food-borne illness

Microorganism	Food-borne illness	Symptoms	Common food sources	Incubation
Bacillus cereus	Intoxication	Watery diarrhea and cramps, or nausea and vomiting	Cooked product that is left uncovered—milk, meats, vegetables, fish, rice, and starchy foods	0.5–15 hours
Campylobacter jejuni	Infection	Diarrhea, perhaps accompanied by fever, abdominal pain, nausea, headache, and muscle pain	Raw chicken, other foods contaminated by raw chicken, unpasteurized milk, untreated water	2–5 days
Clostridium botulinum	Intoxication	Lethargy, weakness, dizziness, double vision, difficulty speaking, swallowing, and/or breathing; paralysis; possible death	Inadequately processed, home-canned foods; sausages; seafood products; chopped bottled garlic; noney	18–36 hours
Clostridium perfringens	Infection	Intense abdominal cramps, diarrhea	Meats, meat products, gravy, Tex-Mex type foods, other protein-rich foods	8–24 hours
Escherichia coli group	Infection	Watery diarrhea, abdominal cramps, low-grade fever, nausea, malaise	Contaminated water, undercooked ground beef, unpasteurized apple juice and cider, raw milk, alfalfa sprouts, cut melons	12–72 hours
Listeria Monocytogenes	Infection	Nausea, vomiting, diarrhea; may progress to headache, confusion, loss of balance and convulsions; may cause spontaneous abortion	Ready-to-eat foods contaminated with bacteria, including raw milk, cheeses, ice cream, raw vegetables, fermented raw sausages, raw and cooked poultry, raw meats, and raw and smoked fish	Unknown; may range from a few days to 3 weeks
Salmonella species	Infection	Abdominal cramps, diarrhea, fever, headache	Foods of animal origin; other foods contaminated through contact with feces, raw animal products, or infected food handlers. Poultry, eggs, raw milk, meats are frequently contaminated.	12–72 hours
Shigella	Infection	Fever, abdominal pain and cramps, diarrhea	Fecally contaminated foods	12–48 hours
Staphylococcus aureus	Intoxication	Nausea, vomiting, abdominal cramping	Foods contaminated by improper handling and holding temperatures—meats and meat products, poultry and egg products, protein-based salads, sandwich fillings, cream-based bakery products	1–12 hours
Hepatitis A	Infection	Jaundice, fatigue, abdominal pain, anorexia, intermittent nausea, diarrhea	Raw or undercooked molluscan shellfish or foods prepared by infected handlers	15–50 days
Norwalk-type viruses	Infection	Nausea, vomiting, diarrhea, abdominal cramps	Shellfish grown in fecally contaminated water; water and foods that have come into contact with contaminated water	12–48 hours
Giardia lamblia	Infection	Diarrhea, abdominal cramps, nausea	Water and foods that have come into contact with contaminated water	1–2 weeks
Trichinella spiralis	Infection	Nausea, diarrhea, vomiting, fatigue, fever, abdominal cramps	Raw and undercooked pork and wild game products	1–2 days

party at Robin's was the best time they had all summer, but a day or two after the party, Robin and her friends were all sick. They all had diarrhea, fever, stomach cramps, and had vomited more times than they had ever imagined possible. Why? Robin and her friends were among the nearly 250,000 Americans who became ill after eating ice cream that fall. The culprit? *Salmonella enteritidis* bacteria. Unseen, odorless, and tasteless, the microscopic organisms contaminated ice cream ingredients on the truck ride to the ice cream factory. The reason? The truck had not been cleaned from its previous load: unpasteurized raw eggs, a prime breeding ground for salmonella.

What Is Food Poisoning?

Food poisoning is a serious public health concern in the United States and around the world. The Centers for Disease Control and Prevention (CDC) estimates that there are at least 250 food-borne illnesses. Even though most food poisoning is not severe enough to require treatment by a doctor, food poisoning in the United States costs between \$5 and \$6 billion every year in direct medical care and lost productivity every year.

Food poisoning is caused by eating foods contaminated with a harmful virus, bacterium, parasite, or chemical. Organisms that can contaminate food live in the soil, raw meat, raw milk products, in animal feces, on bugs, rodents, and on unwashed hands and food-related equipment. Food can be contaminated any time that food handling, preparation, or equipment is unsanitary, and at any point in the farm to table fork cycle. Some common causes of contamination are unrefrigerated, perishable* food; raw or undercooked foods; or preserved foods that were not cooked at high enough temperatures. The CDC estimates that about 97 percent of all food poisoning comes from improper food handling. Of that, 80 percent occurs from food prepared in businesses (e.g., restaurants or cafeterias) or institutions (e.g., schools or jails). The remaining 20 percent occurs from food prepared at home.

Although the food in the United States is among the cleanest and safest in the world, the CDC estimates that 76 million cases of food poisoning occur in the United States each year. Most cases of food poisoning are mild, but about 325,000 individuals are hospitalized for food poisoning each year in the United States, and about 5,000 die. In underdeveloped nations where water supplies are often contaminated and refrigeration is rare, food poisoning may cause a billion illnesses and 4 to 6 million deaths each year. The very young, the elderly, and people with illnesses such as HIV*/AIDS* that weaken the immune system are at the highest risk of dying from certain kinds of food poisoning.

How Does Food Poisoning Occur?

Food poisoning has two basic causes: infectious organisms and illness caused by chemicals. The organisms that cause food poisoning are bacteria, viruses, and parasites. Chemicals can be either natural toxins (poisons)

- * **perishable** means able to spoil or decay, as in perishable foods.
- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

Preventing Food Poisoning

- Organisms grow best at room temperature. Keep hot foods hot (above 140°F or 60°C) and cold foods cold (below 40°F or 4°C).
- Do not eat perishable foods that have been standing at room temperature more than two hours.
- Do not eat raw or undercooked eggs, poultry, or meat. Food should be cooked to an internal temperature of between 140°F and 180°F (60 to 83°C).
- Do not eat raw or unpasteurized dairy products.
- Wash fruits and vegetables before eating them.
- Wash thoroughly all plates, cutting boards, counters, and utensils that have come into contact with raw meats or poultry before using them for something else; do not place cooked food on the same plate that contained raw food without first washing the plate.
- Wash hands and utensils thoroughly between handling raw meat and other items.
- Wash hands thoroughly after using the bathroom.
- Wash hands thoroughly after having any contact with animals, especially reptiles, which sometimes carry bacteria on their skin.
- Defrost food in the refrigerator or microwave and not on the counter at room temperature. Cook promptly when defrosted.

found in plants (e.g., poisonous mushrooms) and animals (e.g., Japanese puffer fish) or they can be human-made chemicals such as pesticides or herbicides. For example, in 2008 the chemical melamine was found to have been improperly added to milk in China, causing hospitalizations and deaths of many children.

Bacteria are a common cause of food poisoning. A single bacterium that divides every half hour can produce 17 million offspring in 12 hours. Bacteria fall into two general categories. One group causes symptoms of food poisoning by directly infecting the intestines causing irritation and diarrhea. The other group release toxins as they grow and reproduce. These toxins affect the digestive system and often cause vomiting and/or diarrhea. Many bacteria cause food poisoning. The following are a few of the more common ones.

- Various *Salmonella* bacteria are found most often in eggs, poultry, dairy products, and beef.
- Bacteria of the genus *Campylobacter* cause more diarrhea illnesses worldwide than any other group of bacteria. They are commonly found in raw chicken and turkey. Putting cooked food on the same spot where raw poultry has been placed is a leading cause of food poisoning from *Campylobacter*.
- *Escherichia coli* are a large group of bacteria, only some of which cause food poisoning. *E. coli* that causes severe food poisoning have been found in undercooked hamburger and in ready-to-eat raw spinach.

A large group of viruses called Norwalk, Norwalk-like, or noroviruses are an extremely common cause of food poisoning. In the early 2000s, Norwalk viruses were often in the news for causing outbreaks of diarrhea and vomiting on cruise ships and in nursing homes. These viruses are usually transferred onto food from infected food handlers.

Parasites that cause food poisoning usually come from contaminated water. They often cause mild symptoms that develop slowly but last for several weeks. *Giardia* and *Cryptosporidium* are two common waterborne parasites that cause diarrhea.

Natural poisons found in some wild mushrooms can cause various symptoms, including nausea and vomiting, hallucinations, coma*, and death, depending on the amount and species of mushroom eaten. Mushroom poisoning is a medical emergency. Oysters, clams, mollusks, and scallops can contain toxins that affect the nervous system. Individuals often feel tingling in the hands and feet and may become dizzy and have difficulty breathing. Shellfish poisoning is a medical emergency because the muscles needed for breathing may become paralyzed. Certain fish, which has been properly refrigerated or which contains toxins can also cause illness.

Human-made poisons include all pesticides, fertilizers, disinfectants, and any other chemicals remaining in food when it is eaten that can cause illness. Contamination is usually the result of ignorance or a misunderstanding of how to apply a chemical. Symptoms vary depending on the chemical. Any suspected chemical poisoning requires prompt medical evaluation.

A KANSAS CANNERY

Poisoning that results from eating food contaminated by *Clostridium botulinum* bacteria is called botulism. The word “botulism” is derived from the Latin word “botulus,” which means sausage.

Originally, scientists believed that the botulinum toxin could only be produced in the presence of animal protein, such as meat. In 1919, however, a botulism outbreak was traced to canned vegetables from a commercial cannery in Kansas. That same year, another botulism scare involved canned olives. Both incidents prompted stricter regulatory control of food processing technology. Most cases of botulism in the United States in the 20th century occurred in improperly home-canned foods or from a honey containing *C. botulinum* given to infants.

In the early 2000s, people realized that *C. botulinum* produces a toxin that affects the nervous system and causes paralysis. If left untreated botulism is often fatal. However, with the development of artificial respirators, the fatality rate for treated botulism is around 2 percent in the United States.

Sing Your Way to Clean Hands

One of the ways to be sure your hands are clean is to wash them under warm running water with soap for at least 15 to 20 seconds. That is the length of time it takes to sing the “A-B-C Song.”

- * **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.
- * **cultures** (KUL-churz) are tests in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.
- * **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

What Are the Symptoms of Food Poisoning?

Symptoms of food poisoning usually occur as soon one hour and as long as three days after contaminated food is consumed. The symptoms usually begin suddenly. People with food poisoning often have nausea, violent vomiting, frequent diarrhea, painful stomach cramps, and fever. They may also feel dizzy, have blurred vision, or difficulty breathing.

How Is Food Poisoning Diagnosed?

Doctors diagnose food poisoning by asking about symptoms, conducting laboratory stool cultures* that test for the presence of specific bacteria in feces, and having food samples analyzed. In mild cases, it usually is not necessary to determine exactly which organism is causing the symptoms. In the case of chemical and natural toxins, it is much more important to determine the exact cause of the food poisoning so that specific treatment can be given. Large outbreaks of food-borne illness may be investigated by the local or state department of health or by national organizations such as the CDC.

How Is Food Poisoning Treated?

Food poisoning lasts for one to seven days and usually does not require hospitalization. Hospitalization is necessary for serious cases of certain types of food poisoning or when the diarrhea or vomiting has caused dehydration*. Diarrhea and vomiting can cause large amounts of fluid

to be rapidly lost from the body. Young children are especially prone to dehydration and should be monitored closely. They can be given replacement pediatric rehydration fluids (e.g., Pedialyte), which are available at supermarkets and pharmacies without a prescription. To treat severe dehydration, the doctor may give a person fluids intravenously, (directly into a vein). If the food poisoning is caused by a bacterium, doctors will prescribe antibiotics to fight the infection.

Prevention

Following basic guidelines will help prevent most food poisoning:

1. Do not eat perishable foods that have been at room temperature for more than two hours.
2. Wash hands and utensils before and after handling any food, after using the bathroom, and after handling raw meat, poultry, or eggs.
3. Cook food thoroughly, and do not eat marinade from raw meat or poultry until it has been thoroughly boiled.

Even when individuals keep themselves and their food clean, contamination may have happened earlier in the production process, as with Robin's ice cream. Food processors, growers, and distributors also need to take steps to keep food safe (e.g., clean processing plants and safe and sanitary storage of food). The Department of Agriculture, the Food and Drug Administration, and local state and city health departments have strict rules for these businesses that are carefully enforced.

▶ See also **Bacterial Infections • Botulism • Salmonellosis**

Resources

Books and Articles

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Scott, Elizabeth, and Paul Sockett. *How to Prevent Food Poisoning: A Practical Guide to Safe Cooking, Eating, and Food Handling*. New York: Wiley, 2001.

Silverstein, Alvin, Virginia Silverstein, and Laura Silverstein Nunn. *The Food Poisoning Update*. Berkeley Heights, NJ: Enslow, 2008.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/dbmd/diseaseinfo/foodborneinfections_g.htm.

Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 888-INFO-FDA. Web site: <http://www.cfsan.fda.gov/~mow/intro.html>.

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD, 20892-3579. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/bacteria>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/foodcontaminationandpoisoning.html>.

Fractures See *Broken Bones (Fractures)*.

Frostbite See *Cold-Related Injuries*.

Fugue See *Memory and Amnesia*.

Fungal Infections

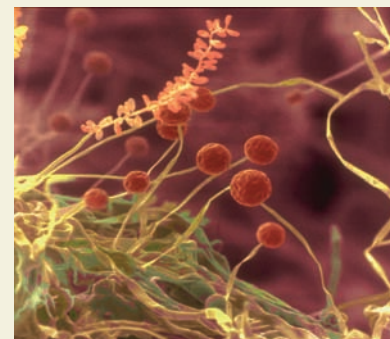
Fungal (FUNG-gul) infections are caused by fungi (FUNG-eye) that can grow on the skin, nails, and hair and within internal organs.

What Are Fungal Infections?

Fungal infections are caused by fungi, tiny microbes* found in soil, air, and water, as well as on plants, animals, and people. Fungi feed on other organisms, living or dead, and play an important role in helping dead plants and animals decay. There are at least 100,000 species of fungi. The most familiar types of fungi are the mushrooms, the fuzzy white or blue-green mold that grows on forgotten foods in the back of the refrigerator, and the mildew on the shower curtain. Fungi grow best in warm, moist areas such as a steamy bathroom or the spaces between the toes.

Relatively few species of fungi cause fungal infections, also called mycoses (my-KO-seez), in humans. Fungal infections are of two basic types: superficial infections and systemic infections. Superficial infections affect the surface of the body, the skin, the nails, and the hair. They most often occur in moist areas, such as between the toes, in the crotch, or in the mouth.

Systemic infections take hold inside the body, in individual organs or throughout the body, and can cause severe or even fatal illness. Systemic



▲
A yeast colony, as seen with an electron microscope, looks like growing vegetation. M. Kalab/Custom Medical Stock Photo, Inc. Reproduced by permission.

* **microbes** (MY-krobes) are microscopic living organisms, such as bacteria, viruses and fungi.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **ringworm** is a fungal infection of the skin or scalp that appears as a round, red rash.

infections are most likely to develop in people who have weak or suppressed immune systems*, such as the following:

- People with leukemia (cancer of the blood cells), Hodgkin's disease, or other kinds of lymphomas (cancers of the immune system)
- People receiving chemotherapy* or radiation treatment
- People with AIDS*
- People who have uncontrolled diabetes*
- People who have received an organ transplant
- People who are taking any type of drug that suppresses the immune system. For example, in September 2008, the U. S. Food and Drug Administration began an investigation into the risk of increased fatal fungal infections in people taking immunosuppressant drugs for rheumatoid arthritis.

In these people, the infections can cause chronic* disease and, in some cases, death.

What Are the Common Signs and Symptoms of Fungal Infections?

Superficial fungal infections, such as jock itch, vaginal yeast infection, athlete's foot, and ringworm*, typically are annoying but not very serious. Their symptoms generally include itchy, dry, red, scaly, or irritated skin. Systemic fungal infections often begin in the lungs and take time to develop. Severe infections occur in people whose immune systems have been weakened, allowing the infection to spread beyond the lungs to other organs. Symptoms of systemic fungal infections depend on which organs become infected and may include respiratory problems, extreme tiredness, coughing, weight loss, fever, night sweats, and headache.

What Are Some Specific Fungal Infections?

Tinea (TIH-nee-uh) is a general term given to a group of superficial fungal infections that affect the nails, feet (athlete's foot), groin area (jock itch), scalp, or skin (ringworm). *Trichophyton* and *Microsporum* fungi cause these related infections. Ringworm is identified by a red, scaly patch on the skin that looks like an expanding ring around a clearing center. Symptoms of athlete's foot include redness and cracking of the skin between the toes, and infected nails on the hands or feet usually look white and appear to be crumbling.

Candidiasis (kan-dih-DYE-uh-sis) is a superficial fungal infection caused by various strains of *Candida* (CAN-dih-duh) fungi. *Candida* is a yeast-like fungus often found in the mouth and the lining of the intestinal tract of healthy people. In people with weak immune systems, however, it can grow out of control, leading to an infection. A *Candida* infection of the mouth and throat is known as oropharyngeal (or-oh-fair-in-JEE-ul) candidiasis (OPC) or thrush, and infection of the vagina is known as

vulvovaginal (vul-vo-VAH-jih-nul) candidiasis (VVC) or vaginal yeast infection. OPC can affect newborns, people with AIDS or diabetes, and other people with weak immune systems. Its symptoms include white, thick patches on the tongue, mouth, and throat. *Candida* infection commonly occurs in newborns in the form of thrush or diaper rash. VVC is associated with vaginal burning or itching and a thick, cheese-like discharge. In certain situations, *Candida* can enter the bloodstream and spread to internal organs. These cases are seen most frequently in hospitalized patients who have weak immune systems and have received powerful antibiotics for other conditions.

Aspergillosis (as-per-jih-LO-sis) is the name for a variety of systemic infections caused by *Aspergillus* (as-per-JIH-lus) fungi. If it is inhaled through the mouth or nose, the fungus can cause a mild allergic reaction or a more serious infection of the sinuses* and lungs. Symptoms of aspergillosis vary and may include fever, cough, chest pain, and wheezing. In severe cases, typically seen in people with weak immune systems, the infection can spread to other organs, including the brain, skin, and bones.

Blastomycosis (blas-toh-my-KO-sis) is a systemic infection caused by the *Blastomyces dermatitidis* fungus commonly found in soil in the southeast, midwest, and south-central United States. The disease's symptoms resemble those of the flu: joint and muscle pain, a cough that brings up sputum*, fever, chills, and chest pain. If it progresses, it can lead to chronic pulmonary* infection, causing permanent lung damage, or widespread disease that affects the bones, skin, and genital and urinary tracts. Blastomycosis leads to death in about 5 percent of patients.

Coccidioidomycosis (kok-sih-dee-oyd-o-my-KO-sis) is a systemic infection caused by *Coccidioides immitis*, a fungus found in soil in the southwestern United States, in Mexico, and in South America. Most people with coccidioidomycosis have no symptoms, but 40 percent of patients experience a flu-like illness, with fever, rash, muscle aches, and cough. Also known as valley fever, the infection can cause pneumonia* or widespread disease affecting the skin, bones, and meninges*, which are the membranes covering the brain and spinal cord.

Cryptococcosis (krip-toh-kah-KO-sis) is a systemic infection caused by the fungus *Cryptococcus neoformans*, usually found in soil or bird droppings. Typically, the fungus enters the body through the mouth or nostrils when someone inhales fungi spores*, and symptoms of a lung infection, such as cough and chest pain, may develop. Although infection with *Cryptococcus* usually produces no symptoms or only mild symptoms in healthy people, the infection may spread in people who have weak immune systems. If it spreads to the central nervous system, it can cause inflammation of the meninges. This complication is especially common among people with AIDS.

Histoplasmosis (his-toh-plaz-MO-sis) is usually a mild systemic infection caused by *Histoplasma capsulatum*. This fungus is found in the eastern



▲ The *Trichophyton* fungus, photographed under an electron microscope at more than 4,000 times its original size, causes ringworm of the scalp (tinea capitis). The fungus is reproducing by flowering. Oliver Meckes/Photo Researchers, Inc.

- * **sinuses** (SY-nuh-ses) are hollow, air-filled cavities in the facial bones.
- * **sputum** (SPYOO-tum) is a substance that contains mucus and other matter coughed out from the lungs, bronchi, and trachea.
- * **pulmonary** refers to the lungs.
- * **pneumonia** (nu-MO-nyah) is inflammation of the lungs.
- * **meninges** (meh-NIN-jeez) are the membranes that enclose and protect the brain and the spinal cord.
- * **spores** are a temporarily inactive form of a germ enclosed in a protective shell.

Friendly Bacteria

Naturally occurring “friendly” bacteria and fungi live side by side in the human body. Some bacteria help keep fungi in check by preventing them from reproducing uncontrollably and causing disease. From time to time, however, doctors need to prescribe antibiotics to combat not-so-friendly bacteria that cause illness. Most antibiotics kill many types of bacteria, both good and bad, and using them for long periods can destroy too many friendly bacteria, allowing fungi to grow unchecked and eventually cause infection. To preserve the bacteria humans need, it is important to use antibiotics only when necessary and prescribed by a doctor.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.

* **boils** are skin abscesses, or collections of pus in the skin.

* **ulcerate** means to become eroded by infection, inflammation, or irritation.

* **endemic** (en-DEH-mik) describes a disease or condition that is present in a population or geographic area at all times.

and central United States in soil that contains bird and bat feces*. When the soil is disturbed, the fungal spores may be inhaled. Histoplasmosis can cause flu-like symptoms, including body aches, fever, and cough. Most people who become infected do not experience symptoms, but as with other fungal infections, people with weak immune systems are at risk for severe disease. In those cases, the infection affects the lungs and may spread to the liver*, spleen*, bones, and brain.

Mucormycosis (mu-cor-my-KO-sis) is caused by a fungus found on decaying plants. Most people do not get sick from exposure to this fungus. However, people with weakened immune systems or uncontrolled diabetes are susceptible to becoming sick. Mucormycosis often starts with a sinus infection. Infection then spreads to the brain and sometimes to the lungs, skin, digestive system, and kidneys. The death rate for this fungal infection ranges from 30 to 70 percent, depending on where the infection is located.

Sporotrichosis (spo-ro-trih-KO-sis) is a skin infection caused by the *Sporothrix schenckii* fungus, which is found in soil, thorny plants, hay, sphagnum (SFAG-num) moss, and other plant materials. It enters the skin through a small cut or puncture, such as a thorn might make. Soon, small reddish bumps resembling boils* form around the cut and often ulcerate*. In some cases, infection can spread to other parts of the body, such as the lungs or joints.

How Common Are Fungal Infections?

Superficial fungal infections, such as athlete’s foot and candidiasis, are common. Systemic infections, by contrast, are rare, appearing in less than one to two people in every 100,000 in the United States, according to the Centers for Disease Control and Prevention. They are more common in certain populations, such as people with AIDS or those who have had organ transplants.

With the so-called endemic* mycoses, rates of disease are higher in specific geographic areas. For example, coccidioidomycosis occurs in about 15 of every 100,000 people in parts of the southwestern United States (with 10 to 50 percent of the population testing positive for exposure to the fungus). In areas where histoplasmosis is found, up to 80 percent of the population test positive for exposure to *Histoplasma capsulatum*, but the disease develops only in people with weak immune systems.

Are Fungal Infections Contagious?

Some fungal infections, such as candidiasis and ringworm, can spread from person to person through contact with the infected area. Most infections, however, develop from fungi found naturally on the human body or in the environment. Many fungi that cause systemic respiratory disease are found in soil or in the droppings of animals or birds. Usually they are inhaled after the soil or droppings are disturbed, sending dust and fungal spores into the air.

How Do Doctors Make the Diagnosis?

Most superficial fungal infections are diagnosed based on their appearance and location. A doctor may also take a skin scraping to examine under the microscope or to culture* in a laboratory. Some fungi glow with a particular color under ultraviolet* light, so a doctor may make the diagnosis by shining such a light on the affected area. Systemic infections can be diagnosed by collecting a sample of blood, urine, cerebrospinal fluid*, or sputum to culture.

Can Fungal Infections Be Treated?

Most superficial fungal infections are treated at home with antifungal creams or shampoos for one to two weeks. Oral (taken by mouth) antifungal medication also may be prescribed, if necessary. Some cases of fungal infection are more persistent and may need to be treated with medicine for two to four weeks or even longer. Systemic illnesses often require hospitalization so that the patient can receive intravenous* antifungal drugs and supportive care.

Can Fungal Infections Be Prevented?

Preventing fungal infections can be difficult, because fungi are everywhere. In general, people who are otherwise healthy rarely contract systemic fungal infections. Practicing good hygiene, keeping the skin dry, and changing socks and underwear every day can help prevent superficial skin infections.

▶ See also **Athlete's Foot • Coccidioidomycosis • Ringworm • Skin and Soft Tissue Infections • Yeast Infection, Vaginal**

Resources

Books and Articles

Brock, David L. *Infectious Fungi*. Philadelphia, PA: Chelsea House, 2006.

Viegas, Jennifer. *Fungi and Molds*. New York: Rosen, 2004.

Organizations

American Academy of Dermatology. P.O. Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: <http://www.aad.org/forms/pamphlets/default.aspx>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dbmd/mdb>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/fungalinfections.html>.

* **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **ultraviolet** light is a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

* **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) fluid is the fluid that surrounds the brain and spinal cord.

* **intravenous** (in-tra-VEE-nus) means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

G

Galactorrhea

Galactorrhea is the spontaneous flow of milk from the nipple at any time other than the expected nursing period right after a pregnancy.

What Is Galactorrhea?

Galactorrhea is the spontaneous flow of milk from the nipple at any time other than the expected nursing period right after a pregnancy. The word galactorrhea comes from the Greek “galaktos,” meaning “milk” and “rhein” meaning “to flow.” The sugar contained in breast milk is called galactose. Galactorrhea is also sometimes called witch milk, because it occurs at unexpected and unexplained times. Galactorrhea may occur in either females or males. Both females and males have mammary glands in their breasts. The mammary glands in a male are less developed than in a female, but under certain conditions may be stimulated to create milk. Galactorrhea may be intermittent or consistent, scant or abundant, and come from one or both breasts. Milk production is caused by the hormone prolactin, which is made by the pituitary gland.

What Causes Galactorrhea?

There are many different causes of galactorrhea. In both males and females, the most common cause of galactorrhea is a prolactin-secreting tumor called a prolactinoma that grows in the pituitary gland. Overproduction of prolactin and the development of galactorrhea may also be caused by specific drugs, including some drugs given for high blood pressure (especially methyl dopa); some narcotic pain killers; and birth control pills. Birth control pills may cause galactorrhea while a person is taking them and after a person stops taking them because resulting changes in estrogen levels have an effect on prolactin production. Some types of antipsychotic drugs* can cause galactorrhea because they act on a receptor for the neurotransmitter* dopamine*. Prolactin production is also regulated by dopamine. Dopamine inhibits (holds back) prolactin production at inappropriate times. Drugs that inhibit dopamine effectively remove inhibition of prolactin production, with galactorrhea as a result. Other causes of galactorrhea that do not involve high levels of prolactin include an underactive thyroid gland in a condition known as hypothyroidism*, chronic kidney failure, and some spinal cord injuries.

Galactorrhea in newborns Galactorrhea may temporarily occur in newborns of either gender. High levels of maternal estrogen in the

* **antipsychotic drugs** are medications that counteract or reduce the symptoms of a severe mental disorder such as schizophrenia.

* **neurotransmitter** (NUR-o-transmit-er) is a chemical produced in and released by a nerve cell that helps transmit a nerve impulse or message to another cell.

* **dopamine** (DOE-puh-meem) is a neurotransmitter in the brain that is involved in the brain structures that control motor activity (movement).

* **hypothyroidism** (hi-po-THY-royd-ih-zum) is an impairment of the functioning of the thyroid gland that causes too little thyroid hormone to be produced by the body. Symptoms of hypothyroidism can include tiredness, paleness, dry skin, and in children, delayed growth and mental and sexual development.

* **endocrine system** is a system of ductless glands, including the thyroid and pituitary among others, that secrete hormones and control many bodily functions.

* **MRI** short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

fetal circulation can result in temporary breast enlargement in newborn infants. Enlargement of the breast may also be associated with secretion of milk. This condition usually resolves on its own, as levels of maternal estrogen gradually fade after birth.

What Role Does the Pituitary Gland Play in Galactorrhea?

The pituitary gland is a pea-sized gland that sits at the base of the brain. It is part of the endocrine system*, which is the system responsible for hormonal regulation of bodily processes such as milk production. The pituitary gland secretes many different hormones that act on other parts of the endocrine system. One of the hormones produced by the pituitary gland is prolactin. The target of prolactin is the mammary glands of the breast.

How Do Prolactinomas Cause Galactorrhea?

Prolactinomas are very small tumors in the pituitary gland that affect the hormone prolactin and these tumors can cause galactorrhea. The tumors tend to be larger in men than in women when discovered, probably because they come to medical attention later. Individuals with prolactinomas are usually between 20 and 35 years of age.

How Is Galactorrhea Treated?

Treatment of galactorrhea is basically directed at the underlying cause of the problem. Self-manipulation of the breast to check for galactorrhea should be stopped, because it can prolong the condition of galactorrhea. Galactorrhea in infants does not require treatment and will stop on its own. Whether the prolactin level is elevated determines how galactorrhea is treated. Patients with isolated galactorrhea and normal prolactin levels do not require treatment if they are not bothered by the galactorrhea, do not wish to conceive, and do not have another physical abnormality or reduced bone density. Prolactin levels are still measured periodically in these patients.

In patients with elevated prolactin levels, an MRI* may be performed if a pituitary tumor is suspected. Treatment tries to reduce excess prolactin secretion and the symptoms it causes, reducing the size of the prolactinomas and preventing their recurrence. Medications that act on dopamine receptors inhibit further prolactin production, stop galactorrhea, and decrease the size of the prolactinomas. As of 2009, bromocriptine and cabergoline were the only dopamine receptor stimulators approved by the Food and Drug Administration for the treatment of elevated blood prolactin and galactorrhea. However, approximately 12 percent of patients cannot take bromocriptine. The side effects include nausea, vomiting, dizziness, headache, nasal congestion, fatigue, abdominal pain, leg cramps, anxiety, depression, confusion, and constipation. While cabergoline may be easier to take, it has serious side effects, too, and is expensive.

Surgery is usually not performed in patients with prolactinomas because the medication is effective. Surgery is only used in cases in which

other procedures have failed or in which the tumor's growth is causing a particular problem, for example when it presses on nerves of the eye necessary for vision. In such a case, the tumor is accessed directly through the sinuses or by radiation.

Resources

Books and Articles

Peña, Kristin S., and Jo Ann Rosenfeld. "Evaluation and Treatment of Galactorrhea." *American Family Physician* 63, no. 9 (May 1, 2001): 1763–70. Also available at <http://www.aafp.org/afp/20010501/1763.html>

Organizations

Pituitary Disorders Education & Support. P.O. Box 571, Brighton, MI, 48116. Telephone: 810-923-3379. Web site: <http://www.pituitary-disorder.net/index.html>.

University of Michigan Health System. 1500 E. Medical Center Drive, Ann Arbor, MI, 48109. Telephone: 734-936-4000. Web site: http://www.med.umich.edu/1libr/wha/wha_galac_crs.htm.

Gallstones

Gallstones are crystal-like particles that form in the gallbladder when certain substances separate out of bile. Gallstones can vary dramatically in size, and while some may cause no symptoms, others may lead to serious medical concerns, including inflammation and infection.*

What Does the Gallbladder Do?

The gallbladder is a small, pear-shaped organ that sits under the liver on the right side of the abdomen*. The gallbladder concentrates and stores the greenish-brown liquid called bile, a digestive juice that is made by the liver. When a person eats food, the gallbladder contracts and sends bile through tubes called bile ducts and into the small intestine, where it helps break down fats in the food.

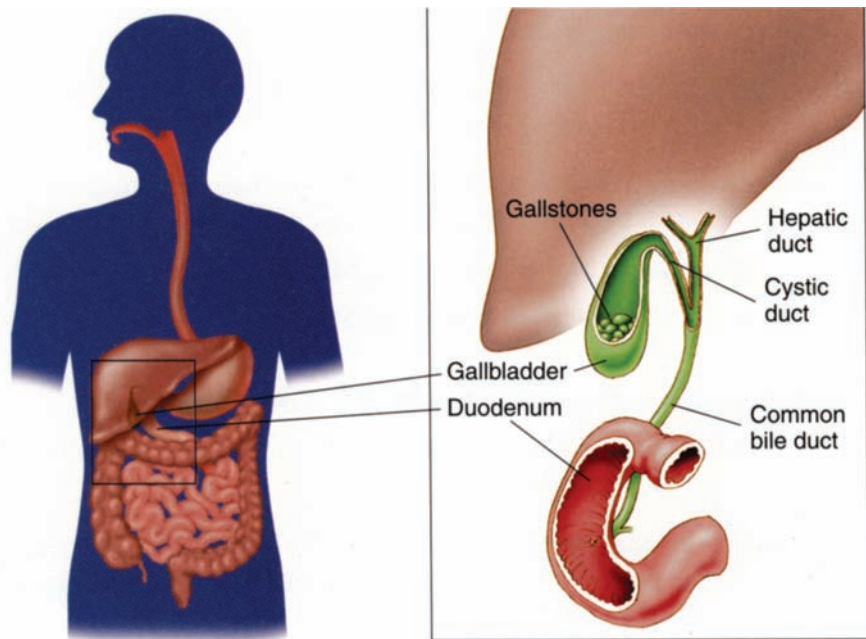
Bile has a number of ingredients, including water and dissolved bile salts. Bile salts act like detergent and help dissolve globules of fat. Bile also contains the following:

- cholesterol, a fat-like substance that is secreted by the liver as waste
- fats, including phospholipids, which are phosphorus-containing fatty substances
- bilirubin, which is a waste product secreted by the liver and formed by the breakdown of red blood cells

* **bile** is a greenish-brown fluid manufactured in the liver that is essential for digesting food. Bile is stored in the gallbladder, which contracts and discharges bile into the intestine to aid digestion of fats after a person eats.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

The gallbladder sits under the liver on the right side of the abdomen near the pancreas. When gallstones are formed, they can block the bile ducts, leading to pain and damage to the gallbladder, liver, and pancreas. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



* **pancreas** (PAN-kree-us) is a gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.

Like the bile salts, these substances are usually completely dissolved in the bile. When an imbalance exists, however, gallstones can develop. For instance, too much cholesterol can cause the bile to form crystals that drop out of the liquid. These crystals are gallstones.

What Are Gallstones?

Gallstones are pieces of solidified bile. The components of bile usually remain dissolved, but when something goes wrong that upsets the normal chemical balance, gallstones can form. Gallstones come in two main types: cholesterol stones, which account for about 80 percent of gallstones in the United States, and pigment stones, which form from bilirubin and calcium, a mineral that is also found in bile.

Gallstones can develop when a chemical imbalance exists in the bile, which causes it to contain more cholesterol (or bilirubin and calcium) than can be dissolved, or when the gallbladder does not contract enough to empty itself of bile on a regular basis. Gallstones can range in size from gravel-like particles to spheres the size of golf balls. Some people have single stones, whereas others develop many stones.

Although gallstones can result in little or no difficulties for many people, they can sometimes cause serious problems when they cause blockages, which can lead to inflammation and infection. When gallstones block the bile duct and trap bile inside the gallbladder, the gallbladder can become inflamed and sometimes develop a bacterial infection. This condition is called cholecystitis. Occasionally, the gallstones move farther down the bile duct to another small opening that is shared by the gallbladder and the pancreas*, a gland located near the stomach. Like the

gallbladder, the pancreas secretes digestive juices into the intestine. If the blockage occurs at this opening, damage to the gallbladder, liver, and pancreas can result. The resulting inflammation of the pancreas is known as gallstone pancreatitis.

Who Is at Risk for Gallstones?

One in every 10 people in the United States, or about 30 million people, have gallstones. Gallstones are rare in children and adolescents, but anyone can get them.

Cholesterol Diets high in cholesterol seem to be linked to gallstones, although some researchers believe that a high cholesterol diet must be accompanied by a genetic predisposition* toward gallstones. Anything that increases the cholesterol level in bile, including pregnancy, hormone therapy, and birth control pills, can increase a person's susceptibility to getting cholesterol stones.

Obesity and other health conditions Obese people also have a higher risk of gallstones, as do people who are fasting or on fad diets. Dieters may develop stones because lack of food means that the gallbladder does not regularly contract to release its bile, and the bile may sit in the gallbladder for a long time. People with liver diseases, infections of the bile ducts, and blood cell disorders (such as sickle-cell anemia*) are prone to developing pigment stones.

Other populations Groups of people who also seem to be at higher risk of developing gallstones include the following:

- women, especially those who have had several children (women are two to three times more likely than men to develop gallstones)
- people of Native American or Mexican ancestry
- people who are older than 60 years of age
- individuals with a family history of gallstones

What Happens When People Have Gallstones?

Most gallstones do not cause symptoms; only one in five people with gallstones experiences problems.

Symptoms Individuals who have symptoms usually feel them after a meal, when the gallbladder contracts to secrete bile. If a stone moves into the bile duct, a person will feel cramping pain in the abdomen and possibly also in the shoulder and back. In some cases, the pain can be severe. Individuals with cholecystitis may also experience nausea, vomiting, sweating, fever, chills, jaundice* (a yellowing of the skin and eyes), and chest pain. Symptoms of gallstone pancreatitis are similar to those of cholecystitis, but the pain may extend to the upper abdomen on the left side or to the back. Individuals who experience symptoms of cholecystitis or gallstone pancreatitis should contact a medical professional immediately.

* **genetic predisposition** is an inherited tendency to get a certain disease.

* **sickle-cell anemia** also called sickle-cell disease, is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

Diagnosis Medical professionals usually only diagnose gallstones if they are causing problems. To look for gallstones, doctors may use x-rays and ultrasound*, a painless procedure in which sound waves passing through the body create images on a computer screen.

Treatment The standard treatment for gallstones, and the only one guaranteed to cure gallstones permanently, is surgical removal of the gallbladder, usually through laparoscopic surgery (surgery performed through tubes that are inserted into the abdomen through small incisions). Doctors perform more than 500,000 of these operations every year in the United States. If a person cannot have laparoscopic surgery, the doctor may remove the gallbladder through an open incision 5 to 8 inches long in the abdomen.

People who cannot have surgery or do not want to have surgery can take medication to help dissolve gallstones, although this process can take months or even years. They may also undergo lithotripsy (LITH-o-trip-see). In this procedure, shock waves pass through the skin to shatter the stone into tiny particles that may be able to pass out of the gallbladder on their own.

▶ See also **Eating Disorders: Overview • Jaundice • Obesity • Pancreatitis • Pregnancy**

Resources

Organizations

American Gastroenterological Association. 4930 Del Ray Avenue, Bethesda, MD, 20814. Telephone: 301-654-2055. Web site: <http://www.gastro.org/wmspage.cfm?parm1=5680>.

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/gallstones>.

Gangrene

Gangrene (GANG-green) is the decay or death of tissue caused by a lack of oxygen supply to the tissue and/or bacterial infection of the tissue.

What Is Gangrene?

Gangrene is not a contagious* disease. It is a condition in which living tissue (e.g., skin, muscle, or bone) begins to decay and eventually dies because blood flow (and oxygen) to an area is blocked or because harmful

bacteria invade the body's tissues after entering through a wound or sore. Gangrene most commonly affects the feet, toes, hands, and fingers. Gangrene can also occur inside the body in abdominal organs such as the intestines.

Doctors recognize three major forms of gangrene: dry, wet, and gas gangrene.

Dry gangrene Dry gangrene is the most common form of gangrene, and it occurs most frequently in the feet of people with diabetes*. Dry gangrene results from the gradual loss of blood supply to a part of the body. The tissue slowly dies because it receives little or no oxygen and nutrients from the blood, but it does not become infected. The first symptoms of dry gangrene are often numbness and tingling in the affected area. These symptoms are usually followed by severe pain as the condition progresses and the tissue begins to die; the skin temperature drops, and the color of the tissue changes, eventually turning black.

Dry gangrene is most often a complication of diabetes, arteriosclerosis*, or frostbite*. Because this condition usually develops gradually, it may go unnoticed for weeks or months, especially in elderly people. Dry gangrene usually is not life threatening, but it needs to be treated promptly.

Wet gangrene Wet gangrene is caused by a bacterial infection from severe wounds or burns or by a crushing injury that causes blood to stop flowing to a certain part of the body. When blood flow stops, bacteria begin to invade the damaged tissue. In wet gangrene, there is pain, swelling, and blistering of the skin, and the wound gives off a foul smell. Organisms that are commonly involved in wet gangrene include *Streptococcus* (strep-tuh-KAH-kus) and *Staphylococcus* (stah-fih-lo-KAH-kus) bacteria. Without treatment, wet gangrene can be fatal.

Gas gangrene Gas gangrene, which is a form of wet gangrene, involves infection of body tissue by certain types of bacteria (such as *Clostridium perfringens*, klah-STRIH-de-um per-FRING-enz) that are capable of thriving in anaerobic (ah-nuh-RO-bik) conditions (in which there is little or no oxygen). Once present in the tissue, these bacteria release toxins* and gas. Gas gangrene is marked by a high fever, brownish pus*, gas bubbles under the skin, skin discoloration, and a foul odor. It is the rarest form of gangrene, and only 1,000 to 3,000 cases occur in the United States each year. Like wet gangrene, gas gangrene can be fatal if not treated immediately.

How Do Doctors Diagnose and Treat Gangrene?

A doctor makes the diagnosis of gangrene based on a physical examination, the patient's medical history, and the results of blood and other laboratory tests. Cultures from the gangrenous area may be taken and laboratory tests performed to identify the type of bacterial infection and determine the extent to which an infection has spread.



▲ People with poor circulation may experience dry gangrene from loss of oxygen and nutrients carried by blood to the extremities. If the tissue turns black and dies, it must be removed surgically. SPL/Photo Researchers, Inc.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **arteriosclerosis** (ar-teer-e-oslav-RO-sis) is a condition in which arteries of the body have become narrowed and hardened from the buildup of calcium, cholesterol, and other substances, causing decreased blood flow through these vessels.

* **frostbite** is damage to tissues resulting from exposure to low environmental temperatures. It is also called congelation (kon-jeh-LAY-shun).

* **toxins** are substances that cause harm to the body.

* **pus** is a thick, creamy fluid, usually yellow or greenish in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

* **amputation** (am-pyoo-TAY-shun) is the removal of a limb or other appendage or outgrowth of the body.

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

Dead gangrenous tissue must be removed surgically by a procedure called debridement (deh-BREED-ment) so that the wound can heal and healthy new tissue can grow. People with gangrene caused by bacterial infections are treated with antibiotics. In more severe cases, amputation* of a finger, toe, or part of a limb may be necessary. Sometimes patients with gangrene are treated in a hyperbaric chamber, where they are exposed to oxygen at a high pressure to help the affected tissue heal.

The outcome for gangrene is usually favorable if the condition is recognized and treated early. Full recovery and new tissue growth can take several weeks to months. Sepsis, a potentially serious spread of infection through the bloodstream and body, can result from wet and gas gangrene. If left untreated, sepsis can result in shock* or death.

Can Gangrene Be Prevented?

Carefully cleaning and watching wounds for signs of infection can help prevent gangrene. It is wise to seek medical attention for any wounds that are not healing well or look infected. People who are susceptible to dry gangrene, such as those with decreased circulation in their legs and feet from diabetes or arteriosclerosis, are advised to pay attention to any skin infection in those areas (because such infections can lead to the development of wet gangrene) and to avoid smoking (because smoking constricts the blood vessels, further decreasing circulation). Daily foot care and hygiene is very important in people with advanced diabetes. Treatment with antibiotics before and after abdominal surgery has been shown to reduce the rate of infection and the possibility of developing wet or gas gangrene.

▶ See also **Bacterial Infections • Cold-Related Injuries • Diabetes • Sepsis**

Resources

Organization

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/007218.htm>.

Gastroenteritis

Gastroenteritis (gas-tro-en-ter-I-tis) is a disease in which the lining of the stomach and intestines becomes inflamed, resulting in what is sometimes referred to as an upset stomach or stomach flu.

What Is Gastroenteritis?

Gastroenteritis is a general term for inflammation* of the gastrointestinal (gas-tro-in-TES-ti-nal) tract, the part of the digestive system consisting of the stomach, small intestine, and large intestine. Loss of appetite, vomiting, cramps, nausea*, and diarrhea* are the most common symptoms of gastroenteritis. In the United States, gastroenteritis usually is a mild disease. In countries in which water supplies are dirty, sewage treatment is poor, or medical facilities are scarce, it sometimes leads to death.

What Causes Gastroenteritis?

There are many different causes of gastroenteritis. Viral infections are the most common cause in the United States. Certain bacteria and parasites that can get into food or water supplies also can lead to the disease. In addition, gastroenteritis can result from food allergies or sensitivities, side effects of certain medications, and alcohol or toxic (poisonous) substances.

How Is Gastroenteritis Treated?

Mild gastroenteritis usually lasts just two or three days. Often, the only treatment needed is rest and drinking lots of clear fluids. However, gastroenteritis can be serious if vomiting and diarrhea cause dehydration (de-hy-DRAY-shun), a condition that results when a person loses fluid and body salts faster than they can be replaced by drinking. If a person becomes dehydrated, hospitalization may be needed to deliver intravenous (in-tra-VEE-nus) fluid replacement therapy. Intravenous (IV) therapy replaces lost fluid by dripping liquids and salts directly into the bloodstream through a small needle inserted into a vein.

How Can Gastroenteritis Be Prevented?

Washing the hands thoroughly after using the toilet and before handling food and before eating are important ways to prevent infectious gastroenteritis. Preparing and storing food properly also are important. For people who plan to visit developing countries, vaccines* are available against some of the diseases that cause gastroenteritis.

▶ See also **Diarrhea • Food Poisoning • Viral Infections**

Resources

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dvrd/revb/gastro/faq.htm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/gastroenteritis.html>.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **nausea** (NAW-zha) refers to a feeling of being sick to one's stomach or needing to vomit.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

* **vaccines** (vak-SEENS) are preparations of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

- * **bisexual** (bi-SEK-shoo-al) means being sexually attracted to both sexes.
- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **genitals** (JEH-nih-tul) refers to the external sexual organs.
- * **androgynous** (an-DRAW-gin-us) having characteristics of both sexes.
- * **transgendered** a person who identifies with and expresses a gender identity that differs from the one which corresponds to the person's sex at birth.

Gay, Lesbian, Bisexual, and Transgender Health

The gay, lesbian, bisexual, and transgender (GLBT) community in the United States consists of a diverse group of people of all ages, races, cultures, genders, and socio-economic backgrounds. Generally, the health concerns of GLBT people are no different than those of heterosexuals. Some health concerns are of specific concern to GLBT communities, however. For instance, gay men are at a higher risk of contracting HIV*/AIDS*. GLBT are also subject to societal bias, violence, and discrimination that can lead to mental health problems such as depression and anxiety.*

What Is Gender?

In its simplest form, the word “gender” refers to a person’s sex (male or female). For many reasons, however, people identify with gender and gender roles differently. Gender can be defined in many different ways, including physiologic gender, emotional gender, and social gender.

Physiologic gender Before the twentieth century, a person’s sex was determined solely based on his or her external genitals.*. Advances in technology have allowed for a fuller understanding of chromosomes and their effect upon gender identity. Generally, human beings are considered either male (with XY chromosomes) or female (with XX chromosomes). In some cases, though, there are combinations of chromosomes and genitalia that do not comply with the traditional definitions of male and female gender. For example, a person born with male or female genitalia may exhibit physical characteristics that are traditionally attributed to the opposite sex. These androgynous* attributes include body shape, body and facial hair, and tone of voice. In addition, some studies suggest that homosexuality itself is genetically determined.

Emotional gender Some individuals emotionally identify more with the opposite gender. There is an apparent conflict between the person’s physical sex and what his or her brain believes to be the essential or true identity, and this inner sense of identify may not comply with socially mandated roles. In some cases, this apparent conflict is resolved by social or professional choices that are fulfilling to individuals. However, profound confusion or contradiction between the physical and emotional identities may cause some individuals to be diagnosed with gender identity disorder. Some people who experience gender identity issues opt to undergo surgical procedures (gender reassignment) to change their sexual characteristics. These people are transgendered*. Gender reassignment surgery strives to create in the body of an individual the sexual physical traits of the opposite sex. This kind of surgery might include either the

removal of a person's breasts, testicles*, or penis, or the addition of breasts or female or male sex organs.

Social gender Social gender refers to the traditional roles that men and women are expected to conform to, based on their physiological gender. In every society, males and females are typically assigned certain gender roles that are widely considered acceptable. For example, in the United States, girls are encouraged to choose toys that are perceived to be feminine, such as dolls, dress-up clothes, kitchen toys, and play cosmetics. Boys are encouraged to choose toys that are perceived as masculine, such as cars, trucks, sports equipment, tools, and play weapons. When children grow up, these social norms predict the girls will become nurturers in roles such as nurses, grade-school teachers, and social workers, and boys will be masterful and dominant in roles such as doctors, scientists, and soldiers. As adults, while there is a majority of one sex in a given role, the opposite sex is represented, too. Men are nurses; women can be truck drivers and soldiers. Thus, stereotypical expectations, which condition children to accept gender-specific roles, do not suit everyone.

What Are GLBT Healthcare Concerns?

Many people feel a level of embarrassment or inhibition that prevents them from seeking medical assistance. If the problem that draws them into the medical setting is assumed to trigger prejudice in the care giver, people may be reluctant to seek medical help. Like other minorities, GLBT people may face bias and discrimination in healthcare settings. For that and other reasons, some people may be reluctant to seek routine medical treatment. Regarding sexual issues, people may feel uneasy discussing their concerns. A young woman who is pregnant but unmarried may feel this hesitancy in seeking help. In the same way, members of the GLBT community may feel hesitant in instance in which the problem is personal and sexual in nature and about which the patient fears the medical provider may have strong opinions. Many medical professionals are not sensitized to treat their patients in a neutral and nonjudgmental way. Plus some controversial federal legislation proposed in 2008 suggested the medical professionals do not have to provide services if they have moral objections to them. GLBT individuals, like others seeking certain services, may be inclined to fear prejudice and criticism among the medical professionals they seek help. In addition, because people in same-sex relationships may not have domestic partner benefits, these individuals are at risk for being uninsured, further compounding the problem of seeking medical help.

What Illnesses and Diseases Affect the GLBT Community

For the most part, GLBT people have the same health concerns that heterosexual* people do, and they live as healthy or unhealthy lives as the rest of the population does. All people can get cancer, heart disease, and HIV/AIDS. All sexually active people ought to be concerned about diseases

* **testicles** (TES-tih-kulz) are the paired male reproductive glands that produce sperm.

* **heterosexual** (he-te-ro-SEK-shoo-al) refers to a tendency to be sexually attracted to the opposite sex.

- * **sexually transmitted disease** is an infection, such as the human immunodeficiency virus (HIV) or herpes, that can be passed from person to person by sexual contact.
- * **anal** refers to the anus, the opening at the end of the digestive system through which waste leaves the body.
- * **herpes simplex** (HER-pee-z SIM-plex) is a virus that can cause infections of the skin, mouth, genitals, and other parts of the body.
- * **syphilis** (SIH-fih-lis) is a sexually transmitted disease that, if untreated, can lead to serious life-long problems throughout the body, including blindness and paralysis.
- * **chlamydia** (kla-MIH-dee-uh) are microorganisms that can infect the urinary tract, genitals, eye, and respiratory tract, including the lungs.
- * **gonorrhea** (gah-nuh-REE-uh) is a sexually transmitted disease (STD) spread through all forms of sexual intercourse. The bacteria can also be passed from an infected mother to her baby during childbirth. Gonorrhea can affect the genitals, urethra, rectum, eyes, throat, joints, and other tissues of the body.
- * **contraception** (kon-tra-SEP-shun) is the deliberate prevention of conception or impregnation.
- * **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

that can spread through sexual activity and need to take precautions regarding them. However, many individuals are uninformed or deny being at risk, and so they engage in activities that may hurt them and their sexual partners.

A sexually transmitted disease* is one that is transmitted between humans through sexual contact, which includes vaginal or anal* intercourse and oral sex. STDs are caused by bacteria, parasites, and viruses. There are more than 20 STDs, including the following:

- HIV and AIDS
- Herpes simplex*
- Syphilis*
- Chlamydia*
- Gonorrhea*

STDs are prevalent among individuals who take sexual health risks and have multiple partners. HIV/AIDS is also a risk for drug users who share infected needles.

Lesbian health As a group lesbians have fewer pregnancies and use less oral contraception*. Those who do not use contraception or get pregnant face neither the risks nor the benefits of these choices. Lesbians who do not have health insurance may visit healthcare providers less frequently than insured individuals, which is also true for the general population. Individuals who use tobacco, have high alcohol consumption, poor nutrition, and are obese* have physical concerns apart from their sexual orientation.

Gay men's health Gay men (clinically referred to as men who have sex with men, or MSM), along with drug-addicted men who share needles, are at risk for contracting HIV/AIDS. When AIDS first appeared in the United States in the early 1980s, the disease was noted specifically among homosexual men. While the disease is contracted by heterosexual men too and by both heterosexual and homosexual women, it has had particularly high rates among American gay men. During the late twentieth century and into the early 2000s, knowledge about the risks of HIV/AIDS spread in the United States. Gay men, along with other men, need to take precautions to help protect themselves from this disease. As of 2009, testing for HIV was more routinely performed, and information was increasingly distributed about this infectious disease. MSM are also at risk of contracting STDs, just as other people are who engage in risky sexual behavior, as in not using condoms consistently, or who have multiple partners.

Transgender health There is limited statistical health information about transgendered individuals, perhaps because they represent such a small minority. Among this group, individuals who act as prostitutes are at particular risk for STDs, just as heterosexual prostitutes are. Risky behaviors such as having multiple sexual partners, sharing needles among IV drug users, and inconsistent use of condoms place these individuals

at risk, as it does all others who engage in these behaviors. Some transgendered individuals may have less access to health care because they are underinsured or uninsured, discriminated against, or afraid of discussing their health and orientation with mainstream medical professionals.

What Mental Health Issues Confront the GLBT Community?

Every human being is susceptible to becoming overwhelmed by stress and pressure, which can lead to mental health issues such as depression, anxiety, substance abuse, and suicide. Because of discrimination, bias, stigma, social pressure, and hate crimes, GLBT persons are at particular risk of having psychological problems. Minority status and laws that underscore it potentially add stress for all individuals who feel like or are outsiders to the dominant culture. This pattern of increased stress can be noted among foreign speakers, illegal aliens, racial minorities, the poor and/or homeless, along with sex-linked minorities.

How Does the GLBT Community Engage in Family Planning

Just like many heterosexual individuals, many GLBT people choose to start their own families and raise children. However, same-sex couples who wish to have children must select alternative paths, which infertile heterosexual couples who want children may explore as well. Some adopt children, and others use various methods to conceive and give birth. Several options are available to same-sex couples and to infertile heterosexual couples:

- In vitro fertilization (IVF) is a process by which a woman's eggs are fertilized outside the body (in vitro). The fertilized egg is then implanted in the uterus, where it can develop into a fetus.
- Artificial insemination involves mechanically placing sperm directly into a woman's uterus in the hopes of fertilization.
- Surrogacy is an arrangement in which one person gestates for another person to adopt. A woman agrees to become pregnant for the sole purpose of carrying a fetus to term for another person who is unable or unwilling to do so. The surrogate agrees to give up the child and all rights regarding the child to the adoptive parent.
- Adoption allows a child to become the legal dependent and responsibility of someone other than its biological parents. The child is permanently placed in a home of the adoptive parent or parents, who agree to raise the child in the same way a biological offspring would be raised.

What Are Hate Crimes?

Hate crimes are illegal acts committed against persons due to race, ethnicity, gender, or sexual orientation and against individuals who sympathize or stand with members of these groups. Hate crimes may involve assault, battery, rape, torture, and murder. Sometimes these crimes have specific

* **incidence** means rate of occurrence.

HIGH PROFILE HATE CRIMES

Numerous high profile hate crimes have brought national attention to the issue of violence against GLBT people.

In 1993, 21-year-old Teena Renae Brandon, an androgynous female who acted and dressed like a male and called herself Brandon Teena, was raped and later murdered in Lincoln, Nebraska, after her physical sexual identity was discovered. The documentary, *The Brandon Teena Story*, served as the basis for the 1999 Academy Award winning film *Boys Don't Cry*, starring Hilary Swank.

In 1998, 21-year-old Matthew Shepard was kidnapped, beaten, and left to die near Laramie, Wyoming. Shepard's death brought national attention to hate crimes, and it spurred state and federal governments to enact hate crime legislation. There have been various films, plays, books, and songs written about Shepard and his murder.

In 2002, 17-year-old Gwen Araujo was beaten and murdered. Araujo was born male but passed as a female and wished to have a sex-change operation. In 2008, 15-year-old Lawrence King, a gay teen, was shot in the head by a fellow student as he sat at his desk in the computer lab of E.O. Green School in Oxnard, California.

These infamous murders made hate crimes more visible and helped to create awareness and legislation to prevent hate crimes and protect people at risk of victimization.

religious, political, or cultural motivations, but other times there seems to be no motivation besides hate. Hate crimes may be perpetrated by individuals or groups, but in some countries, governments torture and execute minority individuals, including those suspected or accused of being gay, lesbian, bisexual, or transgender.

In 2007 the National Coalition of Anti-Violence Programs reported a 24-percent increase in reported hate crimes against GLBT people from the previous year. These included a 61-percent increase in sexual assaults, and the highest murder rate in ten years. In that same period, the number of hate crimes grew by 5 percent.

Domestic violence Domestic violence is a serious problem among both heterosexual and homosexual people, and the incidence* is about the same for the two populations. Many kinds of abuse occur in intimate relationships, including physical violence, emotional and verbal abuse, sexual abuse, and financial intimidation. Many victims of domestic abuse are afraid or ashamed and do not seek help in dealing with their abusive partners.

What Legal Issues Confront the GLBT Community

GLBT people face many legal difficulties that heterosexual people do not face.

Same-sex marriage In the early 2000s, there were six countries that recognized same-sex marriages: Spain, Netherlands, Belgium, Norway, Canada, and South Africa. In 1996 the U.S. Congress passed the Defense of Marriage Act (DOMA), which stated that individual states were not obliged to treat same-sex unions the same as heterosexual marriage and that the federal government would not treat them as the same. Twenty-six states passed amendments that banned recognition of same-sex marriage. As of 2008, only Massachusetts and California recognized same-sex marriages, and the law in California was being contested. New Jersey, Vermont, Connecticut, and New Hampshire allowed civil unions, which provided same-sex couples with benefits and rights similar to those enjoyed by married couples. Domestic partnerships, which grant couples some or all of the rights of marriage, were available in California, Washington, Oregon, Maine, and the District of Columbia.

Estate planning All people need to protect their estates with legal documents, but same-sex couples face certain hurdles that married couples do not. The estates of people who do not prepare for serious illness, injury, or death with advanced legal directives may end up in the hands of the state. Rights of survivorship for married individuals direct the state to disperse an estate to the surviving spouse, whereas laws against same-sex marriage may prevent the state from dispersing an estate to a surviving same-sex partner. For instance, if a gay man dies without a will, his assets may be divided among immediate family members but exclude his legally unrecognized long-term partner. Proper advanced planning can prevent this scenario. Because their intimate relationships are typically not recognized by state law, GLBT individuals need to secure legally their wishes regarding the dispersal of their estates. They can protect themselves by drawing up a will or trust, establishing medical power of attorney, drafting a living will, and designating power of attorney.

Another issue for same-sex couples concerns retirement benefits. In the event of a retired married person's death, the surviving spouse receives the retirement and social security benefits. However, that is not the case for the survivor of a same-sex couple. The prohibition that excludes the surviving member of a same-sex union causes some individuals to set up individual retirement plans for the survivor's protection.

What Family Therapy Resources Are Available to the GLBT Community?

Supporting gay, lesbian, bisexual, or transgendered loved ones can be difficult, given the dominant social prejudice against them. Many people benefit from counseling, therapy, or support groups that help them to understand the problems that their loved ones may face, including discrimination; abuse; and work, family, and relationship difficulties. Such groups as Parents, Families, and Friends of Lesbians and Gays (PFLAG) teach tolerance and acceptance and work to normalize people's attitudes toward sexual differences.

Resources

Books and Articles

Boylan, Jennifer. *She's Not There: A Life in Two Genders*. New York: Broadway Books, 2003.

Burda, Joan M. *Estate Planning for Same-Sex Couples*. Chicago: American Bar Association, 2004.

Downs, Alan. *The Velvet Rage: The Pain of Growing Up Gay in a Straight Man's World*. Cambridge, MA: De Capo Press, 2006.

Organizations

GLAAD (Gay & Lesbian Alliance Against Defamation). 5455 Wilshire Boulevard, #1500, Los Angeles, CA, 90036. Telephone: 323-933-2240. Web site: <http://www.glaad.org>.

National Coalition for LGBT Health. 1325 Massachusetts Avenue NW, Suite 705, Washington, DC, 20005. Telephone: 202-558-6828. Web site: <http://www.lgbthealth.net>.

PFLAG (Parents, Families & Friends of Lesbians and Gays). 1101 Fourteenth Street NW, Suite 1030, Washington, DC 20005. Telephone: 202-638-4200. Web site: <http://www.pflag.org>.

Gender Identity Disorder

Gender identity disorder (GID) is a medical diagnosis for someone who feels a strong sense of discontent with the biological (physical) gender that he or she has been assigned. These individuals often feel a strong desire or need to belong to the sex opposite their own and will dress and behave in ways traditionally ascribed to the opposite gender. People with this condition are generally referred to as transsexuals.

What Is Gender Identity Disorder?

Gender Identity Disorder is a complex condition in which individuals strongly identify with the gender opposite their own and feels trapped or stuck in the wrong body. To better understand this condition, a few terms must be defined:

- **Gender** is the category (male or female) a person is assigned to on the basis of biological sex. The term is used in discussing the different roles, identities, and expectations that the dominant society traditionally associates with males and females.
- **Gender identity** refers to individuals's own perception of their maleness or femaleness.

- **Feminine and masculine** are often used to describe behaviors generally associated with females or males. For example, boys are encouraged to choose toys and activities that are traditionally associated with masculinity, such as cars, sports, tools, and play weapons. By contrast, girls are encouraged to choose dolls, play cosmetics, and dress-up clothes, which are typically considered feminine.
- **Sex** usually refers to the biological (physical) differences between females and males. Specifically, these characteristics are the sex chromosomes* and certain anatomical features, for example, the penis or the vulva*.

Many people identify with, or conform to, traditional roles and expectations that the culture assigns to males and females. Sometimes, individuals may enjoy activities that are most often associated with the opposite sex. For example, someone who is biologically female may like to play football, and someone who is biologically male may like to do embroidery. Generally, this does not interfere with a person's sense that she or he is female or male, and it does not mean that she or he has gender identity disorder. GID should not be confused with nonconformity to traditional or typical gender roles. People who do not conform with all aspects of traditional gender roles seldom have any desire to be the opposite sex.

What Is Cross-Gender Identification?

GID goes beyond a failure or reluctance to identify with traditional roles or expectations about being female or male. There is nothing unusual about girls who prefer football to piano or boys who needlepoint to tools. A person with GID who is biologically female has a strong sense that she is a male. Likewise, a person with GID who is biologically male has a strong belief that he is a female. Cross-gender identification often causes an incredible amount of distress and can impair a person's ability to function. When that occurs, a person is said to have GID.

Mental health Most people realize that they have GID before adolescence. Children with GID may suffer from mental health issues such as depression, anxiety, and low self esteem. This may result in a child's refusal to attend school or social events where feminine or masculine clothing or behavior is expected, because they fear teasing or rejection by their peers. Because these children may choose behaviors and an outward appearance that are traditionally attributed to members of the opposite sex, they may feel isolated from other children. Children with gender identity disorder often express wishes to be the other sex or beliefs that they will "grow up to be" the opposite sex. Young children with this condition may be unhappy about their assigned sex. Older children may fail to develop age-appropriate same-sex relationships with their peers. For adolescents, GID can be very difficult, because these individuals may struggle with feelings of uncertainty about the opposite gender identification or be concerned about being unacceptable to their own family or peers.

Stigma

Boys with GID seem to suffer more than girls, perhaps because of culturally influenced rejection by their peers. In some studies, five times as many boys as girls saw a doctor for GID. Among adults, two or three times as many men as women sought help for GID. This difference probably is due to the greater social difficulties experienced by males who have Gender Identity Disorder.

* **chromosomes** (KRO-mo-somz) are threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.

* **vulva** (VUL-vuh) refers to the organs of the female genitals that are located on the outside of the body.

- * **genitals** (JEH-nih-tuls) are the external sexual organs.
- * **genetically** (je-NE-ti-klee) means due to heredity and stemming from genes. Genes are located on the chromosomes in cells of the human body that help determine physical and mental characteristics, such as hair and eye color. The X and Y chromosomes contain genetic information that determines sex.
- * **bisexual** (bi-SEK-shoo-al) means being sexually attracted to both sexes.
- * **heterosexual** (he-te-ro-SEK-shoo-al) refers to a tendency to be sexually attracted to the opposite sex.
- * **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

Intersex conditions GID is not the same as intersexuality, or intersex conditions. Intersex conditions may be marked, for example, by genitals* that are not completely male or female. The person with this condition may be genetically* male but physically female (or the opposite). For example, a male with an intersex condition would have the XY sex chromosomes of males, but his genitals might appear female. Whereas there are many variations and degrees of intersexuality, about 1 in 1,500 to 1 in 2,000 children are born with noticeably atypical genitalia.

Cross-dressing There also is a difference between GID and transvestitism. A cross dresser or a transvestite becomes sexually excited by dressing in the clothes of the opposite sex. Often, the term transvestite is applied to gay or bisexual* men who dress in women's clothing, and the term cross dresser is applied to heterosexual* men who dress in women's clothing. Transvestites and cross dressers should not be confused with transsexuals (people with GID) who cross-dress to gain a sense of physical and emotional completeness rather than sexual excitement.

Gender Reassignment

The causes of GID are uncertain. Some researchers think that biological factors play a role, and others think that environmental factors, such as the lack of a bond with a parent or caregiver during childhood, are involved. The more important question may be how to resolve the problems that GID may create.

The emotional strain GID causes is real, and, for some adults, the only effective relief for this distress is a gender reassignment procedure, which usually involves sex-change surgical operations that remove and create physical genitalia. Because of the irreversible nature of these procedures, candidates must undergo extensive psychological screening and physical preparation that can take several years to complete.

Screening Gender reassignment procedures begin with lengthy and detailed screenings, as well as psychological evaluations. These interviews determine the existence and severity of GID. The person then is instructed about adopting a lifestyle that agrees with his or her gender identity, which is called real life experience (RLE). If people successfully adjust to this lifestyle change over a period of several months to a year, they often then begin hormone* therapy to develop more of the physical traits of the desired sex. Female patients transitioning to males take androgens, and males transitioning to females take testosterone blocking agents, estrogen, and progesterone.

Surgery After patients successfully complete screening, psychological evaluation, RLE, and hormone therapy, they are ready to undergo gender reassignment surgery. For males wishing to become females, hormone treatments may produce satisfactory breast development, although some people choose later to have breast enlargement surgery. Many people also

elect to have a bilateral orchiectomy, or removal of the testicles, rendering the person infertile and without testosterone. In male to female reassignment, a tracheal shave may be performed in which the Adam's apple is made to appear smaller by removing part of the trachea*. Body and facial hair growth is reduced by the hormone treatments and hair may also be removed by electrolysis*. Males who have gender reassignment surgery to become females undergo vaginoplasty, or the construction of a vagina from the penis, and are able to have sexual intercourse.

Females wishing to become males usually elect to have surgery to remove the breasts (bilateral mastectomy), the uterus*, and the ovaries* and to seal off the vagina*. The operation to construct a penis is extremely complicated, and the resulting penis is not capable of a natural erection. There are, however, artificial devices, such as erectile implants, which can be used to help the person achieve erection and successfully engage in sexual intercourse.

Life after Gender Reassignment Surgery There have been several worldwide studies conducted to assess the outcomes of sex-change surgery. These studies have shown that 9 in 10 transsexuals who undergo hormonal and surgical sex-reassignment procedures experience a satisfactory result. One of the studies found that 94 percent of the people who underwent the surgery and answered questionnaires stated that if they had it to do over again, they would make the same choice.

▶ See also **Body Image**

Resources

Books and Articles

Boenke, Mary. *Trans Forming Families: Real Stories about Transgendered Loved Ones*. Imperial Beach, CA: Walter Trook, 1999.

Brill, Stephanie A., and Rachel Pepper. *The Transgender Child: A Handbook for Families and Professionals*. San Francisco, CA: Cleis Press, 2008.

Brown, Mary, and Chloe Ann Rounsley. *True Selves: Understanding Transsexualism—For Families, Friends, Coworkers, and Helping Professionals*. San Francisco, CA: Jossey-Bass, 2003.

Organization

National Coalition for LGBT Health. 1325 Massachusetts Avenue NW, Suite 705, Washington, DC, 20005. Telephone: 202-558-6828. Web site: <http://www.lgbthealth.net>.

- * **trachea** (TRAY-kee-uh) is the windpipe—the firm, tubular structure that carries air from the throat to the lungs.
- * **electrolysis** (ee-lek-TRAW-li-sis) is a method of destroying hair roots by passing an electric current through them.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.
- * **ovaries** (O-vuh-reez) are the sexual glands from which ova, or eggs, are released in women.
- * **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.

Generic Drugs See *Psychopharmacology*.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **chromosomes** (KRO-mo-somz) are threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.

DNA is a double-stranded molecule that is twisted in a spiral shape, known as a double helix. DNA is made of chemicals called nucleotides that occur in pairs: adenine (A) with thymine (T), and guanine (G) with cytosine (C).

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



Genetic Diseases

Genetic diseases are disorders that are inherited from one's biological parents or are acquired as a result of a spontaneous genetic change.

What Is Heredity?

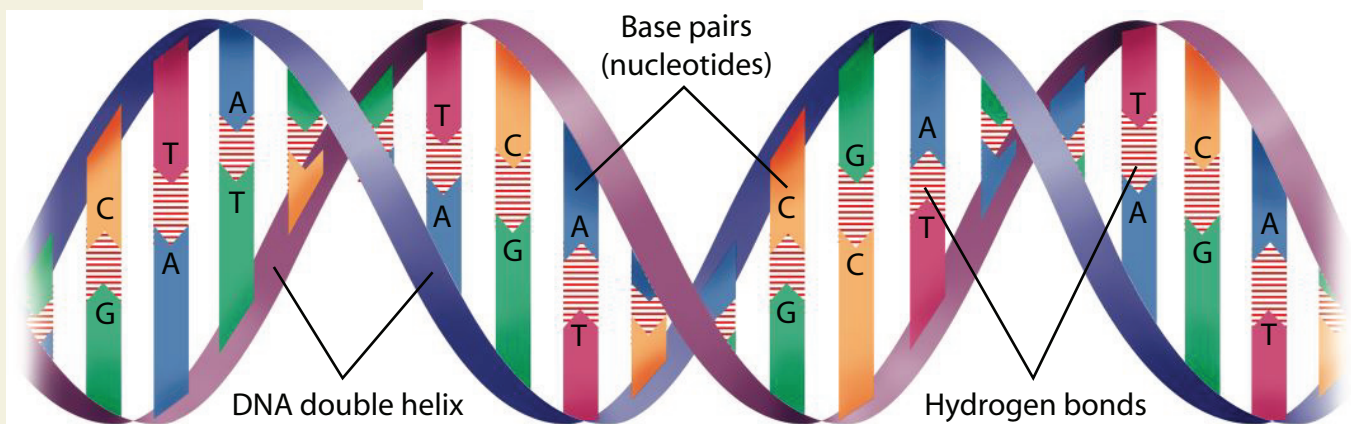
Individuals develop under the influence of a mix of genes* inherited from their biological parents. These genes, or small parts of chromosomes*, determine the architecture and activity of the entire body. They determine visible characteristics, such as eye color, skin color, and height, as well as traits that cannot be seen, such as the risk of certain diseases, the chemicals made by the body, and the functioning of body systems.

Normally, each cell in the body contains two copies of each gene: one that originally came from the egg of the mother and one from the sperm of the father. In many instances, these two copies are slightly different from each other. The result is a child who has some characteristics from the mother and some from the father, but who is never identical to either parent.

Because the cells have two copies, a gene that works normally can usually make up for one that has a defect. For example, a gene with a defect that causes a particular disease may pass down through generations of a family without causing illness. That is because the normal gene in the pair may work well enough to mask the defect of the other gene. However, if a child inherits two genes with the defect, the child will develop the illness, which explains how a child with a genetic disease can be born to parents without it.

What Causes Genetic Diseases?

Individuals can inherit genetic disorders, in which case they are born with the diseases, although some diseases have no symptoms at first. In some instances, however, individuals do not inherit the genetic diseases,



but instead they develop genetic diseases that occur spontaneously when disease-causing mutations* occur during cell division* occur. Since these spontaneous diseases involve changes in the genes, they are also known as genetic disorders.

Some inherited genetic disorders, such as cystic fibrosis* and phenylketonuria* (PKU), result simply from the inheritance of genes that do not work properly. In other disorders, however, genetic and environmental factors seem to work together to cause changes in otherwise normal genes. For example, some forms of radiation or chemicals can cause cancer in people who are prone to be affected due to their genetic makeup.

How Are Diseases Inherited?

How modern genetics began Gregor Mendel (1822–1884) is considered the father of modern genetics*. Mendel was an Austrian monk. While growing peas in the monastery garden, Mendel noted that certain traits appeared in offspring in predictable patterns, and he began to understand the basic rules of inheritance. These rules are called Mendelian (men-DEL-ee-an) laws.

Dominant and recessive genes Under Mendelian laws, each person normally has two copies of every gene, one from the mother and one from the father. A physical feature or a disorder carried by genes can be either a dominant (**G**) or a recessive (**g**) trait. An individual can therefore have one of three combinations: two dominant genes (**GG**), two recessive genes (**gg**), or one of each (**Gg**). If a person has two dominant genes, the dominant trait will appear. If the individual has two recessive genes, the recessive trait will appear. If the individual has one dominant gene and one recessive gene, only the dominant trait will appear because it is the “stronger” of the two. In Mendel’s peas, the trait for smooth peas was dominant over the trait for wrinkled peas. Thus, if a pea plant contains two genes for “smooth”, or one gene for “smooth” and one for “wrinkled,” the seed will be smooth. The pea is only wrinkled when it has two genes for “wrinkled.”

This pattern is also work in the way genetic diseases are inherited. If the disease-related gene is recessive, only individuals with the two copies of the recessive gene will develop the disorder. Therefore, a person with the pattern (**gg**) will be affected, but (**GG**) and (**Gg**) will not be affected by the disorder. If the disease-related gene is dominant, by contrast, a person with the patterns (**GG**) or (**Gg**) will be affected, but (**gg**) will not be affected by the disorder. Two copies of a dominant gene produce a much more serious form of the disorder.

Autosomal and sex-linked traits Of the 23 pairs of chromosomes in human cells, one pair are sex chromosomes, which determine a person’s gender. Sex chromosomes are called X and Y chromosomes. Females have two X chromosomes (**XX**), and males have one X and one Y chromosome (**XY**). The reproductive cells (egg and sperm) each have only one set of

A Genetic Glossary

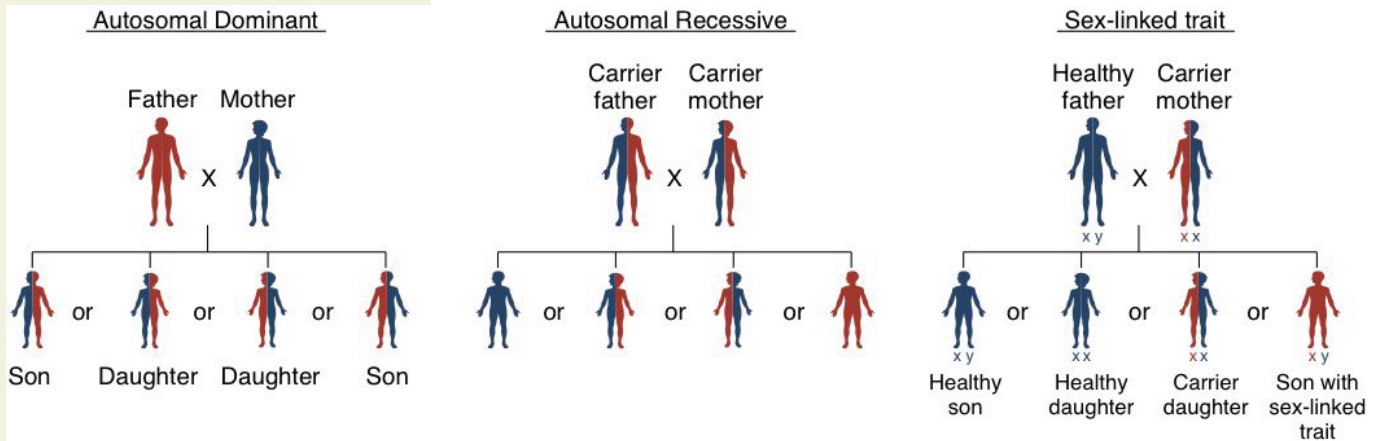
- **Cells:** The units that comprise living beings. The human body is made of about 60 trillion cells.
- **Nucleus:** A membrane-bound structure inside cells that contains DNA.
- **Chromosomes:** DNA is packaged into units called chromosomes. Humans have 23 pairs of chromosomes, for a total of 46.
- **DNA (deoxyribonucleic acid):** A double-stranded molecule, made of chemical bases called nucleotides, that contains the genetic code necessary to build a living being.
- **Genes:** Segments of DNA located on the chromosomes. Genes are the units of heredity. They help determine a person’s characteristics, from eye color to how various chemicals work in the body.
- **Genome:** An animal’s entire collection of genes. The human genome contains approximately 25,000 genes.

* **mutations** (mu-TAY-shuns) are changes in a chromosome or a gene.

* **cell division** is the process by which a cell divides to form two daughter cells, each of which contains the same genetic material as the original cell.

* **cystic fibrosis** (SIS-tik fy-BRO-sis) is a disease that causes the body to produce thick mucus that clogs passages in many of the body’s organs, including the lungs.

* **phenylketonuria** (fen-ul-ke-ton-U-ree-a), or PKU for short, is a genetic disorder of body chemistry that, if left untreated, causes mental retardation.



▲
Three common inheritance patterns.
Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

* **genetics** (juh-NEH-tiks) is the branch of science that deals with heredity and the ways in which genes control the development and maintenance of organisms.

23 chromosomes. While an egg always carries an X chromosome, a sperm cell can carry either an X or a Y, so it is the sperm that determines gender in the offspring. Inherited genetic disorders that are carried on the sex chromosomes are referred to as sex-linked. Sex-linked disorders usually affect males more often than females, because a female has two copies of the X chromosome, each of which carries a set of genes. In contrast, a male has only one X chromosome, so he has only one set of these genes. If his copy is damaged or defective, he has no normal copy to override or mask the defective one. Depending on the problem with the gene, the result can be an X-linked disorder.

Besides the sex chromosomes, human cells have 22 other pairs of chromosomes. These are called autosomes (AW-to-somes), or non-sex chromosomes, and disorders carried on these chromosomes, which are numbered 1 through 22, are referred to as autosomal (aw-to-SOME-al). In general, autosomal disorders are likely to affect males and females equally.

What Are the Common Inheritance Patterns of Genetic Diseases?

Single-gene autosomal diseases Most genetic disorders are caused by defective genes on the autosomes. If a single gene is responsible, then the following rules of inheritance usually apply. Exceptions exist, but these rules are useful guidelines for understanding inheritance. In an autosomal dominant disorder, the following applies:

- Only one copy of the gene is necessary to cause the disorder. So if a child inherits the disease, at least one of the parents has the disease as well.
- It is possible for the gene to change by itself in the affected person. This change is called a mutation. In this case, the disease is not passed down from a parent.
- Unaffected children of a parent with the disorder have unaffected children and grandchildren.

In an autosomal recessive disorder, the following applies:

- If two people without the disorder have a child with the disorder, both parents carry one copy of the abnormal recessive gene. Both parents' genetic pattern is therefore **Gg**. The parents are called "carriers."
- If a person with the disorder (**gg**) and a carrier* (**Gg**) have a child, that child has a fifty-fifty chance of having the disorder. Any child without the disorder will be a carrier.
- If a person with the disorder (**gg**) and a non-carrier (**GG**) have children, all of the children will be carriers (**Gg**), but none will have the disorder.
- If two people with the disorder (**gg**) have children, all of the children will have the disorder (**gg**).

Single-gene sex-linked diseases More than 150 disease traits are carried on the X chromosome. X-linked dominant disorders are rare. In an X-linked recessive disorder, the following applies:

- Nearly all people with sex-linked disorders are male. The disorder is transmitted through the female, because a son's X chromosome always comes from his mother. (The other sex chromosome, the Y chromosome, always comes from the father. A female, by contrast, receives two X chromosomes—one from her mother and one from her father—and no Y chromosome.) The mother is unaffected, however, because she has a second X chromosome that usually contains a normal gene for the trait.
- A male with the disorder never transmits it to his sons, because a father passes only his Y chromosome to his sons. Only his daughters receive his X chromosome.
- A son born to a female carrier (**Gg**) has a fifty-fifty chance of having the disorder, because he may receive the affected X chromosome, rather than the unaffected one.
- All daughters of affected males will be carriers, because they will all receive the father's affected X chromosome.

Multiple-gene diseases Many disorders are exceptions to the Mendelian laws of inheritance. One reason is that numerous genetic disorders result from a combination of many genes, rather than a single affected gene. These genetic disorders are known as multifactorial (mul-tee-fak-TOR-e-al) disorders. In addition, some disorders show reduced penetrance (PEN-e-trance), which means that a gene is not wholly dominant or recessive. For example, a person who has one recessive gene for a disorder might show milder symptoms of the disorder, but someone with two copies will have the full-blown disorder.

Chromosome disorders Other genetic disorders result from extra or missing chromosomes. In Down syndrome*, a person has three copies

* **carrier** is a person who has in his body a bacterium or virus or gene for a disease that he can transmit to other people without getting sick himself.

* **Down syndrome** is a genetic disorder that can cause mental retardation, shortness, and distinctive facial characteristics, as well as many other features.

- * **cri du chat** (kree-doo-SHA), French for cat's cry, is a genetic disorder that can cause mental retardation, a small head, and a cat-like whine.
- * **Turner syndrome** is a genetic disorder that can cause several physical abnormalities, including shortness, and lack of sexual development.
- * **embryo** (EM-bree-o), in humans, is the developing organism from the end of the second week after fertilization to the end of the eighth week.
- * **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.

of chromosome 21, rather than the usual two copies. In cri du chat*, a piece of chromosome 5 is missing. In Turner syndrome*, which affects only girls, all or part of an X chromosome is missing.

In most cases, chromosome disorders are not inherited. Instead, the problems occur for unknown reasons when the egg and sperm meet to form the embryo*.

Spontaneous (new) genetic mutations Sometimes, a child may be born with a dominant inherited disorder even though neither parent has the disorder. The cause is usually a spontaneous (or new) mutation in a gene or genes. The mutation may occur in a parent's egg or sperm cell, or it may occur after the egg has been fertilized and begins to develop into an embryo. This is frequently the case in achondroplasia (a-kon-dro-PLAY-zha), a form of dwarfism in which 90 percent of children born with the condition have unaffected parents. When this child grows up, the child will pass the gene on to his or her children according to the autosomal dominant inheritance pattern described above.

The Past and Future of Genetic Diseases

Mendel figured out the basic concepts of inheritance in the 1800s, before people knew that genes are the units of inheritance. It was not until 1953 that scientists described the structure of DNA. From the 1980s into the 21st century, scientists' understanding of genes and how they work grew at an incredibly rapid pace. They identified many disease-causing genes, opening the door to research on ways to fix genetic defects. This field of science is referred to as gene therapy.

Gene therapy A number of treatments for genetic disorders are available. For some disorders, the treatment is a special diet to prevent the buildup in the body of compounds that are toxic to patients. In other disorders, the treatment involves blocking or rerouting chemical pathways and essentially short-circuiting the disease. A third kind of treatment actually replaces defective genetic material with normal genetic material inside the cells. As of 2009 researchers were considering a variety of methods to perform this procedure. These include the use of microscopic "bullets" consisting of genetic material and viruses to deliver normal genes to cells.

Prenatal testing Medical professionals can test a fetus* for many genetic disorders before it is born. They conduct tests for prenatal (before birth) diagnosis on samples taken from the tissue or fluid surrounding a fetus. They then study the fetus's chromosomes using a karyotype (KAR-e-o-type), which is a visual display of the chromosomes from cells viewed under a microscope. Other techniques enable scientists and doctors to look directly at the DNA that makes up the genes contained in the chromosomes. Common prenatal tests include the following:

- **Amniocentesis** (am-nee-o-sen-TEE-sis): In amniocentesis, a needle passes through the mother's belly into her uterus* to collect some

of the fluid in which the fetus lives. This fluid, called amniotic fluid, contains cells from the fetus.

- Chorionic villus (kor-e-ON-ik VIL-us) sampling (CVS): CVS collects cells from the fetus with a needle. In this case, medical professionals remove the cells from the chorionic villi, which are structures in the uterus that are part of the placenta (the organ in the uterus that delivers nutrients and oxygen to the fetus).
- Percutaneous umbilical (per-ku-TAY-ne-us um-BIL-i-kal) blood sampling (PUBS): In PUBS, fetal blood from the umbilical cord*.

Genetic testing and counseling Geneticists believe that each person probably carries about 5 to 10 defective recessive genes. Thus, both potential parents may be worried about having a child with birth defects. If relatives have genetic disorders—or if ethnic or other background factors increase the risk of certain genetic diseases—parents-to-be may be even more concerned. For this reason, some adults seek genetic testing of themselves or their relatives to determine if they are carriers and whether their future children are susceptible to certain genetic disorders. Medical experts recommend that genetic testing is followed by counseling, which advises clients of the nature of the disorders, their options in family planning, and any steps they can take to increase the likelihood of having a healthy child.

Ethical concerns Increasingly in the 21st century, people will have the option to be tested to find out if they carry genes for genetic disorders. For example, women can find out if their unborn children have certain genetic defects or if they themselves have genes that make them more likely to develop certain disorders, such as breast cancer. This advance led to controversy about how this information should be used. Genetic testing can have far-reaching social, financial, and ethical effects. For example, a woman who thinks she will develop breast cancer might decide against having children or might decide to have her breast tissue removed before cancer cells develop. In addition, her insurance company might decide not to insure her because she is a high-risk client. With knowledge comes responsibility, and genetic testing surely will be at the forefront of debates about medical ethics for many years to come.

▶ See also **Albinism • Alzheimer's Disease • Anemia, Bleeding, and Clotting • Color Blindness • Cystic Fibrosis • Gout • Huntington's Disease • Muscular Dystrophy • Neurofibromatosis • Phenylketonuria (PKU) • Sickle-cell Anemia • Tay-Sachs Disease**

Resources

Books and Articles

Baker, Catherine. *Your Genes, Your Choices: Exploring the Issues Raised by Genetic Research*. Washington, DC: American Association for the Advancement of Science, 2000.

Inheritance Patterns of Some Genetic Diseases

The following are autosomal dominant disorders:

- Achondroplasia
- Huntington's disease
- Neurofibromatosis

The following are autosomal recessive disorders:

- Albinism
- Cystic fibrosis
- Phenylketonuria (PKU)
- Sickle-cell anemia
- Tay-Sachs disease

The following is a X-linked dominant disorder:

- Diabetes insipidus (one form)

The following are X-linked recessive disorders:

- Color blindness
- Hemophilia
- Hunter's syndrome
- Muscular dystrophy (Duchenne type)

The following are multiple genes disorders:

- Alzheimer's disease
- Some cancers (breast, colon, lung)
- Gout
- Rheumatoid arthritis

* **umbilical cord** (um-BIH-lih-kul) is the flexible cord that connects a baby to the placenta, the organ that unites the unborn child to the mother's uterus, the organ in which the baby develops.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

Zallen, Doris. *To Test or Not to Test: A Guide to Genetic Screening and Risk*. Piscataway, NJ: Rutgers University Press, 2008.

Organizations

Genetic Alliance. 4301 Connecticut Avenue NW, Suite 404, Washington, DC, 20008-2369. Telephone: 202-966-5557. Web site: <http://www.geneticalliance.org>.

March of Dimes. 1275 Mamaroneck Avenue, White Plains, NY, 10605. Telephone: 914-997-4488. Web site: <http://www.modimes.org>.

National Center for Biotechnology Information, National Library of Medicine. Building 38A, Bethesda, MD, 20894. Telephone: 301-496-2475. Web site: <http://www.ncbi.nlm.nih.gov>.

National Human Genome Research Institute. 9000 Rockville Pike, 31 Center Drive, MSC, 2152, Building 31, Room 4B09, Bethesda, MD 20892-2152. Telephone: 301-402-0911. Web site: <http://www.genome.gov>.

World Health Organization. Avenue Appia 20, 1211 Geneva 27, Switzerland. Web site: <http://www.who.int/genomics/en>.

Genital Warts

Genital warts are small fleshy growths of skin on or near the sexual organs that are caused by the human papillomavirus and are usually spread by sexual contact.

What Are Genital Warts?

Genital warts may be dome shaped or nearly flat, but most commonly they grow on stalks in clumps that look like small heads of cauliflower. Warts of this shape are called condylomata acuminata (kon-dil-o-MAT-a a-koo-min-NAT-a). Genital warts are highly contagious*, and sexually active individuals have approximately a 60 percent chance of getting them after a single sexual contact with an infected person. Genital warts usually cause no pain, but they can be bothersome or uncomfortable depending on their location.

Human papillomavirus The human papillomavirus (pap-i-LO-ma vi-rus) (HPV) is common and has many subtypes. Genital warts usually are caused by HPV-6 or HPV-11. Many people may become infected with HPV at some point during their lives but not know it because they do not have the visible warts. Among sexually active people in the United States, about 1 percent (1.4 million people) have genital warts and another 14 percent (19 million) have HPV infection without warts.

Cervical cancer Other kinds of HPV (mainly HPV-16 or HPV-18) can cause cancer of the cervix*, part of the female reproductive tract. Even though visible genital warts usually do not contain cancer-causing forms of the virus, women who have warts should be sure to get the yearly test for cervical cancer, called the Pap smear*, that is recommended for all women.

Removing genital warts Genital warts can be removed in a number of ways: by surgery, laser surgery* treatment, freezing (cryotherapy), or repeated treatment with chemicals that the doctor paints directly on the warts. They often recur after being removed. If untreated, they may grow, remain the same, or disappear on their own.

Preventing genital warts The surest protection is sexual abstinence, that is, not having sex at all. Those who have sex with multiple partners have a higher chance of getting infected (although all it takes is having sex with one partner with an HPV infection to become infected), and should always use condoms. Condoms offer protection against infection, although the exact degree of that protection is not known. Medical professionals do not know whether the removal of visible genital warts makes a person's infection less contagious. Even after removal, a person's chance of getting warts again is almost 50 percent.

In 2006, the Food and Drug Administration approved an HPV vaccine, known as Gardasil, for use in girls and women ages 9 to 26. The National Cancer Institute stated that widespread vaccination* had “the potential to reduce cervical cancer deaths around the world by as much as two-thirds, if all women were to take the vaccine and if protection turns out to be long-term.” It also noted that the vaccines can “reduce the need for medical care, including biopsies*, and invasive procedures associated with the follow-up from abnormal Pap tests, thus helping to reduce health care costs and anxieties related to abnormal Pap tests and follow-up procedures.”

▶ See also **Cervical Cancer • Human Papilloma Virus (HPV) • Pregnancy • Sexually Transmitted Diseases (STDs) • Warts**

Resources

Books and Articles

Nardo, Don. *Human Papillomavirus (HPV)*. Detroit, MI: Lucent Books, 2007.

Organizations

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-ACS-2345. Web site: http://www.cancer.org/docroot/CRI/content/CRI_2_2_2X_What_causes_cancer_of_the_cervix_Can_it_be_prevented_8.asp.

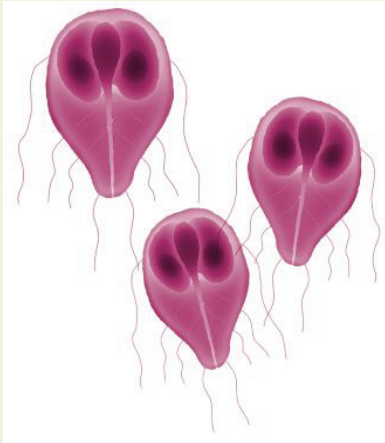
* **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.

* **Pap smear** is a common diagnostic test used to look for cancerous cells in the tissue of the cervix.

* **laser surgery** uses a very narrow and intense beam of light that can destroy body tissue.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.



▲
Giardia lamblia protozoa. Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

* **parasite** (PAIR-uh-sites) is an organisms such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

American Social Health Association's National HPV and Cervical Cancer Prevention Resource Center. P.O. Box 13827, Research Triangle Park, NC, 27709. Telephone: 919-361-8400. Web site: http://www.ashastd.org/hpv/hpv_learn_dysplasia.cfm.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: <http://www.cdc.gov/std/hpv/default.htm>.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov/cancertopics/factsheet/prevention/hpv-vaccine>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-6612. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/genitalWarts/default.htm>.

German Measles See *Rubella (German Measles)*.

Giardiasis

Giardiasis is an infection of the small intestine by the Giardia lamblia parasite. It is spread from person to person or by contact with contaminated water or food. Its major symptom is diarrhea.

What Is Giardiasis?

Giardiasis (je-ar-DY-a-sis) is a common infection caused by the *Giardia lamblia* (je-AR-de-a LAM-bli-a) protozoan, which is a one-celled organism that lives as a parasite*. *Giardia* contamination can occur in any water source, from clear mountain streams to poorly filtered city water supplies. The most common carriers of giardiasis are dogs, beavers, and humans. Giardiasis is easily passed from person to person through poor hygiene.

Giardiasis occurs worldwide in both developed and developing countries and in both temperate and tropical climates. In developing nations, infection rates from 20 to 50 percent may occur. In the United States, the disease is estimated to affect up to 20 percent of the population, with toddlers in diapers at busy day-care centers at particular risk. Giardiasis is the most commonly diagnosed parasitic infection in the United States, and although most cases are relatively mild or asymptomatic, it nonetheless results in thousands of hospitalizations each year.

What Are the Signs and Symptoms of Giardiasis?

It is estimated that more than 50 percent of people with giardiasis have no symptoms or only mild symptoms. When symptoms of giardiasis do occur, they may start gradually or suddenly, usually within one to three weeks after exposure to the parasite. The illness usually begins with frequent watery diarrhea* without blood or mucus. Because giardiasis affects the body's ability to absorb fats and carbohydrates from ingested foods (malabsorption), giardiasis often produces foul-smelling, oily stools that float. Symptoms may also include abdominal* cramps, a swollen or large abdomen, excessive gas, nausea and vomiting, loss of appetite, and sometimes a low-grade fever. Persistent symptoms can lead to weight loss and dehydration*. Severe symptoms may require hospital care.

How Do Doctors Diagnose Giardiasis?

Giardiasis is diagnosed by examination of stool samples under a microscope. Doctors look for evidence of trophozoites (tro-fo-ZO-ites), which are active *Giardia* protozoa inside the body, or for evidence of cysts, which are *Giardia* surrounded by a protective wall, the form of the protozoan during the resting stage of its life cycle. Detecting *Giardia* is difficult, so doctors often need to repeat the stool sample tests several times before they can confirm or rule out *Giardia* infection. Diagnostic tests may sometimes take as long as four or five weeks.

How Do Doctors Treat Giardiasis?

Several drugs are used to treat giardiasis, and some of them work well with a single dose. Sometimes a second round of drug treatment is required. There is some controversy among doctors about whether to treat people who carry the parasite but who do not have symptoms of giardiasis. Treatment is sometimes considered because these individuals may transmit the infection to others and may eventually show symptoms themselves.

How Do People Prevent Giardiasis?

There is no vaccine or prophylactic (disease-preventing) drug for giardiasis. Preventing giardiasis depends on maintenance of safe supplies of drinking water, the sanitary disposal of human and animal waste, washing of fruits and vegetables before eating or cooking, and proper hygiene, which includes thorough washing of hands after going to the bathroom and before eating.

The *Giardia* protozoan can be filtered from water but is otherwise difficult to destroy. It can survive in cold water for as long as two months, and it is resistant to chlorine levels used to purify municipal water supplies. When municipal water supplies have been approved by local health departments, the water may be considered safe to drink. However, when people are camping or traveling, they need to make sure that drinking water, cooking water, and ice come only from safe sources. Clear cold mountain streams may look safe and inviting, but they may also carry the *Giardia* parasite.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

▶ See also **Diarrhea • Gastroenteritis**

Resources

Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/parasites/giardiasis>.

Gigantism See *Growth and Growth Disorders*.

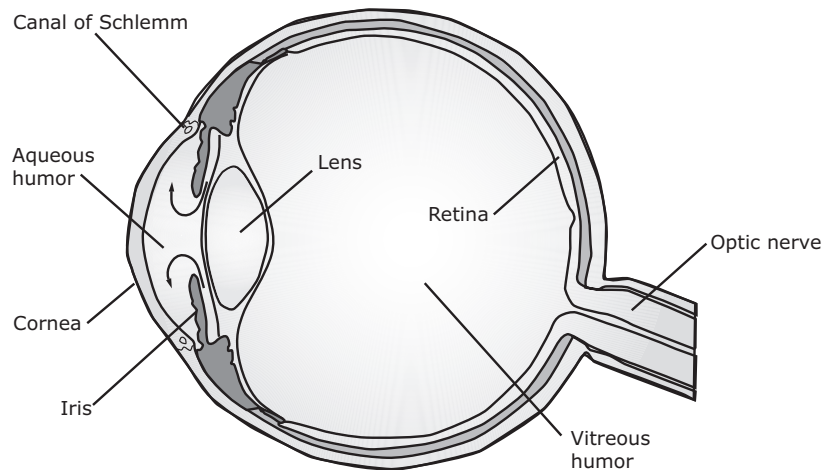
Gingivitis See *Gum Disease*.

Glaucoma

Glaucoma (glaw-KO-ma) is a group of disorders that cause fluid pressure to increase inside the eye, which may result in vision loss.

What is Glaucoma?

If a balloon is slowly filled with water, eventually it bursts. But if the same balloon has several pin-sized holes at one end, then it becomes possible to continue adding water to the balloon to maintain its round shape, without



Anatomy of the eye. The arrows show the flow of aqueous humor from behind the iris, through the pupil, to the front of the eye, where it drains through the canal of Schlemm. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

breaking the balloon, as long as the amount of water being added is equal to the amount escaping through the pinholes.

The eye has a similar system of liquid that continuously flows in and out of a small chamber at the front of the eyeball. The problem for people with glaucoma is that the drainage out of the eye is blocked or not working properly. It is similar to the balloon that is filling with water. Without a way to make room for more liquid, pressure builds up. Although a pressure buildup will not cause the eye to burst, it may damage nerves at the rear of the eyeball that carry images to the brain.

Glaucoma is one of the leading causes of blindness in the United States. It affects more than 3 million people, especially the elderly and people of African ancestry. The disease is also hard to diagnose. Pressure can grow in the eye for years before the effects on vision are noticed. By then, often the damage has been done.

How Does Glaucoma Affect the Eye?

The eye is about the same size as a ping-pong ball and is divided into two compartments. The larger compartment at the rear of the eye contains a gel-like substance called vitreous (VIT-re-us) humor, which helps to maintain the eyeball's shape and to transmit light. The front compartment, or anterior chamber, is smaller and is filled with a watery liquid called aqueous (AY-kwee-us) humor. This clear liquid brings in nutrients vital to the eye's health and carries out waste that can damage it.

The aqueous humor flows from behind the front colored portion of the eye, which is called the iris. It moves through the pupil, the opening in the center of the iris, into the front chamber of the eye. The liquid flows through the chamber and out a tiny drainage canal that has a fine, mesh-like covering. The small hole on the canal rests at an angle where the colored iris meets the cornea, the clear cup-shaped disc at the front of the eyeball.

About 90 to 95 percent of people with glaucoma have a problem with this drainage system. The cause is unknown, as there is no visible blockage. It appears that the cells in the mesh covering the drainage canal do not do their job properly or that they lose their ability to allow proper drainage over time. Glaucoma develops gradually, but there is a rarer acute* form of glaucoma that develops suddenly when the iris closes off the drainage canal. This painful condition constitutes a medical emergency and requires immediate treatment.

The cause of most cases of glaucoma is not understood, although people of African ancestry, people who have diabetes or other family members with glaucoma, or those who have suffered eye injuries are at greater risk. Aging is another risk factor for glaucoma.

How Is Glaucoma Diagnosed?

Except for the rare cases of acute glaucoma that develop suddenly, most people do not realize they have glaucoma. As pressure is building in the eye, many of the millions of nerve cells at the rear of the eye are destroyed. The nerves that die first affect peripheral (pe-RIF-er-al) vision, the ability

* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

No Mountain Too High

Glaucoma rarely occurs in young people, but Erik Weilenmayer was born with an eye disease that caused glaucoma. By age 13, he was totally blind. Erik did not let glaucoma prevent him from becoming a teacher and a mountain climber. He has scaled some of the toughest peaks, including Alaska's Mt. McKinley, the highest in the United States.

"When I first went blind, I wondered what I could do," Weilenmayer said in 1998. "It's really a kick to do extreme activities and do them well—and no more dangerously than anyone else."

Erik's accomplishments are a reminder that physical challenges and differences do not have to prevent people from participating in life's most difficult and demanding activities.

to see the sides of a normal field of vision. When the loss of vision becomes severe enough for a person to notice, the damage is so great that little can be done.

The best way to diagnose glaucoma is through an eye exam that uses an instrument called a tonometer (to-NOM-e-ter) to measure the pressure in the eye. One type of tonometer registers eye pressure by lightly touching the eye's surface. Eye drops are used to make this procedure painless. Another tonometer uses a puff of air to measure eye pressure. The doctor or eye specialist (ophthalmologist or optometrist) may also use a scope that shines light in the eye to look for damage to the optic nerve. Peripheral vision can be checked as part of the eye exam.

Why Are Early Diagnosis and Treatment Important?

Diagnosis Early diagnosis of glaucoma is the key to preventing vision loss. If glaucoma is discovered before the increased eye pressure has destroyed many nerves, vision can be saved in many cases. Routine eye exams, including tests for glaucoma, are important, especially for adults older than 35. Such eye exams are especially important for people at greatest risk for glaucoma, including people of African ancestry, people with relatives who have glaucoma, people with diabetes, and people with previous eye injuries.

Treatment The most common treatment involves eye drops that reduce pressure. Sometimes surgery is necessary either to open the drainage canal or to create a new one.

▶ See also **Aging • Blindness • Cataracts**

Resources

Books and Articles

Flammer, Josef. *Glaucoma: Guide for Patients, an Introduction for Care-Providers, a Quick Reference*, 3rd rev. ed. Cambridge, MA: Hogrefe, 2006.

Trope, Graham E. *Glaucoma: A Patient's Guide to the Disease*, 3rd ed. Toronto: University of Toronto Press, 2004.

Organizations

Glaucoma Research Foundation. 251 Post Street, Suite 600, San Francisco, CA, 94108. Toll free: 800-826-6693. Web site: <http://www.glaucoma.org>.

National Eye Institute. 2020 Vision Place, Bethesda, MD, 20892-3655. Telephone: 301-496-5248. Web site: <http://www.nei.nih.gov/glaucoma>.

Glomerulonephritis

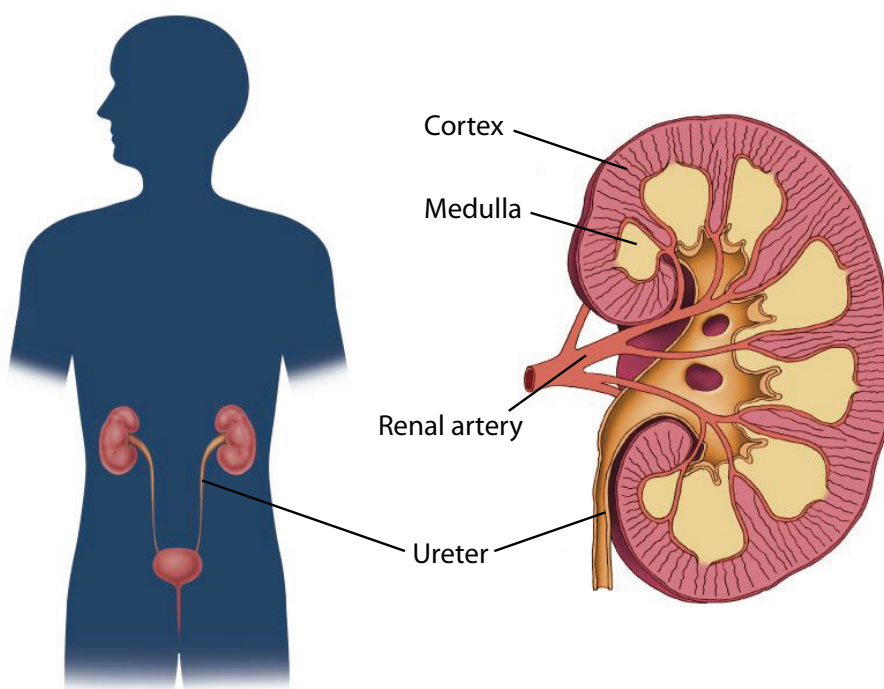
Glomerulonephritis refers to a group of diseases that damage the filtering ability of the kidney in a way that prevents the body from getting rid of metabolic waste and excess water.

Polly's Sore Throat

Polly will always remember fifth grade because she missed so much of it. She missed one week of school because she had strep throat, a sore throat caused by streptococcal bacteria. Several weeks later, Polly felt very tired, she lost her appetite, her abdomen and back hurt, and her face looked puffy. She rarely had to urinate, and when she did, her urine* was dark like cola. Polly's doctor suspected that she had a case of acute* (sudden) glomerulonephritis that was caused by her strep throat. Her doctor explained that Polly's kidneys were not working properly and that waste products from the cells were building up inside her body. Polly's condition got worse. She spent several days in the hospital, then she recuperated at home for several weeks.

What Are the Kidneys?

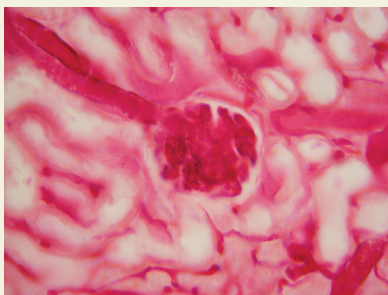
The kidneys are a pair of bean-shaped organs located in the back of the abdominal cavity right above the waist. There is one on each side of the spinal column. The kidneys perform a number of functions, chiefly filtering about 400 quarts of blood per day to remove cellular waste products and extra water to create urine, adjusting the chemical and fluid balance



* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

◀ The kidneys are located on both sides of the spinal column just above the waist.
Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



▲
Kidney glomerulus seen under a microscope. *Image copyright Jubal Harshaw, 2008. Used under license from Shutterstock.com.*

* **glomerulus** (glom-ER-you-lus) is from a Greek word meaning filter. The glomerulus is a knot of blood vessels that have the job of filtering the blood.

* **ions** are positively or negatively charged elements or compounds, such as hydrogen, sodium, potassium, and phosphate, which are necessary for cellular metabolism.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

in the body by controlling the concentration of urine, and participating in the control of blood pressure. The kidneys also are involved in regulating the effects of vitamin D on the body and in stimulating bone marrow to create new red blood cells. When the kidneys are damaged by disease, some or all of these functions can be impaired. When the kidneys do not function properly, a person can become very ill; when they fail to function at all, a person will die without treatment.

Each kidney is made up of about one million units called nephrons (NEF-rons). Each nephron consists of a collecting tubule that eventually takes wastes to the bladder, and a filtering unit called a glomerulus*.

What Is Glomerulonephritis?

In a person with glomerulonephritis, the glomeruli (plural of glomerulus) do not function properly. When the glomeruli are damaged, the filtering mechanism does not work properly. Instead of keeping proteins in the blood, while allowing excess water, ions*, and wastes to pass through the filter into collecting tubules where they become urine, the glomeruli filters leak. This leakage allows proteins to move out of the bloodstream with the water and wastes and to be excreted in the urine. Loss of large amounts of protein from the blood then causes fluid to leak out of the bloodstream into the body's tissues. The retention of fluid gives the body, especially the face and legs, a puffy and bloated appearance.

Although there are many causes of glomerulonephritis, scientists think that they are all related to a problem caused by immune system* proteins called immunoglobulins. Some event that is not completely understood stimulates these proteins to collect in glomerular cells. This causes inflammation* in cells that results in damage to the glomeruli.

Acute Glomerulonephritis

Acute glomerulonephritis most often occurs in children between 2 and 15 years of age and is uncommon in adults over age 40. Post-streptococcal glomerulonephritis is the most common kind of acute

RICHARD BRIGHT'S CONTRIBUTIONS

Richard Bright (1789–1858), a British physician, was the first to describe the kidney disorder known later as Bright's disease, a type of glomerulonephritis. Bright studied kidney function and was meticulous in his clinical observations. He worked with kidney patients, studying their symptoms, and then he correlated symptoms with the kidney defects he observed during autopsies (dissecting examinations after death).

The results of Bright's research first appeared in *Reports of Medical Cases* in 1827. Bright also contributed to the study of lung disease, heart disease, various fevers, and tumors.

glomerulonephritis. It usually develops two to three weeks after a streptococcal infection in the throat or (rarely) on the skin. In some people, the streptococcal infection triggers an inappropriate response in the immune system that results in immune system proteins being deposited in the glomeruli. Post-streptococcal glomerulonephritis is decreasing in developed countries such as the United States, probably due to the prompt treatment of streptococcal infections with antibiotics. Other infections, such as bacterial endocarditis*, a heart infection, can also trigger acute glomerulonephritis.

Symptoms of acute glomerulonephritis include blood in the urine, which turns it a brownish color, a decreased volume of urine, and puffiness in the face and ankles from fluid retention. Eventually fluid may accumulate in the lungs making breathing difficult. Blood and urine tests are done to determine the extent of the kidney damage.

In treating acute glomerulonephritis, the physician corrects any chemical imbalances in the blood caused by loss of proteins and other molecules in the urine. Diuretic drugs are used to help eliminate excess fluid from the body. Antibiotics and corticosteroid* drugs are given to control infection and inflammation. In serious cases, dialysis may be temporarily necessary to remove waste products that have built up in the blood. Most people recover completely from acute glomerulonephritis, but in about 10 percent of people, the condition becomes chronic*.

Chronic Glomerulonephritis

Chronic glomerulonephritis may develop without symptoms for many years. The disease can be triggered or associated with many diseases and conditions, including the autoimmune diseases systemic lupus* erythematosus, HIV*/AIDS* infection, and Goodpasture's syndrome* (a rare condition). Chronic glomerulonephritis also can develop from diabetes* and severe high blood pressure (hypertension).

Symptoms of chronic glomerulonephritis often go unrecognized for a long time and include protein in the urine, foamy urine, high blood pressure, swelling in the face and ankles, and frequent urination. Often the first indication of chronic glomerulonephritis comes from an abnormal urinalysis during a routine physical examination. As kidney failure progresses, fatigue, nausea and vomiting, difficulty sleeping and nighttime muscle cramps develop.

Diagnostic blood, urine, and imaging tests are done to determine the underlying cause of the disease and to assess how far kidney failure has progressed. A kidney biopsy* is sometimes performed.

Chronic glomerulonephritis cannot be cured, but it can be treated. If an underlying disease such as diabetes or lupus is causing the kidney damage, that disease is treated. Chronic glomerulonephritis tends to worsen with time, eventually ending in complete kidney failure. When the kidneys fail people either need kidney dialysis several times per week or a kidney transplant in order to survive.

What Is Kidney Dialysis?

When the kidneys stop filtering blood properly due to injury or disease, hemodialysis ("hemo" means "blood") is the most common treatment. A dialysis machine acts as an artificial kidney. People undergoing dialysis are hooked up to the machine via needles and tubes so that blood is pumped out of their body and through the filters in the machine. The machine does the job of the kidney in removing wastes and excess water, then the cleaned blood is returned to the body through a vein. Some people need dialysis temporarily while their kidneys heal, but many more depend on it permanently to stay alive. The only alternative to dialysis for these people is a kidney transplant.

* **endocarditis** (en-do-kar-DYE-tis) is an inflammation of the valves and internal lining of the heart, known as the endocardium (en-doh-KAR-dee-um), usually caused by an infection.

* **corticosteroid** (KOR-ti-ko-STER-oid) is one of several medications that are prescribed to reduce inflammation and sometimes to suppress the body's immune response.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **lupus** (LOO-pus) is a chronic, or long-lasting, disease that causes inflammation of connective tissue, the material that holds together the various structures of the body.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **Goodpasture's syndrome** is an autoimmune disorder of unknown cause, characterized by circulating antibodies in the blood that attack the membrane of the kidney's glomeruli and the lung's alveoli.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- * **metabolic** (meh-tuh-BALL-ik) pertains to the process in the body (metabolism) that converts food into energy and waste products.
- * **enzymes** (EN-zimes) are proteins that help speed up a chemical reaction in a cell or organism.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **hypoglycemia** (hi-po-gly-SEE-mee-uh) is a condition that occurs when the amount of glucose, or sugar, in the blood becomes too low. Symptoms can include dizziness, trembling, sweating, and confusion.

▶ See also **Kidney Disease**

Resources

Organizations

National Kidney and Urologic Diseases Information Clearinghouse. 3 Information Way, Bethesda, MD, 20892-3580. Web site: <http://kidney.niddk.nih.gov/kudiseases/pubs/glomerular/index.htm>.

National Kidney Foundation. 30 East Thirty-third Street, New York, NY, 10016. Toll free: 800-622-9010. Web site: <http://www.kidney.org>.

Nephron Information Center. Web site: http://nephron.org/diseases_categories/secondary_nephritis/glomerulonephritis_infectious.

Glycogen Storage Diseases

Glycogen storage diseases (GSD) are a group of inherited metabolic diseases in which there is a deficiency of one of the enzymes* involved in glycogen metabolism.*

What Is a Glycogen Storage Disease?

The major energy reserve of the body is glycogen stored in the liver* and muscles. Glycogen is formed from glucose, and glycogen is broken down into glucose, a multiple step process requiring proper functioning of several enzymes, which are deficient in GSD. As a result, blood glucose levels are low (hypoglycemia*), and there is excess storage of glycogen in the liver and muscles. There are several types of GSD, with symptoms ranging from mild (muscle cramps) to life-threatening (liver or kidney failure and death).

What Is a Metabolic Disorder?

Human bodies convert food into energy, a process called metabolism. In metabolic disorders, a defective metabolism leads to energy failure. Glucose is the major energy source in the body, especially for brain, heart, and muscle function, and it is obtained directly from food in the digestion process that breaks down protein and fat. Excess blood glucose present after a meal is converted into glycogen, which is stored in the liver and muscle. In between meals or after strenuous exercise, glucose demand is met by breaking down stored glycogen into glucose. In GSD, one of several enzymes involved in glycogen metabolism is defective, which leads to either too much or too little glycogen stores in tissue or results in an

abnormal form of glycogen storage. Normal glucose and glycogen metabolism are so essential to the functioning of every cell in the body that any abnormality in this process can result in catastrophic illness or death.

How Do People Get a Glycogen Storage Disease?

Glycogen storage diseases are inherited or sex-linked*. The information about the structure and function of the body is stored in chromosomes* in the form of DNA* clusters called genes*. There are two copies of each gene, and a person gets one copy from each parent. If one or both copies of the gene are defective, there is a change in genetic information inherited by the child which results in abnormal structure and/or function in the child's body. Most forms of GSD occur when both parents have one abnormal copy of a gene responsible for a particular enzyme and both parents pass on this abnormal copy to the child. In such parents, each pregnancy has a 25 percent chance of producing a normal child, a 25 percent chance of producing a child with GSD, and a 50 percent chance of having a child with one defective gene copy. People who have the gene but not the disease are called carriers.

How Common Are Glycogen Storage Diseases?

These are rare diseases, with an overall incidence of 1 in 20,000 births. Four of the twelve types of GSD are more common, accounting for more than 90 percent of all cases. Accurate statistics are unavailable for the other types of GSD. Certain ethnic groups are more likely to develop the disease, such as North African Jews. The age of onset varies from birth to childhood.

What Are Common Symptoms of Glycogen Storage Diseases?

Although each type of GSD has slightly different symptoms depending on the affected organ(s), common symptoms include the following:

- Hypoglycemia due to the body's inability to provide sufficient glucose from glycogen
- Enlarged liver due to excess glycogen storage
- Muscle cramps, pain, fatigue, and muscle breakdown after exercise due to lack of readily available glucose for muscle function
- Protein and fat deficiency from break down to produce glucose, leading to growth retardation, weak bones, and muscle wasting

How Are Glycogen Storage Diseases Diagnosed?

Milder cases of GSD may not ever be diagnosed or may go undiagnosed into adulthood, whereas more severe cases are seen in infancy or childhood. The important symptoms are hypoglycemia, liver damage, growth retardation, muscle cramps, and abnormal blood chemistry profile (abnormally high levels of protein and fat breakdown products such as lactic acid, uric acid, and cholesterol).

* **sex-linked** genetic traits involve the chromosomes that determine whether a person is male or female. They usually affect boys, who have only one X chromosome.

* **chromosomes** (KRO-mo-somz) are threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

- * **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.
- * **echocardiogram** (eh-ko-KAR-dee-uh-gram) is a diagnostic test that uses sound waves to produce images of the heart's chambers and valves and blood flow through the heart.
- * **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- * **placenta** (pluh-SEN-ta) is an organ that provides nutrients and oxygen to a developing baby; it is located within the womb during pregnancy.
- * **amniocentesis** (am-nee-o-sen-TEE-sis) is a test in which a long, thin needle is inserted in the mother's uterus to obtain a sample of the amniotic fluid from the sac that surrounds the fetus. The fetal cells in the fluid are then examined for genetic defects.
- * **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

In cases of excess liver glycogen deposition, an ultrasound* shows an abnormally enlarged liver. In types of GSD which involve the heart, the heart is enlarged, which can be seen by an echocardiogram*. X-rays may show fractured bones.

More definitive tests include liver or muscle biopsy* and microscopic examination for glycogen deposition and for levels of enzyme activity. If a fetus is suspected of having the disease, a small piece of the placenta* can be removed for genetic testing. With amniocentesis*, GSD can be detected prior to birth. In some cases, genetic testing can be done from skin and/or blood samples. Before undergoing such testing, the prospective parents should meet with a genetic counselor in order to make an informed decision about whether to have children.

How Are Glycogen Storage Diseases Treated?

Treatment depends on the type of GSD, the organ affected, and the predominant symptom. In most cases, a team of doctors, including specialists in the heart, nervous system, respiration, and genetics, are needed, as GSD are rare and complex diseases. Hypoglycemia is avoided by modifying the diet. Avoiding strenuous exercise and avoiding fasting is important in all GSD. Treatment approaches involving gene therapy and genetic engineering were as of 2009 areas of continuing research.

What Are the Different Types of Glycogen Storage Disease?

There are twelve types of GSD that are numbered in the order in which the deficient enzyme was discovered, given the name of the person who first described the disease, or identified by the deficient enzyme. Another common way of categorizing GSD is by the organ system that is most affected, which depends on which tissue shows the enzyme deficiency.

Glycogen storage diseases affecting the liver Eight types of GSD affect the liver. Two of these are severe and show up in early infancy or childhood. Common features include hypoglycemia, liver and/or kidney enlargement, growth retardation, and motor delay. Diagnosis is usually by liver ultrasound, liver biopsy, analysis of enzyme activity, and genetic testing. Treatment includes frequent carbohydrate-rich meals either by mouth, intravenously*, or by a tube in the stomach in order to maintain a consistent blood glucose level. In older children, cornstarch can be given orally at night to prevent hypoglycemia. Cornstarch is a complex compound of glucose that is broken down in the body over several hours to maintain a steady supply of glucose. To maintain healthy bones and to promote growth, a high protein diet with multivitamin and calcium supplements is recommended.

Type I Type I (also called von Gierke's disease or hepatorenal glycogenosis) is the most common GSD, accounting for 25 percent of all cases with an incidence of 1 in 50,000 to 100,000 births. Within hours of birth,

affected babies become hypoglycemic when glucose derived from the mother is exhausted. They are lethargic and may have convulsions*, may stop breathing, or go into a coma*. Later characteristics in the young child include irritability, difficulty waking from sleep, tremors, and overwhelming hunger. Affected children have delayed puberty*, growth retardation, a characteristic doll-like face (due to fat deposits in the cheeks), skinny limbs, and a bulging belly due to the enlarged liver. Glycogen depositis in the kidneys leads to kidney failure. Nosebleeds occur due to non-sticky platelets*. In later life, benign* or cancerous tumors* can occur in the liver and kidney. This GSD is usually diagnosed in individuals between 4 and 10 months of age. No prenatal* testing was available as of 2009. Besides hypoglycemia, blood tests show abnormally high levels of lactic acid, cholesterol, and uric acid.

Hypoglycemia is avoided by frequent modified meals and by using cornstarch. Children are advised to avoid contact sports due to the likelihood of bleeding and liver injury. Infections should be avoided and promptly treated when they occur. Treatment may include organ transplantation, which has been performed with some measure of success. As of 2009, no genetic therapy was available for enzyme replacement.

Type III Type III (also called Cori or Forbes disease, Debrancher deficiency, or limit dextrinosis) affects about 1 in 100,000 births with increased incidence among the Inuit of North America and the Sephardic Jews of North Africa. Symptoms first appear in babies about three to four months of age, yet many patients may live in their 60s. The symptoms are similar to Type I in infancy. Over time, the liver shrinks and becomes scarred. Muscle wasting, heart enlargement, and bone fractures are common. Hypoglycemia is not as severe as in Type I. A carbohydrate and protein rich diet is advised.

Type VI Type VI (also called Hers' disease or liver phosphorylase deficiency) accounts for up to 30 percent of all GSD cases, and most cases are X-linked. The enzyme called phosphorylase, which is involved in the first step of glycogen breakdown in the liver, is deficient. Type VI is a milder disease than Type I, with symptoms beginning between one and five years of age with hypoglycemia, growth retardation, and liver enlargement. Liver size becomes normal after puberty. Several symptoms normalize or become milder as patients grow older. A carbohydrate and protein rich diet is advised.

Type VIII and XI These are rare disorders caused by defects of the enzymes in the liver and have symptoms similar to Type VI.

Type IX Type IX (also called Phosphorylase kinase deficiency) is due to deficiency of liver glycogen phosphorylase kinase, which is an enzyme made up of four different subunits. Overall, this disease is very similar to Type VI in terms of the symptoms, but it is much milder, with symptoms

- * **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.
- * **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.
- * **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.
- * **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.
- * **benign** (be-NINE) means a condition is not cancerous or serious and will probably improve, go away, or not get worse.
- * **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.
- * **prenatal** (pre-NAY-tal) means existing or occurring before birth, with reference to the fetus.

* **ketones** (KEE-tones) are the chemicals produced when the body breaks down fat for energy.

* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

improving after puberty. Most patients reach their full potential height and weight in adulthood. Some patients also have exercise-related muscle pain and cramps. A carbohydrate and protein rich diet is advised.

Type X Type X is caused by a defect in an enzyme and causes symptoms similar to Types VI and IX.

Type 0 Type 0 (also called glycogen synthetase deficiency) is a rare disease in which the problem is not with breakdown of glycogen but deficient glycogen synthesis from amino acid and fat. In this disease, the liver has limited glycogen stores, and patients become hypoglycemic quickly with fasting. After a meal, blood sugar rises quickly as the body is unable to shunt all the excess glucose into glycogen. When glucose is demanded by the body between meals, the liver is unable to provide enough. Hypoglycemia is seen in infants and children as early morning fatigue or convulsions. Long-term complications are short stature and weak bones. Type 0 is usually diagnosed by blood tests that show fasting hypoglycemia and excess ketones*. Liver biopsy shows low glycogen content and low or no enzyme activity. Consumption of frequent protein-rich meals and taking cornstarch at night in order to slowly release glucose are recommended.

Glycogen storage diseases that predominantly affect the muscle GSD that affect the muscle are Types II, IV, V, and VII. Of these, Type II affects the heart and skeletal muscle; Type IV affects muscle and liver; and Type V and VII affect only the skeletal muscle. Hypoglycemia usually does not occur. Muscle weakness in infants is detected in delayed motor milestones such as rolling over and sitting up. Children have difficulty running and climbing stairs. Respiratory muscle weakness leads to progressive respiratory failure. In adolescents and adults, muscle weakness is detected after strenuous exercise. With severe muscle breakdown, the urine* may become burgundy-colored due to the presence of a muscle protein. Enlarged heart and heart failure may occur. Avoiding strenuous exercise is essential. A high protein diet is advocated. Some patients may need walkers or wheelchairs along with physical and occupational therapy. Respiratory difficulty is most pronounced at night, and patients may need to be on breathing machines. In some conditions, enzyme replacement or liver transplant is performed.

Type II Type II (also called Pompe's disease, acid maltase deficiency, or lysosomal storage disorder) occurs in about 1 in 40,000 births and highest rates occur among African Americans. The acid alpha-hydrolase (acid maltase) enzyme is deficient in the lysosomes of the heart and skeletal muscles. Lysosomes are small compartments inside the cell that function as recycling centers for substances such as glycogen. When this does not happen, as in Type II, glycogen accumulates in the heart and muscle lysosomes leading to injury.

There are three types based on the age of onset: infantile, juvenile, and adult. In the infantile form, infants appear normal at birth. Around four to six months of age, they develop muscle weakness leading to floppy limbs and delayed motor milestones. They also develop breathing difficulty, an enlarged heart, and heart failure. Despite best medical treatment, death usually occurs by one to two years of age. The juvenile form is characterized by skeletal and respiratory muscle weakness, which progresses slowly into the second to third decades, resulting in death due to respiratory failure. The adult onset form has slowly progressing respiratory and skeletal muscle weakness leading to sleep apnea, respiratory failure, and death. Hypoglycemia is not a symptom.

Treatment attempts to handle the symptoms only. Diet modifications are not of much use in these cases. Enzyme replacement can be done. Treatment of respiratory and heart failure can be performed but does not prolong life. Importantly, parents of an affected child need counseling regarding the chance of having another affected child in subsequent pregnancies.

Type IV Type IV (also called Andersen's disease, brancher deficiency, amylopectinosis, or adult polyglucosan body disease [APBD]) accounts for only 3 percent of all GSD and is more common in the Ashkenazi Jews. In this disease, the branching enzyme that is responsible for normal branching of glycogen is deficient and leads to deposition of abnormal glycogen with long branches in the liver and muscle. A foreign-body like reaction ensues that activates the immune system to attack these tissues, leading to scarring of the liver and muscle.

There are several forms of the disease. Typically, in the first year of life the afflicted person has an enlarged liver and spleen and general failure to thrive. Children usually die due to progressive liver failure and cirrhosis by about five years of age. Hypoglycemia is not common. The milder forms have non-progressive liver dysfunction, and these individuals tend to survive into adulthood. Other forms of disease cause skeletal, respiratory, and cardiac muscle weakness. In the perinatal* form, the individual shows nerve and muscle symptoms before birth or immediately after birth. The polyglucosan form causes brain and nerve injury.

Liver biopsy is helpful in detecting scarring and determining enzyme activity. Liver transplant is the only solution for progressive liver failure.

Type V Type V (also called McArdle's disease, muscle phosphorylase, or myophosphorylase deficiency) is caused by glycogen phosphorylase deficiency in skeletal muscles. It is a rare disease with only a few hundred known cases. Symptoms can be mild, and they usually appear in the second to third decade. Patients complain of severe muscle cramps and tenderness after exercise with muscle breakdown and red-colored urine in severe cases. Following some rest, patients experience a second-wind phenomenon and can continue their exercise. Some patients develop

* **perinatal** (per-ee-NAY-tal) means existing or occurring around the time of birth, with reference to the fetus.

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

sustained muscle weakness especially in the large thigh muscles. Patients are normal in stature, and the muscles themselves look normal. A variant of this disease leads to a fatal infantile form with death from rapidly progressive respiratory muscle failure. Avoiding strenuous exercise, taking breaks during exercise in order to take advantage of the second-wind phenomenon, and a high-protein diet are the main treatments.

Type VII Type VII (also called muscle phosphofructokinase deficiency or tarui disease) is the least common GSD, and worldwide only about 50 patients with the disease had been identified as of 2008. The disease is very similar to Type V and is characterized by exercise intolerance. However, the symptoms occur earlier in childhood and are more severe. Patients also have anemia and develop jaundice*. Kidney stones develop and may block the urinary tract. There is no treatment other than restricting high carbohydrate diet and avoiding vigorous exercise.

What Is the Long-term Prognosis for Patients with Glycogen Storage Diseases?

The long-term prognosis depends on the severity of the disease and how effectively symptoms are managed. Maintenance of a healthy blood glucose level can reverse all signs in a milder types (e.g., VI, IX and X) and a normal healthy lifespan can be expected. In other types (e.g., II and IV), death occurs in infancy. Death is usually due to severe hypoglycemic coma, liver failure, respiratory failure, and infections.

▶ See also **Metabolic Disease**

Resources

Books and Articles

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Organizations

American Academy of Neurology. 1080 Montreal Avenue, St. Paul, MN, 55116. Telephone: 612-695-1940. Web site: <http://aan.com>.

Association for Glycogen Storage Diseases. P.O. Box 896, Durant, IA, 52747. Telephone: 563-785-6038. Web site: <http://agsdus.org>.

Goiter See *Thyroid Disease*.

Gonorrhea

Gonorrhea (gah-nuh-REE-uh) is a sexually transmitted disease (STD) and is spread through all forms of sexual intercourse. It can also be passed from an infected mother to her baby during childbirth. Gonorrhea primarily affects the mucous membranes of the genital and urinary tracts (including the urethra). Non-genital sites of infection include the rectum*, eyes, throat, other organs and tissues of the body, and (in cases of gonococcal arthritis) joints.*

What Is Gonorrhea?

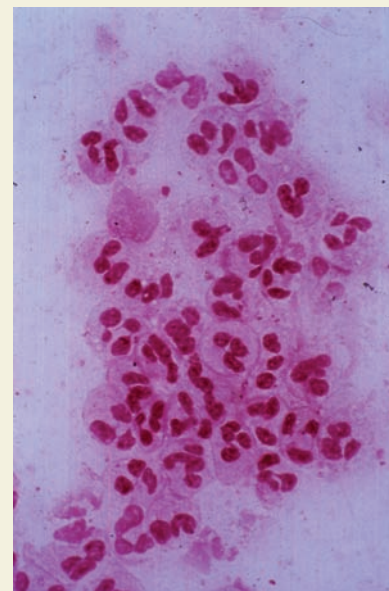
Gonorrhea is an infection caused by the bacterium *Neisseria gonorrhoeae* (nye-SEER-e-uh gah-no-REE-eye), which can colonize and multiply in the body's mucous membranes, especially the mucous membranes of the male and female genital* tracts. It affects primarily the cervix and the male urethra. There are non-genital sites of infection: The bacterium can also affect the mucous membranes of the rectum, eyes (the conjunctiva), and throat. In the female, the cervix is the most common site of infection and the vagina is generally spared. In gonorrhea infection there may be a discharge from the penis or vagina and pain during urination.

In women, the first site of infection is usually the cervix*; if untreated, infection can spread to the uterus* and the fallopian tubes* and result in pelvic inflammatory disease (PID), a severe infection of a woman's reproductive organs, including the fallopian tubes, uterus, and ovaries*, sometimes with spread of the infection to other body tissues near these organs. Babies born to mothers who have gonorrhea can develop an eye infection that can lead to blindness and other complications if it is not treated.

How Common Is Gonorrhea?

Gonorrhea is the second most commonly reported STD in the United States, according to the Centers for Disease Control and Prevention (CDC); chlamydial infection* is number one. The CDC states that after a period of several years in which the annual number of cases of gonorrhea declined, the number began to increase again in 2005. There were 358,366 cases of gonorrhea reported in the United States in 2006; however, many more went unreported. Some experts estimate that as many as 2 million cases occur per year.

Gonorrhea is most common in highly populated urban areas and in people who have more than one sexual partner; however, anyone who has sexual relations with an infected person can contract gonorrhea. Most infected men are between the ages of 20 and 24; most infected women are between the ages of 15 and 19. After 2000 the incidence of gonorrhea was higher among women than among men. Gonorrhea in children almost always points to sexual abuse.



▲ Magnification of *Neisseria Gonorrhoeae*, the bacteria which causes gonorrhea (in fuschia). Custom Medical Stock Photo, Inc. Reproduced by permission.

- * **urethra** (yoo-REE-thra) is the tube through which urine passes from the bladder to the outside of the body.
- * **rectum** is the final portion of the colon that terminates at the anus.
- * **genital** (JEH-nih-tul) refers to the external sexual organs.
- * **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.
- * **fallopian tubes** (fa-LO-pee-an tubes) are the two slender tubes that connect the ovaries and the uterus in females. They carry the ova, or eggs, from the ovaries to the uterus.
- * **ovaries** (O-vuh-reez) are the female reproductive organs from which ova, or eggs, are released in women.

* **chlamydial infection** (kla-MIH-dee-ul) infection is infection by bacteria of the genus *Chlamydia*. The microorganisms can occur in various forms in which the bacteria can invade the urinary and genital systems of the body, as well as the eyes and lungs. One of its most common forms is a sexually transmitted disease (STD), usually passed from one person to another through unprotected sexual intercourse.

* **semen** (SEE-men) is the sperm cell-containing whitish fluid that is produced by the testes, travels in the male reproductive tract, and is discharged from the penis during ejaculation.

* **lymph (LIMF) nodes** are small bean-shaped masses of tissue that contain immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **abdominal** (ab-DAH-mih-nul) refers to the body cavity below the ribs and above the hips that contains the stomach, intestines, and other organs.

Is Gonorrhea Contagious?

Gonorrhea is highly contagious. The risk of contracting the disease is increased in sexually active people who do not use condoms during sexual activity and in people who have multiple sexual partners. A person who has gonorrhea even in the absence of symptoms can transmit the disease to others starting at the time of initial infection.

The bacteria that cause gonorrhea are transmitted via direct contact (mucous membrane-to-mucous membrane and mucous membrane-to-skin) during all types of sexual activity. The bacteria are also carried in vaginal fluids and semen*, and transmission as a result of contact with these fluids is also possible. Infected women can pass the infection to their babies during childbirth.

People can infect themselves if they touch an infected body part of another person and then rub or scratch their eyes. Gonorrhea can also be spread through kissing; however, this method of transmission is rare.

How Do People Know They Have Gonorrhea?

Many people who contract gonorrhea have only mild symptoms or even none at all. Males are much more likely than females to know they have gonorrhea, but up to 20 percent of males do not experience any symptoms. Within two weeks after being infected, males often have a burning sensation during urination. They may have pain in or a greenish discharge from the penis. The lymph nodes* in the groin may swell, and the urethral meatus (the external opening of the urinary tract at the head of the penis) may become irritated and red.

Between 30 and 60 percent of infected women may not have any noticeable symptoms of infection. Those who develop symptoms usually begin to experience them within two to three weeks after contact with the bacterium. Symptoms may include a bloody or greenish-yellow discharge from the vagina; pain during urination and/or sexual intercourse; and itching, soreness, or redness in the genital area. Other symptoms, including abdominal* pain, bleeding during or after intercourse, and bleeding between periods may mean a woman has PID.

How Do Doctors Diagnose and Treat Gonorrhea?

Because the symptoms of gonorrhea are similar to those of chlamydial infection, doctors usually test a person experiencing symptoms that point to gonorrhea for both of these STDs. In addition, doctors usually test a patient who has suspected gonorrhea or chlamydial infection for syphilis and ask him or her to be tested for HIV infection. In September 2006 the CDC revised its recommendations for HIV testing to include yearly HIV screening for people at high risk of infection—which includes those diagnosed with other STDs—unless the patient refuses testing.

Diagnosis A sample of fluid or discharge obtained from the vagina, cervix, tip of the penis, or rectum can be cultured and tested for *Neisseria*

gonorrhoeae bacteria. Results are usually known within 48 hours. Another test, the polymerase (pah-LIM-er-ace) chain reaction (PCR), can be used to look for the presence of the bacterium's DNA* from the bacteria in urine, fluid from the cervix, or from fluid discharge from the urethra. This test gives faster and more accurate results.

Pharyngeal (fair-un-JEE-ul), or throat, gonorrheal infection can be established by doing a throat culture. In newborns at risk for gonorrheal eye infection, doctors swab the baby's eye discharge and do a culture to confirm the diagnosis. Gonorrheal eye infection is uncommon in U.S. infants because newborns routinely receive antibiotic eye drops or ointment at birth to prevent infection.

Treatment Gonorrhea is curable when treated with antibiotics, although some strains* of the bacteria are increasingly resistant to medication. In April 2007 the CDC added gonorrhea to the list of so-called superbugs; that is, diseases that are resistant to most antibiotics in common use.

It is important for individuals who are diagnosed with gonorrhea to discontinue all sexual activity during the period of illness. All sexual partners should be made aware of the diagnosis and should undergo testing, even if they do not have symptoms. If they have the disease they should also be treated with antibiotics. People who have both gonorrhea and chlamydial infection are treated with a combination of antibiotics; people diagnosed with gonorrhea alone are often treated for chlamydial infection as well, since gonorrhea has a shorter incubation* period and its symptoms typically start a week or so earlier than those of chlamydial infection. Newborns infected with gonorrheal conjunctivitis are given antibiotics intravenously (directly into a vein).

With appropriate antibiotic treatment, gonorrhea usually clears up within two weeks. It is important to take all of the medication even if the symptoms improve prior to completion of the full course, and to contact the doctor if they do not. When treated early, patients do not usually have any long-term complications.

Complications If a person has had gonorrhea before, he or she can become infected again. In fact, the reinfection increases the likelihood of complications. In women, untreated gonorrhea can lead to PID, which can cause ectopic pregnancy* and sometimes it can lead to infertility (the inability to become pregnant). Women have a 15 percent likelihood of becoming infertile after a single episode of PID; if they have another episode, the likelihood rises to 50 percent. Ectopic pregnancies require emergency surgery; an ectopic pregnancy in which the fallopian tube bursts can cause massive bleeding and even death.

Without treatment, the bacteria can spread throughout the body, to the blood, and via the bloodstream and to the joints, heart, and brain, although these complications rarely occur in young people who are in good health. Newborns that are not treated for gonorrheal eye infection are at risk for blindness. People with untreated gonorrhea are more

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **strains** are various subtypes of organisms, such as viruses or bacteria.

* **incubation** (ing-kyoo-BAY-shun) is the period of time between infection by a germ and when symptoms first appear. Depending on the germ, this period can be from hours to months.

* **ectopic (ek-TAH-pik) pregnancy** is an abnormal pregnancy in which the fertilized egg lodges and grows outside the uterus, usually within one of the fallopian tubes.

* **HIV** or human immunodeficiency (HYOO-mun ih-myoo-no-dih-FIH-shen-see) virus, is the virus that causes AIDS (acquired immunodeficiency syndrome).

likely to contract HIV* if they have unprotected sex with someone who is HIV-positive.

Can Gonorrhea Be Prevented?

Unfortunately, there is no vaccine against gonorrhea as of 2009. The best way to avoid contracting gonorrhea is to suspend or discontinue all forms of sexual activity. For those persons who are sexually active, the proper use of latex condoms during all forms of intercourse is important. Doctors advise women who are sexually active to have a yearly gynecological exam with STD screening. They also recommend that people with any symptoms of gonorrhea or who are at risk for STDs see a doctor. If a person is found to have gonorrhea, all their sexual partners must also be tested and treated. Doctors in the United States are required by law to report cases of gonorrhea to the CDC and to local public health departments.

▶ See also **AIDS and HIV Infection • Chlamydial Infections • Sexually Transmitted Diseases (STDs) • Syphilis**

Resources

Books and Articles

Kollar, Linda, and Brian Schmaefsky. *Gonorrhea*. Philadelphia, PA: Chelsea House, 2005.

Michaud, Christopher. *Gonorrhea*. New York: Rosen, 2007.

Organizations

American Social Health Association. P.O. Box 13827, Research Triangle Park, NC, 27709. Telephone: 919-361-8400. Web site: http://www.ashastd.org/learn/learn_gonorrhea.cfm.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: <http://www.cdc.gov/std/gonorrhea/stdfact-gonorrhea.htm>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-6612. Telephone: 301-496-5717. Web site: <http://www3.niaid.nih.gov>.

Gout

Gout (GOWT) is a painful, inflammatory disease of the joints caused by deposits of crystals of uric (YUR-ik) acid.

Gout

Gout risk factors

- Family history of the disease
- Male
- Overweight
- Excessive alcohol
- Purine-rich diet
- Enzyme defect that makes it difficult for the body to break down purines
- Exposure to lead in the environment
- Organ transplant recipient
- Use of medicines such as diuretics, aspirin, cyclosporine, or levodopa
- Take niacin (vitamin)

Signs of gout

- Hyperuricemia
- Presence of uric acid crystals in joint fluid
- More than one attack of acute arthritis
- Arthritis that develops in a day, producing a swollen, red, and warm joint
- Attack of arthritis in only one joint, often the toe, ankle, or knee

SOURCE: National Institute of Arthritis and Musculoskeletal and Skin Diseases, National Institutes of Health, U.S. Department of Health and Human Services

*Illustration by GGS Information Services.
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What Is Gout?

Gout is a disease that causes painful inflammation in joints. Gout falls under the broad category “arthritis,” which means inflammation of the joints. While it can affect any joint, gout commonly afflicts the joints of the big toe, and this foot-related gout is sometimes called podagra (po-DAH-grah). The inflammation results from deposits of thin, sharp crystals of uric acid. Uric acid is a product in the metabolism of foods and of DNA in the nuclei of cells. Foods and DNA break down into nitrogen-containing chemicals called purines, and the enzyme xanthine oxidase continues the process by metabolizing the purines to uric acid. The uric acid that results typically dissolves in the blood and, after passing through the kidneys, flushes from the body in the urine*. In a patient with gout, however, the body either produces too much uric acid or excretes too little, and the excess crystallizes and accumulates in the joints and other tissues, causing inflammation and pain.

Gout comes in two types: primary and secondary. Primary gout results from excess uric acid that accumulates in the system of people with a genetic background of gout and strikes mainly men 40 years of age and older. Secondary gout occurs in situations in which the body is

* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

* **leukemia** (loo-KEE-me-uh) is a form of cancer characterized by the body's uncontrolled production of abnormal white blood cells.

A VIVID DESCRIPTION

Gout has an unusually long written history. The Greek physician Hippocrates (c. 470–410 B.C.E.) described this painful form of joint inflammation, or arthritis. One of the best known early accounts of the disease comes from English physician Thomas Sydenham (1624–1689), who also suffered from acute attacks of gout. In 1683, he wrote “Tractatus de podagra et hydrope”, in which he attempted to put down on paper the symptoms of such an attack:

The victim goes to bed and sleeps in good health. About 2 o'clock in the morning, he is awakened by a severe pain in the great toe; more rarely in the heel, ankle, or instep. This pain is like that of a dislocation, and yet the parts feel as if cold water were poured over them. Then follow chills and shiver and a little fever.

The pain which [is] at first moderate becomes more intense. With its intensity the chills and shivers increase. After a time this comes to a full height, accommodating itself to the bones and ligaments of the tarsus and metatarsus [the ankle and feet]. Now it is a violent stretching and tearing of the ligaments—now it is a gnawing pain, and now a pressure and tightening. So exquisite and lively meanwhile is the feeling of the part affected, that it cannot bear the weight of bedclothes nor the jar of a person walking in the room.

presented with large amounts of nuclear purines to metabolize because billions of excessive cells are turning over. This happens most frequently in acute leukemia*. When the leukemia responds to treatment, the uric acid concentrations subside and gout treatments can be stopped. Besides primary and secondary gout, doctors sometimes describe a patient's condition as tophaceous gout, a chronic form of the disease in which the uric acid crystals form hard masses, called tophi, around the joints.

Overall, according to the Arthritis Foundation, gout affects about 2.1 million Americans.

How Is Gout Diagnosed and Treated?

Usually, a doctor's first suspicion of gout is based on a patient's report of his or her symptoms. These may include swelling, redness, tenderness, heat, and a sudden onset of pain—usually severe—in a joint. For many patients, the first gout attacks occur in the big toe. Typically, these attacks last about a week with the most severe pain occurring for one or two days. Cases vary, however, and some people may have attacks that last from several hours to several weeks, whereas others may experience constant and milder joint pain. To make a definite diagnosis, medical professionals will test for the presence of uric acid crystals in the fluid—called synovial fluid—around an arthritic joint. After using a needle to extract the fluid, lab technicians examine it for the crystals, which are a characteristic sign

of gout. A doctor may also recommend a blood test to check uric acid concentrations in the blood serum. A high concentration, called hyperuricemia, may indicate gout. However, some people with high concentrations may not develop gout, whereas others with low, even normal levels, may get the disease.

Because gout can be caused by the excess production of uric acid, by the inability to adequately excrete it in the urine, or by both, treatments vary. One commonly prescribed medication is allopurinol. The development of this medication, which led in part to a 1988 Nobel Prize in Physiology or Medicine for collaborating researchers Gertrude Elion (1918–1999) and George Hitchings (1905–1998), inhibits xanthine oxidase and, therefore, blocks the production of uric acid. Medications known as uricosuric drugs, including probenecid, work by boosting the excretion of uric acid in the urine. To quell intense inflammation, doctors may recommend anti-inflammatory agents, such as colchicine, ibuprofen, and other nonsteroidal anti-inflammatory drugs (NSAIDs). In addition, medical professionals typically caution patients to reduce or eliminate alcohol intake, and the consumption of certain fish and red meat—especially organ meats such as liver, pancreas, brain, and other types of meat rich in cell nuclei and, therefore, purines.

▶ See also **Arthritis**

Resources

Books and Articles

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Konshin, Victor. *Beating Gout: A Sufferer's Guide to Living Pain Free*. Williamsville, NY: Ayerware, 2008.

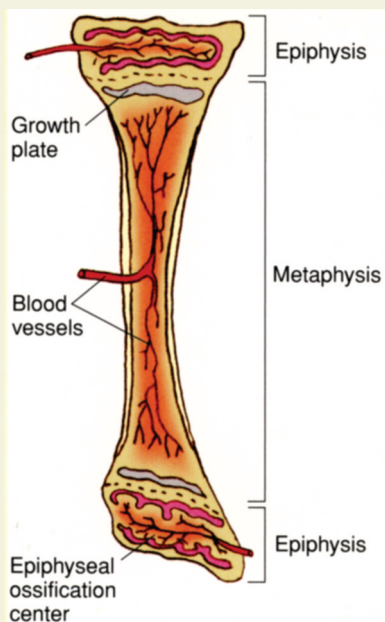
Organizations

Arthritis Foundation. P.O. Box 7669, Atlanta, GA, 30357-0669.
Toll free: 800-283-7800. Web site: <http://www.arthritis.org>.

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Web site: <http://www.niams.nih.gov>.

Graves' Disease See *Thyroid Disease*.

Grief See *Death and Dying*.



▲ Anatomy of bones. When all of the cartilage in the growth plate turns to bone, growth stops. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **endocrinologist** (en-do-krin-OL-o-jist) is a doctor who specializes in treating patients with hormone-related disorders.

* **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

Growth and Growth Disorders

Growth is the normal development of children and teens as they increase in height, skeletal durability, and muscular strength. Normal growth is determined based on an average measure with a wide range of variance. Growth disorders are conditions of abnormal growth in children. The disorders may be caused by poor nutrition, abnormal levels of certain hormones involved in growth, genetic disorders of bone growth, and other diseases.

Daniel and Jeremy's Story

When Daniel turned eight, he was the smallest child in his class. Many younger children were bigger. He was worried that something was wrong with him.

His parents took him to see a pediatric endocrinologist*. The doctor took Daniel's medical history and performed blood tests, x-rays, and measurements. The doctor found nothing abnormal in Daniel's health. The doctor concluded that Daniel was normal for his age. Most children with short stature do not have a medical condition. There is a wide range of normal heights at any age in childhood.

While at the doctor's office, Daniel met Jeremy who was the same age but shorter. Jeremy felt like he was trapped inside the body of a four-year-old. "My friends teased me and called me 'Shorty,'" he said. "I felt terrible being so much shorter than my brother who was three years younger." Jeremy's parents were told that his body was not making enough growth hormone*. Daily shots of human growth hormone helped Jeremy, who grew to be taller than his brother.

Concerns about what is normal are different for boys and girls, particularly during adolescence. Girls begin puberty* and have a growth spurt before boys do. For several years many normal adolescent girls are taller than the boys in their peer group. However, many girls grow taller than they really want to be. Many adolescent girls do not want to be tall and are uncomfortable with their height even though it is within normal range. With each successive generation growing taller than the previous one, an adolescent girl can expect to be taller than her mother or aunts. While being tall may not feel good to teen girls, most tall women enjoy their height as mature women.

What Is Normal Growth?

Everyone has a different size and shape, and there is a wide range of what doctors consider normal growth. In order to monitor growth, doctors use an established range of normal heights and weights for different age groups. From the time a child first goes to the doctor, measurements of height and weight are taken. The doctor uses a growth chart to compare a child's height and weight growth rate with those of others the same age.

As a newborn, everyone starts out at about the same size. Yet, some end up short and some tall.

When developing a standard growth chart, researchers take a large number of children of different ages and make a graph of their heights and weights. The height at the fiftieth percentile means the height at which half of the children of that age are taller and half are shorter. The twenty-fifth percentile means that three-fourths (75%) of the children are taller at that age, and one-fourth (25%) are shorter. The seventy-fifth percentile means that three-fourths of the children (75%) are shorter and one-fourth (25%) are taller.

People vary greatly, and if children are between the third and ninety-seventh percentile, and if they are growing at a normal rate, they usually are regarded as normal. If children are outside these ranges (over ninety-seventh percentile or under the third percentile), doctors may look for some explanation. Most often, these children simply have inherited “short” or “tall” genes* from their parents, and they will continue to grow at a normal pace. While adult height is related to the height of a person’s parents, there is still much variation among siblings.

How Are Growth and Puberty Related?

During adolescence, a growth spurt normally occurs. Generally, growth spurts for girls start about two years earlier than growth spurts for boys. Rates of growth and change during puberty vary with the individual. Parents’ growth and puberty patterns often are passed on through their genes to their children: If one or both parents had a late puberty, then their children are more likely to reach puberty later and to experience a later growth spurt. The medical term for this “late bloomer” pattern is constitutional growth delay.

Children with precocious puberty experience early growth spurts due to the abnormally early rise in sex hormone levels in their bodies. Although initially this causes these children to grow taller than others their age, their skeletons mature more rapidly as well, often causing them to stop growing at an early age. Therefore, if precocious puberty is left untreated, it may lead to a decrease in a child’s ultimate height.

As would be expected, children with delayed puberty do not experience growth spurts at the usual age, so they lag behind in height as their peers grow rapidly and mature sexually. When puberty finally occurs for these children, on its own or as a result of treatment, they “catch up”: They may continue to grow into their late teens and may even exceed the final adult heights of some of their peers.

How Does Growth Take Place?

Growth occurs when bones of the arms, legs, and back increase in size. The long bones of the limbs have a growth plate at the end. The growth plate is made of cartilage, which is a tough, elastic tissue. Cartilage cells in the growth plate multiply and move down the bone to produce a matrix



▲ 7 foot, 8 inch (233-centimeters)-tall Azad Khan Masood, 25, shakes hand with his partner, 36 inch (91-centimeters)-tall Ali Zaman, 41, as they visit a school in Islamabad on June 1, 2001. Masood and Zaman earn their living by visiting schools. *AP Images.*

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person’s body structure and physical characteristics. Inherited from a person’s parents, genes are contained in the chromosomes found in the body’s cells.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **sickle-cell disease** is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.

* **cystic fibrosis** (SIS-tik fy-BRO-sis) is a disease that causes the body to produce thick mucus that clogs passages in many of the body's organs, including the lungs.

* **dysplasia** (dis-PLAY-zha) means abnormal growth or development.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

(tissue from which new bone is formed). These cartilage cells then die, leaving spaces. Special cells called osteoblasts (OS-tee-o-blasts), meaning bone beginners, then produce bone (by laying down the minerals calcium and phosphorus) to fill the spaces and replace the matrix. Once all the cartilage in the growth plate has been turned to bone, growth stops, which usually occurs before ages 16 to 18. An x-ray of the hand or knee can show the doctor the bone age (maturity of the bone) and how much potential growth remains.

Why Do Some Children Not Grow Normally?

Nutrition Children with poor nutrition may have poor growth. A balanced diet with adequate protein is essential for normal growth. Some parts of the world have serious problems with malnutrition, and the growth of children may be affected in these areas.

Chronic diseases Chronic diseases that may impair growth include diabetes*, congenital heart disorders, sickle-cell disease*, chronic kidney failure, and cystic fibrosis*.

Furthermore, intercurrent illnesses can bring a slowdown or stop in height increments. These involve two or more illnesses that would have little effect alone but cause serious problems when occurring together. These illnesses may be recognizable or may be too subtle for recognition.

Bone disorders One form of extreme short stature is caused by abnormal formation and growth of cartilage and bone. Children with skeletal dysplasia* are short and have abnormal body proportions. Their intelligence levels usually are normal. Most of these conditions are inherited or occur due to genetic abnormalities.

Intrauterine growth retardation If growth in the uterus is interrupted while a fetus* is forming or developing, the condition is called intrauterine (meaning within the uterus) growth retardation (IUGR). IUGR is not the same as when a baby is born prematurely. The small size of a premature infant usually is normal according to the gestational (jes-TAY-shun-al) age (or the age from conception).

Failure to grow normally in the uterus may result from a problem with the placenta (the organ that supplies nutrients and oxygen to the baby). Growth of the fetus can be affected by the mother smoking cigarettes or drinking alcohol during the pregnancy. Infections, such as German measles, may cause the problem, but sometimes the cause cannot be determined.

Failure to thrive Failure to thrive (FTT), or inadequate weight gain any time after birth, occurs frequently in infants. There are many possible causes, and the doctor must examine the child carefully. Often, the baby or child simply is not getting enough to eat. Sometimes other illnesses are

interfering with weight gain that must be treated. Severe social deprivation such as occurs in an inadequate orphanage or institution can also lead to a slowdown or stoppage in height gains.

Genetic conditions Disorders of certain chromosomes* also can cause short stature. For example, Down syndrome, a condition that occurs when a person has three copies of chromosome 21, results in arms and legs that are shorter than usual. Another genetic condition, Turner syndrome, is caused by a missing or partially missing X chromosome. The average height of adult women with Turner syndrome is between 4 feet 6 inches and 4 feet 8 inches without treatment. Adolescent girls with Turner syndrome have underdeveloped ovaries.

Marfan syndrome is a hereditary condition affecting connective tissue and is associated with tall stature. People with Marfan syndrome have very long arms and legs, eye problems, and differences in facial features. Other physical problems, such as aortic aneurysms and other heart abnormalities, also may be present. It is commonly believed that Abraham Lincoln had Marfan syndrome.

Achondroplasia

Achondroplasia (a-kon-dro-PLAY-zee-a) is a genetic condition that affects the skeletal system and causes people to be unusually short. Gene mutations (changes) that cause achondroplasia can be spontaneous (not carried by the parents), and most people with achondroplasia are born to average-sized parents. In some cases, however, achondroplasia is inherited. The most common form of short stature, achondroplasia affects about 1 in 25,000 people. The average adult height of people with achondroplasia is little more than four feet.

Unusually short stature and very short legs and arms are the most visible signs of achondroplasia. Some people are also affected by other problems, which may include the following:

- Late development of motor skills
- Increased susceptibility to middle ear infections
- Pressure on the brain and spinal cord, resulting in nerve and breathing problems
- Hydrocephalus (hy-dro-SEF-a-lus), excess fluid in the brain
- Crowding of teeth in the jaw
- Disproportionately large head with a bulging forehead
- Curvature of the spine and bowed legs
- Problems with joints

Once achondroplasia is suspected in a developing child (for instance because of outward appearance, failure to grow, or how bones look in x-rays), doctors look for the genes that cause achondroplasia. As of 2009 there was no cure for achondroplasia. Treatments involved resolving accompanying medical problems, such as surgery to alleviate joint discomfort.

* **chromosomes** (KRO-mo-somz) are threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.

Sometimes, people with achondroplasia opt for an experimental surgical procedure that lengthens the arms and legs. It involves cutting a bone, inserting a scaffold between the bone segments, and allowing new bone to grow and fill in the gaps. Limb-lengthening surgery is not a common treatment because it is controversial, painful, requires repeated surgeries, and can lead to complications, such as nerve damage.

How Do Hormones Cause Growth Disorders?

Growth is controlled by hormones (chemical messengers) from various glands. An important growth hormone is secreted by the pituitary gland. The gland looks like a peanut sitting at the base of the brain. Other hormones are also essential for growth. The thyroid gland in the neck secretes thyroxine (thy-ROX-in), a hormone required for normal bone growth. Sex hormones from the ovaries (estrogen) and testicles (testosterone) are essential for the growth spurt and other body changes that occur during puberty.

Pituitary hormones The pituitary gland is attached by a stalk to the hypothalamus, an area of the brain that controls the function of the pituitary. The anterior or front part of the pituitary gland secretes the following hormones that can affect growth:

- Growth hormone to regulate bone growth
- Thyroid-stimulating hormone to control the production and secretion of thyroid hormones
- Gonad-stimulating hormones for development of the sex glands (gonads) and secretion of sex hormones
- Adrenal-stimulating hormone to regulate the secretion of adrenal gland hormones

Too little growth hormone Sometimes the pituitary gland does not make enough growth hormone (hypopituitarism), which usually slows a child's growth rate to less than two inches per year. The deficiency may appear at any time during infancy or childhood. When doctors have ruled out other causes of growth failure, they may recommend special tests for growth hormone (GH) deficiency. Children with growth hormone deficiency are treated with daily injections of the hormone, often for several years. With early diagnosis and treatment, these children usually increase their rate of growth and may catch up to achieve average or near-average height as adults.

In pituitary dwarfism, caused by low amounts of growth hormone, the person is short but has normal body proportions. This is different from other forms of dwarfism due to genetic skeletal dysplasia. In these cases, the person with dwarfism is short, and the growth of the arms, legs, torso, and head often is out of proportion. For example, the person's arms and legs may appear relatively smaller than the head or torso.



Acromegaly results from excessive secretion of growth hormone and causes enlargement of many parts of the body, including the hands (left), fingers, toes, ears, nose, and jaw. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

Too much growth hormone Two conditions arise from excessive amounts of growth hormone (hyperpituitarism) in the body: acromegaly and gigantism. The cause usually is a benign* pituitary tumor*.

Acromegaly, a condition caused by increased secretion of growth hormone after normal growth has been completed, occurs in adults. The condition is rare, occurring in 6 out of 100,000 people. Because the adult cannot grow taller, the excess growth hormone in acromegaly causes adult bones to thicken and other structures and organs to grow larger. Usually, it does not appear until middle age, when the person notes a tightening of a ring on the finger or an increase in shoe size. Tests at that time may reveal a pituitary tumor.

Gigantism occurs when excessive secretion of growth hormone occurs in children before normal growth has stopped, which results in the overgrowth of long bones. The vertical growth in height is accompanied by growth in muscle and organs. The result is a person who is very tall, with a large jaw, large face, large skull, and very large hands and feet. Many health problems may be associated with gigantism, including heart disease and vision problems. Untreated gigantism may lead to acromegaly. Delayed puberty also may occur in this condition. Surgery or radiation can correct the problem. Hormone replacement may be necessary if there is pituitary damage from this treatment.

Too little thyroid hormone The thyroid gland looks like a butterfly at the base of the neck. One wing is on one side of the windpipe or trachea, and the other is on the other side. The wings are joined by a thin strip of thyroid tissue. The thyroid gland makes the hormone thyroxine (thy-ROX-een).

* **benign** (be-NINE) means a condition is not cancerous or serious and will probably improve, go away, or not get worse.

* **tumor** (TOO-mor) is an abnormal growth of body tissue that has no known cause or physiologic purpose. A tumor may or may not be cancerous.

The thyroid is controlled by the pituitary gland, which makes thyroid-stimulating hormone. The hormone thyroxine controls the rate of chemical reactions (or metabolism) in the body. Too much thyroxine, or hyperthyroidism, speeds up metabolism.

The opposite condition is hypothyroidism, which is caused by the body's underproduction of thyroid hormone, and this condition affects many different body processes. A child with thyroid hormone deficiency has slow growth and is physically and mentally sluggish. The lack of this hormone may be present at birth, if the thyroid gland did not develop properly in the fetus. Or the problem may develop during childhood or later in life as a result of certain diseases of the thyroid.

In most states, babies are tested for hypothyroidism at birth. Blood tests can detect the problem, and treatment usually is a daily pill that replaces the missing thyroid hormone. Early diagnosis and continuing treatment help these children grow and develop normally.

Too much cortisol The adrenal glands, which are located on top of the kidneys in the abdomen, secrete the hormone cortisol. If too much cortisol is made by the child's adrenals, or if large doses of the hormone are given to the child to treat certain diseases, Cushing's syndrome may develop. Children with this syndrome grow slowly, gain weight excessively, and may experience delayed puberty due to the effects of the abnormally large amounts of cortisol in the body.

A Complex Problem

There are many causes for growth problems. In order to detect these disorders early, it is important for doctors to track growth carefully in infants and children. Many of these conditions can be treated effectively, resulting in more normal adult heights for children with growth disorders.

▶ *See also* **Birth Defects and Brain Development • Cushing's Syndrome • Dietary Deficiencies • Down Syndrome • Genetic Diseases • Hydrocephalus • Marfan Syndrome • Metabolic Disease • Thyroid Disease • Turner's Syndrome**

Resources

Books and Articles

Kaplowitz, Paul, and Jeffrey Baron. *The Short Child: A Parents' Guide to the Causes, Consequences, and Treatment of Growth Problems*. New York: Warner Wellness, 2006.

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Roloff, Matt, and Tracy Sumner. *Against Tall Odds: Being a David in a Goliath World*. Sisters, OR: Multnomah, 1999.

Organizations

Eunice Kennedy Shriver National Institute of Child Health and Human Development. 31 Center Drive, Building 31, Room 2A32, MSC 2425, Bethesda, MD, 20892-2425. Toll free: 800-370-2943. Web site: <http://www.nichd.nih.gov>.

Human Growth Foundation. 997 Glen Cove Avenue, Glen Head, NY, 11545. Toll free: 800-451-6434. Web site: <http://www.hgfound.org>.

Little People of America/National Headquarters. P.O. Box 745, Lubbock, TX, 79408. Toll free: 888-LPA-2001. Web site: <http://www.lpaonline.org>.

March of Dimes. 1275 Mamaroneck Avenue, White Plains, NY, 10605. Telephone: 914-997-4488. Web site: http://www.marchofdimes.com/pnhec/4439_1224.asp.

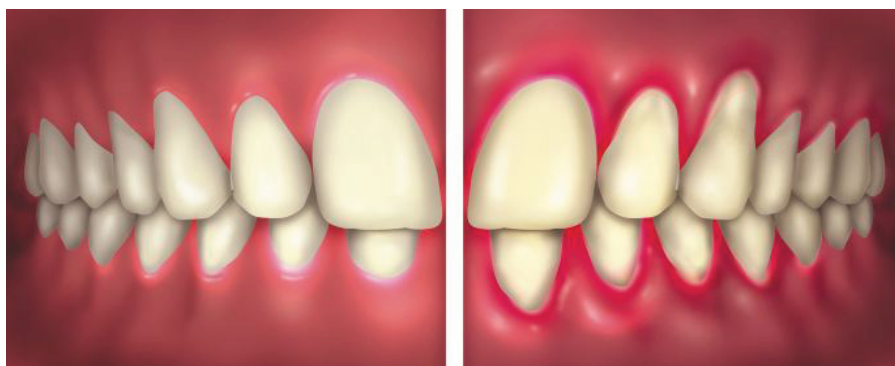
Guillain-Barré Syndrome *See Paralysis.*

Gum Disease

Gum disease is an infection caused by bacteria that affect the tissues surrounding and supporting the teeth.

What Is Gum Disease?

Like getting gray hair and wrinkles, losing teeth once seemed to be an inevitable part of growing old, and gum disease was a primary reason for the tooth loss. In the early 2000s, the number one cause of tooth



Gum disease causes the gums to become red, swollen, and inflamed. Compare the healthy gums on the left to the diseased gums on the right. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

loss in adults is still gum disease, also known as periodontal (per-ee-o-DON-tel) disease. This infection is caused by bacteria that affect the tissues surrounding and supporting the teeth. Tooth loss, however, does not occur until the disease is advanced. Fortunately, people can often prevent it by taking good care of the teeth and gums and seeing a dentist regularly.

The mildest form of gum disease is known as gingivitis (gin-gi-VY-tus). It causes the gums to become red and swollen and to bleed easily. At this stage, gum disease is still easily treatable. If gingivitis is left untreated, though, it can turn into periodontitis (per-ee-o-don-TY-tis), a more serious gum disease. In advanced periodontitis, the gums and the bone that supports the teeth can be badly damaged. The teeth may become loose and fall out, or a dentist may have to pull them out.

What Causes Gum Disease?

The cause of gum disease is plaque, a sticky film on the teeth that comes from bacteria living in the mouth. If an individual does not remove plaque each day by brushing and flossing, it will harden into a rough substance called calculus, also known as tartar. The bacteria in plaque produce chemicals that irritate the gums and cause infection. Left in place, these chemicals cause the gums to pull away from the teeth and create pockets of space between the teeth and the gums. The pockets are prime locations for infection. As the infection gets worse, the pockets get deeper, which can result in destruction of the bones in the jaw that hold the teeth in place.

Teenagers may get gingivitis, but they rarely develop periodontitis. Gum disease becomes more common as a person ages. In the United States, about half of adults 35 to 44 years old have gingivitis, and about half of people aged 55 years old and older have periodontitis. Individuals who smoke or chew tobacco, have uncontrolled diabetes, eat poorly, or have too much stress are all at greater risk for developing gum disease. Female hormones can play a part, too, and girls who are going through puberty* and pregnant women are at risk.

What Happens When People Have Gum Disease?

Symptoms Gum disease is usually painless in the early stage, but some signs do exist. These may include the following:

- Gums that bleed easily during tooth brushing or flossing
- Red, swollen, or tender gums
- Gums that have pulled away from the teeth
- Bad breath that does not go away
- Pus between the teeth and gums
- Loose teeth

- A change in the way the teeth fit together when the person bites
- A change in the fit of a partial set of false teeth

Diagnosis A dentist can check the gums for signs of disease. Besides carefully looking at the gums, the dentist can use a probe with a special rounded tip to check them. The dentist gently moves this probe around the gum line to search for pockets in the gums.

Treatment Treatment depends on the type of gum disease and how far along it is. For gingivitis, the dentist typically performs a deep cleaning of the tooth surface to remove plaque and tartar. For people with periodontitis, the cleaning usually also includes root planing, which smooths out any rough spots on the root. These rough spots are havens for bacteria. This two-part cleaning helps the gum tissue heal and reattach to the tooth surfaces.

If the pockets are too deep to clean inside, the dentist may need to perform surgery to shrink the pockets. If part of the bone supporting the teeth has been destroyed, the person may need further surgery. Such surgery can reshape or rebuild the bone that has been lost. Dentists also have other ways of treating gum disease. A dentist may recommend that patients with severe gum disease—and sometimes those with gingivitis—rinse with a solution called chlorhexidine gluconate. This solution curbs swelling and redness of the gums and reduces the number of bacteria in the mouth. Another drug for treating severe gum disease doxycycline hyclate, which is usually taken in tablet form, helps prevent the destruction of the teeth and gums.

How Can Gum Disease Be Prevented?

Brushing and flossing the teeth helps remove plaque, and in the early stage of gum disease, brushing twice a day and flossing every day usually cures the problem. Guidelines include the following:

- Using a soft-bristled toothbrush
- Picking a brush that feels comfortable and will reach all the teeth, even those in back
- Replacing the brush when the bristles show signs of wear
- Brushing with a short, gentle, back-and-forth motion
- Remembering to brush the inside surfaces, the back teeth, and the tongue
- Flossing to reach plaque between the teeth and under the gum line, where a brush cannot get.

In addition, individuals should see a dentist regularly for checkups and professional cleanings.

▶ See also **Abscesses • Bacterial Infections • Canker Sores (Aphthous Ulcers) • Cavities • Diabetes • Halitosis**



▲ Long-term gum disease causes the gums to pull away from the teeth. *Biophoto Associates/Photo Researchers, Inc.*



▲
Man suffering from gynecomastia. *John Radcliffe Hospital/Photo Researchers, Inc.*

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

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Books and Articles

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Organization

American Academy of Periodontology. 737 N. Michigan Avenue, Suite 800, Chicago, IL, 60611-6660. Telephone: 312-787-5518. Web site: <http://www.perio.org/consumer>.

American Dental Association. 211 East Chicago Avenue, Chicago, IL, 60611-2678. Telephone: 312-440-2500. Web site: <http://www.ada.org>.

National Institute of Dental and Craniofacial Research. 45 Center Drive, MSC 6400, Bethesda, MD, 20892-6400. Telephone: 301-496-4261. Web site: <http://www.nidcr.nih.gov>.

Gynecomastia

Normally, women have breasts and men do not. However, when the breast tissues, or mammary glands, of men overdevelop, along with (sometimes) the swelling of the nipples, the condition is called gynecomastia. When gynecomastia does occur, it usually happens in male babies, teenage males, and older men. Such abnormally large breasts often secrete milk from the nipples. The cause of gynecomastia was not fully understood as of 2009. However, one of the prime causes is an imbalance of sex hormones.*

What Are Possible Causes of Gynecomastia?

Gynecomastia is caused primarily by an overabundance of the female hormone estrogen or an undersupply of the male hormone testosterone. However, in 25 percent of the cases, the cause is unknown. More than one-half of male newborn babies have the condition for two to three weeks after being born. Excess estrogen in the blood system of their mothers causes this temporary problem. About one in three adolescent boys around the age of thirteen or fourteen years is temporarily afflicted with gynecomastia because of hormonal changes due to puberty*. Very tall or obese boys are more likely to have gynecomastia. For nine out of ten boys, breast size reduces partially within months and disappears totally within a few years.

Elderly men, especially those who are overweight or obese, sometimes have gynecomastia due to complications from cancers of the liver, kidney,

lung, pituitary gland, adrenal glands*, or testicles*. Older men can get the condition due to chronic conditions such as cirrhosis* of the liver or an overactive thyroid. Other causes include spinal cord injuries, chest wall injuries and, even, starvation.

Males of any age can acquire gynecomastia due to excessive use of alcohol, medications, and illicit drugs. Medicines that can cause gynecomastia include steroids such as prednisone; ulcer medicines such as cimetidine; heart medicines such as digitalis; and AIDS* (acquired immune deficiency syndrome) medications such as those used with highly active antiretroviral therapy. Other medicines that may cause the problem are ulcer medicines such as cimetidine; epilepsy* medicines such as phenytoin; antiandrogen drugs such as flutamide; anti-anxiety and anti-depressant medicines such as diazepam (Valium); and various chemotherapy* drugs.

Illicit drugs, which can possibly contribute to the disorder, include marijuana, amphetamines, anabolic steroids/androgens, and heroin. Obesity can also bring on gynecomastia because being overweight increases production of the female hormone estrogen. Males can get the condition when using large amounts of lotions and oils containing tea tree oil or lavender.

What Are the Symptoms and How Is Gynecomastia Diagnosed?

Breast enlargement is the obvious symptom. The breasts can also feel hard or rubbery. Young males may notice a small breast bud on either side, or both sides, of the breast. These usually disappear within a year or so.

Gynecomastia is diagnosed with a physical examination that pays attention to the breast tissue, abdomen, and genitals. In addition, the physician will compile a medical history. Sometimes the doctor orders chest x-rays, testicular ultrasound* scans, computerized tomography* scans, or magnetic resonance imaging* scans. Physicians often perform a biopsy with the presence of a large breast lump, which is tender or firm, especially if breast cancer has occurred within the family.

How Is Gynecomastia Treated?

Gynecomastia is normally not treated for males younger than their early twenties because it generally goes away on its own. However, if it does not, hormonal treatments may be necessary to lower estrogen levels, raise testosterone levels, or both. Surgery is an elective cosmetic (although not medically necessary) option, which includes either liposuction to remove breast fat (but not breast tissue) or mastectomy* to remove breast tissue. If certain medicines have caused gynecomastia, then the individual is advised to discontinue using them. In most cases, gynecomastia is not life threatening or physically harmful, but it can be an early indicator of a serious medical condition. Emotional problems (such as embarrassment) can sometimes result, especially for teenage boys who may be teased by the appearance of enlarged breasts.

Reducing the risk of Gynecomastia

To minimize the chance of contracting gynecomastia, males should maintain a healthy lifestyle. Doing so entails avoiding the use of illicit drugs; stopping, or at least minimizing, the intake of alcohol; maintaining a healthy weight; and reviewing all medications, both pre-scribed and over-the-counter, with their family doctor.

- * **adrenal glands** (a-DREEN-al glands) are the pair of endocrine organs located near the kidneys.
- * **testicles** (TES-tih-kulz) are the paired male reproductive glands that produce sperm.
- * **cirrhosis** (sir-O-sis) is a condition that affects the liver, involving long-term inflammation and scarring, which can lead to problems with liver function.
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **epilepsy** (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.
- * **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.
- * **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **computerized tomography** (kom-PYOO-fer-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

* **mastectomy** (mas-TEK-to-mee) is the surgical removal of the breast.

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Organization

Gynecomastia. 2917 McClure Street, Oakland, CA, 94609. Telephone: 510-627-0090. Web site: <http://www.gynecomastia.org>.

H

Hair and Hair Loss

Hair loss refers to the partial or total loss of hair from part of the body where normally it grows.

Hair Today, Gone Tomorrow

Hair is said to be a person's crowning glory. Most of the hair on a person's head is growing constantly. Scalp hair grows about half an inch per month, although this growth rate slows as people age. For each individual hair, the growth stage lasts for two to six years. It is followed by a resting stage, lasting two to three months, during which the hair still is attached but no longer grows. After the resting stage, the hair falls out, and a new hair starts to form. Hair loss occurs when people lose more hairs than normal or when new hairs do not grow to replace the lost ones.

How Does Hair Grow?

Hair is made of keratin (KER-a-tin), the same protein that makes up nails and the outer layer of skin. The part of a hair that shows is called the hair shaft. Below the skin is the hair root, which is enclosed in the follicle (FOL-i-kul), a tiny, bulb-shaped structure. The root is alive, but the shaft is composed of dead tissue made by the follicle.

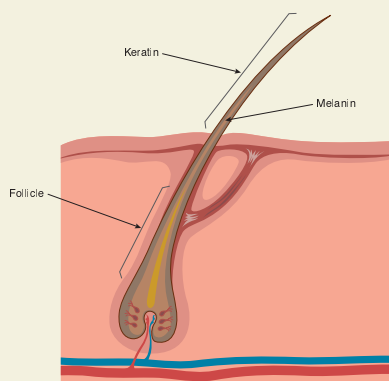
Hair color is inherited and is determined by multiple genes. The color comes from two types of pigment in the hair: pheomelanin (feo-MEL-an-in) and eumelanin (u-MEL-an-in). Pheomelanin ranges from yellowish reddish in color. Eumelanin is either brown or black. The relative amounts of these two pigments determine hair color.

What Is Hair Loss?

Hair loss refers to the partial or total loss of hair from part of the body where it normally grows, especially the scalp. Alopecia (AL-o-PEE-sha) is the medical term for baldness, which is the loss of all or a significant part of the scalp hair. Hair for humans is mostly decorative. Losing hair is not a medical problem in itself, although in some cases, it can be a sign of illness. Many people are perfectly comfortable being bald. However, others feel that hair loss makes them less attractive.

What Causes Hair Loss?

Hair loss is extremely common. About half of all men and one-fourth of all women over age forty experience some thinning of the hair on the



▲ A strand of hair showing the follicle, melanin, and keratin. *Illustration by Bryon Thompson. Reproduced by permission of Gale, a part of Cengage Learning.*

- * **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **menopause** (MEN-o-pawz) is the end of menstruation.
- * **immune system** is the body system that fights disease.
- * **thyroid gland** (THY-roid GLAND) is located in the lower part of the front of the neck. The thyroid produces hormones that regulate the body's metabolism (me-TAB-o-LIZ-um), the processes the body uses to produce energy, to grow, and to maintain body tissues.
- * **fungus** (FUN-gus) is any organism belonging to the kingdom Fungi (FUN-ji), which includes mushrooms, yeasts, and molds.
- * **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.
- * **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

head. This is normal and is not related to any medical problem. However, hair loss also can occur for other reasons. Following are some specific hair loss conditions and their causes.

Common baldness At least 95 percent of scalp hair loss is caused by a combination of age, genetics, and changes in the level of hormones* called androgens (AN-dro-jenz). This type of hair loss is called androge-netic (AN-dro-je-NET-ik) alopecia. In men, the condition usually starts with a hairline that keeps moving higher, followed by a thin or bald spot that appears on top of the head. Eventually, all that may be left is a horse-shoe-shaped fringe of hair around the sides and back of the head, which is known as male-pattern baldness. In women, the condition usually leads to thinning of the hair over the whole head, which is especially common after menopause*. It is known as female-pattern baldness.

Alopecia areata Alopecia areata (ar-ee-AY-ta) can develop in people of any age, including children. This condition leads to sudden hair loss, often in round patches on the scalp about the size of a coin or larger. In severe cases, the hair may fall out from the whole head, including the eyebrows and beard, or the whole body. Alopecia areata is thought to be caused by a problem with the immune system* in which immune cells attack the body's own follicles, for reasons that are not clear. People who develop alopecia areata are usually otherwise in good health. The hair often grows back on its own within 6 to 24 months.

Medical conditions and hair loss Several medical conditions and treatments can cause hair loss in people of all ages and both sexes. Sometimes, people notice a lot of hair falling out within one to three months after having a high fever, a severe infection, or a major operation. Some women also lose a large amount of hair within a few months after giving birth due to changing hormone levels following pregnancy. Changing hormone levels are also why babies lose a great deal of their hair during the first six months of life. In addition, an overactive or underactive thyroid gland* can cause hair loss, as can ringworm (a fungal* infection) of the scalp.

People with cancer often lose their hair during chemotherapy*. Other medications may cause hair loss as well, including blood thinners, birth control pills, and medicines for depression* and high blood pressure. Fortunately, this kind of hair loss usually is temporary. Typically, the hair grows back once the body adjusts, the disease is treated, or the medicine is stopped.

Trichotillomania Trichotillomania (trik-o-til-o-MAY-nee-a) is a psychological* disorder in which people pull out their own hair, leading to noticeable hair loss. The most commonly affected spots are the scalp, eyebrows, and eyelashes. This nervous habit may be a reaction to emotional stress or anxiety. It often begins in childhood, although it occurs in adults, too. The hair grows back once the hair pulling is stopped.

Poor diet When people do not get enough protein from their diet, the body may try to save protein by shifting hairs from the growing stage to the resting stage. As a result, a large number of hairs may fall out two to three months later, when the resting stage ends. Lack of iron also can lead to hair loss. Eating a healthy diet or taking iron pills can prevent or reverse this problem.

Improper hair care Chemicals such as dyes, bleaches, straighteners, and permanents can damage the hair if used too often or left on too long. Even shampooing, brushing, and combing can harm the hair if done too roughly. Hairstyles that pull the hair, such as tight ponytails and braids, also put a lot of stress on it. Mistreating the hair in any of these ways can lead to temporary hair loss.

How Is the Cause of Hair Loss Identified?

People who experience sudden, fast, or unusual hair loss should see a physician, who can identify the cause. In some cases, doctors may decide that the baldness is simply due to aging. In other cases, doctors may check the scalp and take samples from it to look for signs of disease. In addition, doctors may pluck several hairs from one spot on the head. These hairs then are examined under a microscope to see whether they are in the growing or resting stage. The percentage of hairs in each stage can provide another clue to the cause of the hair loss.

How Is Baldness Treated?

Hair loss due to alopecia areata usually clears up on its own with time. In the meantime, the condition sometimes is treated with corticosteroid* medicines that are rubbed onto the skin or taken by mouth or in an injection.

Common baldness due to aging does not need treatment for medical reasons. However, some people seek help, because they are concerned about the way their appearance. There are several treatment options.

Hairstyles, wigs, and hair additions Simply getting the right haircut and styling the hair in a flattering way can make a big difference with thinning hair or scattered hair loss. For more widespread hair loss, wigs are an easy solution. Several kinds of partial wigs, known as hair additions, are available as well. They can be attached to the remaining hair or anchored to the scalp with special glues or fasteners.

Medication Two medications are approved in the United States for regrowing lost hair or preventing further hair loss: minoxidil (mi-NOK-si-dil) and finasteride (fi-NAS-ter-ide). Minoxidil (Rogaine) can be bought without a prescription. It is a liquid that is rubbed onto the scalp. Only about one-fourth of men and one-fifth of women who use regular-strength minoxidil regrow a significant amount of hair, and it may take several months before these results are noticeable. The new hair

* **psychological** (SI-ko-LOJ-i-kal) refers to mental processes, including thoughts, feelings, and emotions.

* **corticosteroid** (KOR-ti-ko-STER-oid) is one of several medications that are prescribed to reduce inflammation and sometimes to suppress the body's immune response.

Hair-Raising Facts

- Natural blondes have about 140,000 hairs on their head, on average. Brunettes have about 105,000 hairs, and redheads have about 90,000 hairs.
- At any given time, about 90 percent of the hairs on a person's head are growing. About 10 percent of the hairs are resting, getting ready to fall out.

A Hairy Situation

Some people worry about having too little hair. Others worry about having too much. Hirsutism (HIR-soot-iz-uhm) is the medical term for excessive hair growth on the body and face, especially in women. Many women, particularly those of southern European and Middle Eastern descent, develop quite a bit of body and facial hair when they reach puberty. This is perfectly normal, and in both women and men, the amount of body and facial hair often increases slowly with age.

If a person does not like the way the hair looks, it can be bleached or removed in a variety of ways. However, sometimes there is an increase in the growth of coarse, dark facial and body hair over a period of weeks or months. This can be a sign of a medical problem in which the level of androgens in the blood is abnormally high, as in certain disorders of the ovaries and adrenal glands.

Some medicines, such as steroids and certain blood pressure drugs, also may cause the growth of body and facial hair. In addition, anorexia nervosa (AN-o-REK-se-a ner-VO-sa), an eating disorder that involves self-starvation and often occurs in teenage girls, may cause an increase in fine body hair.

often is thinner and lighter in color than the original hair. Also, any hair growth that occurs ceases once the treatment is stopped.

Finasteride (Propecia) is a pill sold by prescription. This drug is approved for sale only to men, because it has not been shown to work in women, and it can cause birth defects if used by pregnant women. More than four out of five men who use finasteride have slowing of their hair loss, and more than three out of five have some hair regrowth. As with minoxidil, positive effects can take months to see.

Surgery Hair transplantation (trans-plan-TAY-shun) surgery is a lasting but expensive and often painful solution to hair loss. When done for cosmetic reasons, it normally is not covered by medical insurance. The operation involves cutting tiny plugs of hair-bearing scalp from parts of the head where hair still grows, and then reattaching the plugs to bald parts of the head. No new hair is added. Existing hair simply is moved from one spot to another. Because hundreds or even thousands of the tiny plugs must be moved to get good results, the procedure usually is done in several surgery sessions that are months apart. Sometimes, a larger flap of skin is moved instead of many tiny plugs.

Scalp reduction surgery is another procedure, which may be combined with hair transplantation. It involves removing a bald area of scalp from the top of the head and then stretching the hair-bearing scalp to cover the area. Hair surgery is performed by dermatologists and cosmetic and plastic surgeons.

Coping with Hair Loss

Hair loss can be upsetting, even when it is temporary. Hairstyles, wigs, hair additions, hats, and bandannas can help hide hair loss if it makes a person uncomfortable. For many people, hair loss simply does not matter. Others wear their baldness with pride. Many even shave any remaining hair if the hair loss is patchy.

▶ **See also** **Cancer: Overview** • **Dietary Deficiencies** • **Fungal Infections** • **Ringworm**

Resources

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Organizations

American Academy of Dermatology. P.O. Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: http://www.aad.org/public/publications/pamphlets/common_hairloss.html.

American Hair Loss Council. 30 South Main Street, Shenandoah, PA, 17076. Web site: <http://www.ahlc.org>.

National Alopecia Areata Foundation. 14 Mitchell Boulevard, San Rafael, CA, 94930. Telephone: 415-472-3780. Web site: <http://www.naaf.org>.

Halitosis

Halitosis is bad breath.

What Causes Halitosis?

Halitosis is the medical name for bad breath. Often people with halitosis do not know that they have it. Halitosis can be caused by many factors:

- Eating certain strong smelling foods, such as garlic and onion, which have odors that are absorbed into the bloodstream, transferred into the lungs, and then released when a person exhales
- Having poor oral hygiene habits, which leave food particles in the mouth to collect odor-causing bacteria
- Tooth decay
- Gum disease*
- Smoking
- Sinus or respiratory infections
- Unusual dryness of the mouth, a condition called xerostomia (ze-ro-STO-me-a)
- Medical disorders, such as liver disease, kidney disease, or diabetes
- Certain medications
- Dieting and ketone* build-up in the body

How Is Halitosis Treated and Prevented?

Treatment for halitosis depends on its cause. Dentists can identify oral causes, which account for most cases of halitosis, and develop an appropriate treatment plan. For halitosis due to gum disease, dentists may refer people to periodontists (gum specialists). If a person has a healthy mouth but still has halitosis, a dentist may also recommend a visit to a doctor. The doctor can then try to determine the cause of the bad breath and select treatment options.

Good dental hygiene is essential for preventing halitosis. Good dental hygiene includes the following steps:

- Brushing teeth at least twice every day
- Brushing the tongue

* **gum disease** is an infection caused by bacteria that affect the tissues surrounding and supporting the teeth.

* **ketones** (KEE-tones) are the chemicals produced when the body breaks down fat for energy.

* **stimulus** (STIM-yoo-lus) is an agent in the environment that excites a response or reaction. A stimulus might cause a person to function, become active, or respond. The plural form is stimuli.

- Using dental floss every day to remove pieces of food that remain caught between teeth even after brushing and cause an accumulation of bad-smelling bacteria.
- Visiting a dentist's office for a regular check-up and cleaning

Some dentists also recommend that their patients scrape the tongue as part of their regular cleaning routine. In this quick, painless procedure, an individual drags a metal or plastic scraper over the tongue to mechanically remove bacteria that might cause odor.

People who wear dentures must take precautions, too. They should take out their dentures every night and clean them well before putting them in again.

▶ See also **Bacterial Infections • Gum Disease**

Resources

Organization

American Dental Association. 211 East Chicago Avenue, Chicago, IL, 60611-2678. Telephone: 312-440-2500. Web site: <http://www.ada.org>.

Hallucination

A hallucination (ha-LOO-sin-A-shun) is something that a person, while awake, perceives as real but that is not actually caused by an outside stimulus.*

Is It All in Their Heads?

A good magician can make audience members think that they are seeing something they really are not, such as an animal disappearing into thin air or a bouquet appearing from under a handkerchief. These tricks are often referred to as illusions. The magician knows how to perform the illusion so that the viewer's eyes and brain are likely to misinterpret what is really happening.

Hallucinations are different from illusions. Illusions are mistaken perceptions of real events. During an hallucination, the person is not reacting to something real in the outside world. The brain creates its own stimulation instead of relying on input from the five senses. In other words, the entire experience, its cause and its response, takes place inside the brain.

Hallucinations occur when a person is conscious or awake, so although dreams may cause people to think that what they are dreaming is real, these are not true hallucinations. However, a large percentage of the population reports having brief hallucinations when they are just at

the edge of consciousness while falling asleep or waking up. These are true hallucinations, and they are considered normal and harmless.

Hallucinations can involve any of the five senses: sight, hearing, taste, smell, and touch. They can appear in the form of seeing visions, hearing voices or music, smelling odors that are not really present in the environment, distorting the taste of food, or feeling as if something is crawling over or touching either the skin or the interior of the body. These sensations can be brief or extended. Often they are quite vivid and seem absolutely real to the person who experiences them. In people with mental illness, hallucinations often are accompanied by delusions. A delusion is a strong belief about something that is clearly false. For example, a delusional person might believe that the television is sending out signals that control his brain and cause him to hear voices.

What Triggers Hallucinations?

Hallucinations can occur when a person is mentally ill, uses certain drugs, is under prolonged stress, is exhausted or sleep deprived for a long time, experiences extremely high fever, or has certain nervous system diseases. People who are blind or deaf may also have hallucinations due to lack of sensory input from the eyes or ears. Scientists are not exactly sure why some people hallucinate, but they do know that nerves in specific areas of the brain responsible for interpreting sensory information are activated on their own without outside stimuli when a person hallucinates.

The most common hallucinations are those that accompany psychotic (sy-KOT-ik) disorders*, such as schizophrenia*. About three-fourths of people who are treated for schizophrenia experience hallucinations. These hallucinations can reach the point where the sense of reality is so impaired that a person cannot function normally. Along with hallucinations, people with psychotic disorders may experience delusions, incoherent speech, and agitated behavior, but they usually are not aware of their altered mental state. They lose touch with aspects of reality, which affects their thinking and behavior. They often report hearing voices that tell them that they are bad or that they should act in a certain way. For example, the serial murderer Son of Sam (David Berkowitz) claimed to have repeatedly heard voices in his head telling him to kill. People with schizophrenia also tend to see disturbing visions. Medications can help with hallucinations caused by schizophrenia, and in some cases, people can be trained to recognize and even control their hallucinations. This level of improvement usually requires intensive therapy.

Anxiety* disorders and intense emotions or a highly traumatic experience also can generate hallucinations. For example, people who experience the death of a loved one often report hallucinations in which they see that person or hear the person's voice. Similarly, people who undergo extreme abuse sometimes report later visions of their abuser. Soldiers or others with post-traumatic stress disorder*

Phantom Limb Syndrome: A Tactile Hallucination

People who have undergone amputation of a limb or other appendage help researchers understand what may happen in the brain when it hallucinates. Many of these patients report that they feel like the missing body part is still there, even though they know the arm, leg, hand, or other body part is gone. For example, it is common for people who lose a leg to try to stand up and walk after their surgery. Feeling like an amputated limb is still present is called phantom limb syndrome, and there are two main theories about why it happens. It may be that the nerve cells in the brain area that used to receive signals from that limb go into overdrive and stimulate themselves because that input has disappeared. Another theory is that the brain is programmed for a body that is whole and intact and in the right place so that when certain signals are missing, spontaneous nerve cell activity takes over. In either case, the brain is compensating for the lack of sensory input.

* **psychotic (sy-KOT-ik) disorders** are mental disorders, such as schizophrenia, in which the sense of reality is so impaired that a person can not function normally. People with psychotic disorders may experience delusions, hallucinations, incoherent speech, and agitated behavior, but they usually are not aware of their altered mental state.

* **schizophrenia** (skit-so-FREE-nee-ah) is a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors, which distort their view of reality.

- * **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.
- * **post-traumatic stress disorder** (post-traw-MAT-ik STRES dis-OR-der) is a mental disorder that interferes with everyday living and occurs in people who survive a terrifying event, such as school violence, military combat, or a natural disaster.
- * **flashbacks** are intensely vivid, recurring mental images of a past traumatic event. People may feel or act as if they were reliving the experience.
- * **hallucinogenic drugs** are substances that cause a person to have hallucinations.
- * **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.
- * **Alzheimer's (ALTS-hy-merz) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.
- * **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.

may also experience hallucinations as flashbacks* to especially traumatic events.

Hallucinogenic drugs* such as the street drugs ecstasy, LSD, mescaline, peyote, and psilocybin (magic mushrooms) are artificial sources of brain overstimulation. They excite the central nervous system* so much that certain areas of the brain produce visions, sounds, and feelings that are not based in reality. Some hallucinogenic drug users continue to experience bizarre visions and sounds even long after they stop using the drug. Some prescription drugs also can produce hallucinations as an unwanted side effect.

That the brain may compensate for a lack of sensory input helps to explain why people who are deaf or blind or who are placed in extended solitary confinement often experience hallucinations. Under such circumstances, the different areas of the brain that were used to receiving signals through the senses start to stimulate themselves. Reduced sensory input also may explain why people tend to “see” ghosts at night instead of during the day; the brain is more likely to create the vision of ghosts when other visual stimuli are absent.

Some nervous system diseases such as Alzheimer's (ALTS-hy-merz) disease* may also cause hallucinations. Brain damage, brain tumors, or lesions* in the brain also may stimulate the production of hallucinations.

▶ See also **Anxiety and Anxiety Disorders • Delusions, Delusional Disorders, and Paranoia • Psychosis • Schizophrenia**

Resources

Books and Articles

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Organization

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.healthyminds.org/factsheets/LTF-Schizophrenia.pdf>.

Hangover

A hangover, also known as veisalgia (vy-SAL-gee-uh), occurs after a person becomes intoxicated due to drinking too much alcohol. Hangovers may have several unpleasant symptoms, including headache, sensitivity to sound, jitteriness, tiredness, and nausea.

What Is a Hangover?

When individuals drink too much alcohol, they may wake up the next morning with a hangover. Generally, the more alcohol they drink, the worse their hangover is. The amount of alcohol that brings on a hangover varies from person to person. Frequently an amount of alcohol that causes a hangover in a person who is a light drinker may not cause one in a person who is a frequent, heavy drinker. Frequent and heavy drinkers develop a tolerance to alcohol.

However, heavy alcohol consumption can lead to many serious health problems. In the near term, alcohol poisoning is a drug overdose, which can lead to persistent vomiting, changes in mental status, coma*, and death. Over the long term, heavy drinking can lead to cirrhosis* of the liver, which can be fatal.

Regular consumption of alcohol can also lead to alcoholism, a progressive long-lasting dependency on alcohol. Alcoholics have a physical craving for alcohol. Chronic alcohol consumption can lead to many health and other problems. Alcohol consumption can affect people's work life, their finances, and their relationships with family and friends. Habitual drinkers who drive are likely to experience legal problems with traffic tickets or accidents. They may lose their license to drive. The court can order them to attend driver responsibility sessions or attend meetings of Alcoholics Anonymous. The best way to prevent alcoholism is to avoid drinking alcohol or to drink infrequently and then only small amounts. Restricting alcohol consumption avoids a lot of potential problems, and it prevents having a hangover the morning after.

What Are the Symptoms of Hangover?

Typically, hangover symptoms begin a few hours after individuals stop drinking, often beginning the following morning and continuing for several hours. Symptoms may include one or more of the following:

- Mild to severe headache
- Jitteriness
- Sensitivity to sound and sometimes to light
- General feeling of being sick
- Tiredness
- Dry mouth and eyes, and a desire to drink water
- Poor coordination
- Drowsiness
- Trouble sleeping and/or concentrating
- Loss of appetite
- Stomachache, nausea, and/or vomiting
- Muscle aches
- Diarrhea

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **cirrhosis** (sir-O-sis) is a condition that affects the liver, involving long-term inflammation and scarring, which can lead to problems with liver function.

- Increased blood pressure and a higher heart rate
- Feelings of anxiousness
- Heightened irritability
- Sweating
- Dizziness and/or vertigo
- Trembling or shaking

Many people with a hangover also feel strongly repulsed by a mere thought of alcohol.

A study in 2003 showed that women appear to get much more severe hangover symptoms than men do. The study suggested that because in general women weigh less than men, women are more easily intoxicated and have more troublesome hangovers.

What Causes a Hangover?

The hangover is related to do the hormone vasopressin (vay-zo-PRESS-in). Drinking alcohol puts alcohol into the bloodstream. The alcohol the release of antidiuretic hormone from the posterior pituitary gland. Normally, vasopressin signals the kidneys to send water back into the body where it can be used. When alcohol blocks vasopressin production, however, the kidneys send most of the water to the bladder, which then releases it as urine. This water comes from the body itself as well as from the alcoholic beverage. In fact, drinkers' bodies release up to four times more water than is present in the beverages they consume. For this reason, people who are drinking alcoholic beverages urinate frequently.

The water imbalance causes many of the symptoms of a hangover. Some of these occur because urine releases both sodium and potassium, along with water. When the body loses too much sodium and potassium, its muscles and nerves do not function correctly. This dysfunction results in headaches, tiredness, and nausea. In addition, alcohol-induced water loss can cause a dry mouth.

Besides its effects on vasopressin and the subsequent water loss, alcohol also affects the liver. The liver regulates blood sugar, the body's primary fuel. Blood sugar is also known as glucose (GLUE-cose). The liver regulates glucose by storing some of it in a slightly different form, called glycogen (GLY-co-jen). When individuals drink alcohol, the alcohol breaks down the glycogen in the liver and converts in into glucose, but instead of moving the glucose into the bloodstream for the body's cells to use, the glucose goes into the urine and then leaves the body. This reduces the amount of energy available to the body and causes hangover symptoms such as fatigue, general weakness, and poor coordination.

In addition, most alcoholic beverages contain congeners, which are substances that are generally added for flavor or color. Certain types of alcohol contain higher amounts of congeners, which may contribute to hangover symptoms. Dark liquors, such as brandy and whisky, have more congeners than clear ones, such as vodka and gin.

Can Hangovers Be Prevented?

Avoiding alcohol is the surest way to prevent hangovers. People who do drink can also avert hangovers by taking certain steps. One way is to drink only on a full stomach, to drink slowly, and to consume moderate amounts of alcohol. Drinking several eight-ounce glasses of water prior to going to sleep may help relieve the dry mouth and dehydration*. The National Institute on Alcohol Abuse and Alcoholism recommends a maximum of one drink per day for women and two per day for men. The institute defines one drink as a 12-ounce beer, a 4-ounce glass of wine, or a mixed drink with 1.5-ounces of liquor (80-proof distilled spirits). Another suggestion is to drink a glass of water after every alcoholic beverage. Doing so helps to replace some water loss, to reduce dehydration, and to limit the amount of alcohol consumed by exchanging some of those alcoholic drinks with glasses of water. Finally, choosing alcohol with lower congener content may also help to prevent hangover.

How Is Hangover Treated?

Frequently recommended hangover treatments include the following:

- Staying in bed and getting some rest
- Eating fruits or honey, and drinking fruit juice. These contain a type of sugar called fructose (FROOK-tose), which some studies indicate may help to remove the alcohol from the body more quickly.
- Eating salty foods to replace the body's lost minerals

When treating hangover, some people take aspirin for headache. They should not, however, take acetaminophen*, which appears in many over-the-counter pain medications and which in the presence of alcohol can be harmful to the liver. People who are frequent, heavy drinkers should avoid acetaminophen at all times. The National Institute on Alcohol Abuse and Alcoholism also cautions that people who are taking any medications should talk to a doctor or pharmacist before drinking alcohol, because many medications interact harmfully with alcohol and can result in increased risk of illness, injury, or death. The institute also notes that many medications can make a person more susceptible to the effects of alcohol, so drinking while taking these drugs may be dangerous.

▶ See also **Alcoholism • Cirrhosis of the Liver**

Resources

Books and Articles

The Hangover Companion: A Guide to the Morning After. London: Michael O'Mara Books, 2006.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.



▲
A researcher weighs a mouse caught in a trap near Placitas, NV, during a 1996 study of hantavirus. Hantavirus is carried by rodents such as deer mice and spread through their urine or feces. *AP Images.*

* **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. Viruses can only reproduce within the cells they infect.

Organizations

Discovery Communications. One Discovery Place, Silver Spring, MD, 20910. Telephone: 240-662-2000. Web site: <http://health.howstuffworks.com/hangover.htm>.

National Institute on Alcohol Abuse and Alcoholism. 5635 Fishers Lane, MSC 9304, Bethesda, MD, 20892-9304. Telephone: 301-443-3860. Web site: <http://www.niaaa.nih.gov/FAQs/General-English/default.htm>.

Hansen's Disease *See Leprosy (Hansen's Disease).*

Hantavirus Pulmonary Syndrome

Hantavirus pulmonary syndrome (HAN-tub-vy-rus PUL-mo-nar-ee SIN-drome) is a lung disease that causes respiratory distress (breathing difficulty) and, in some cases, death. Hantavirus, the virus that causes the disease, is carried by rodents.

What is Hantavirus Pulmonary Syndrome?

Hantavirus pulmonary syndrome, or HPS, is a potentially deadly disease that attacks the lungs. A family of viruses* called hantavirus causes HPS. These viruses live in rodents but do not make them sick. The Sin Nombre virus (SNV) hantavirus causes most HPS in the United States, but some cases have come from the Bayou, the New York, and the Black Creek Canal viruses.

Rodents, usually mice and rats, shed hantavirus in their saliva, urine, and droppings. Humans catch the virus when they disturb dried droppings (by sweeping, for example) and inhale the particles that are sent into the air. People can also contract hantavirus by touching an infected animal or its droppings and then touching their nose or mouth. Eating food or drinking water contaminated by rodent droppings is another way to contract the infection. Rodent bites, although rare, can also spread the disease.

The most common carriers of hantavirus are deer mice (found almost everywhere in North America), cotton rats and rice rats (found in the southeastern United States and Central and South America), and white-footed mice (found in most parts of the United States and Mexico). Cats and dogs do not carry hantavirus, and they cannot catch it from rodents. However, cats and dogs can spread hantavirus to humans if they bring an infected rodent into a home or other buildings where people live or work.

Is Hantavirus Pulmonary Syndrome Common?

HPS is rare. Health authorities first recognized the disease in the United States in 1993, and the Centers for Disease Control and Prevention (CDC) recorded only 465 reported cases through early 2007. Although HPS occurs in people throughout North and South America, most cases in the United States appear in the Southwest and in places that have large rodent populations.

People of every age, sex, and race can contract HPS, but it is not contagious and cannot be spread by sneezing, coughing, kissing, or having other bodily contact.

What Are the Symptoms of Hantavirus Pulmonary Syndrome?

The first symptoms of HPS usually appear one to five weeks after a person has been exposed to the virus. HPS can be difficult to diagnose because the early signs, such as fever, tiredness, and body aches, are similar to those of the flu. About half of the people who catch HPS may also experience dizziness, chills, nausea, vomiting, abdominal* pain, or headaches.

From two to five days after the first symptoms, a person infected with hantavirus starts coughing and experiences shortness of breath. The disease quickly becomes more severe, and people who do not receive immediate treatment may become extremely ill and go into shock*, needing intensive care in a hospital.

How Do Doctors Diagnose Hantavirus Pulmonary Syndrome?

A doctor may suspect HPS if a person with flu-like symptoms complains about difficulty breathing, especially if the person has been exposed to rodents or rodent droppings. To confirm the diagnosis, the doctor uses blood tests to see if the person has developed antibodies* to a strain* of hantavirus. Chest x-rays or ultrasound* images can help the doctor check the condition of a person's heart and lungs.

How Is Hantavirus Pulmonary Syndrome Treated?

HPS is a serious disease, and someone who has it needs treatment in a hospital's intensive care unit. There the patient might be given fluids, have his or her blood pressure monitored, and have a tube inserted in the throat to make it easier to breathe. Because a virus causes HPS, antibiotics do not work against it, although an antiviral drug may help some patients. According to the CDC, as of the early 2000s, 38 percent of reported cases of HPS have been fatal.

Doctors know more about the disease and are quicker to get patients into treatment. The earlier people with HPS receive help, the better their chances of survival. Recovery from HPS is fairly fast, although patients may feel worn out for several months.

Camp with Care

The great outdoors is home for most rodents, and many of them carry hantavirus. Campers can help keep camping and hiking trips safe by following a few simple precautions:

- using a tent with a built-in floor and pitching it away from woodpiles or any rodent nests or burrows
- sleeping on a raised surface, at least 12 inches off the floor
- airing out cabins that have not been used for a half hour or more, then checking for rodent droppings
- using water and disinfectant to wipe out the area (without sweeping)
- keeping all food in rodent-proof containers
- burying or burning trash
- using bottled water for drinking, cooking, and all washing
- staying away from mice, rats, chipmunks, and all other rodents.

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **strain** is a subtype of an organism, such as a virus or bacterium.

Symptoms of hay fever

Symptoms

Sneezing
Runny nose
Watery eyes
Postnasal drip
Sore throat and roof of mouth
Head congestion
Ear pressure
Sleep disturbances
Nasal discharge
Swollen, blue-colored skin under the eyes
(allergic shiners)
Fatigue
Irritability

▲
Illustration by Corey Light. Reproduced by permission of Gale, a part of Cengage Learning.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

* **allergies** (AL-uhr-jeez) are immune system-related sensitivities to certain substances, for example, cat dander or the pollen of certain plants, that cause various reactions, such as sneezing, runny nose, wheezing, or swollen, itchy patches on the skin, called hives.

* **atopy** (AT-uh-pee) is an allergic hypersensitivity that affects parts of the body not in direct contact with the allergen, as hay fever, asthma, or eczema.

Can Hantavirus Pulmonary Syndrome Be Prevented?

There is no vaccination* available for HPS. The best way to avoid contracting the virus is to get rid of possible sources of infection, which means avoiding woodpiles and other places where rodents live outdoors and keeping homes and workplaces free of mice and rats. Experts also recommend sealing holes where rodents can enter (they can squeeze through spaces as small as 0.25 inch in diameter) and wearing a mask and gloves when cleaning out areas with rodent droppings.

▶ See also **Zoonoses**

Resources

Books and Articles

Leuenroth, Stephanie J. *Hantavirus Pulmonary Syndrome*. New York: Chelsea House, 2006.

Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/diseases/hanta/hps/index.htm>.

Hare Lip See *Cleft Palate*.

Hay Fever

Hay fever is an allergic reaction to plant pollen, in the United States most commonly ragweed, tree, or grass pollen. Hay fever may be either seasonal, meaning that the person has a runny nose and other symptoms only during certain periods of the year, or perennial, which means that the person has symptoms all year long.

What Is Hay Fever?

Hay fever is one of several allergies* that are called atopy* or atopic (a-TOP-ik) allergies because they affect parts of the body that are not in direct contact with the allergens*. About 20 percent of people with hay fever eventually develop asthma, and some develop eczema* as well. Doctors refer to hay fever as allergic rhinitis* because it involves irritation

and inflammation of the nasal passages. Other names for hay fever are grass fever and rose fever.

How Common Is Hay Fever?

Hay fever is very common in the United States. The National Institutes of Health estimates that between 20 and 25 percent of Americans have some form of hay fever, although the specific pollens that trigger the symptoms vary from region to region across the United States. In general, the hay fever season is shorter in the northern states and longer in the South, particularly along the East Coast. From mid-spring to early summer the pollen count is highest in most parts of the country.

The most common sources of the pollens that trigger hay fever are plants or trees that are pollinated by the wind rather than by bees or other insects. Such trees and other plants include birch, alder, willow, and horse chestnut trees; ryegrass, Kentucky bluegrass, timothy, and Bermuda grass; and ragweed, sorrel, and sagebrush.

Hay fever affects children more often than adults. About 80 percent of people with hay fever develop it before age 20, with the average age at the time of the first episode being between 8 and 11 years of age. Some doctors think that as many as 40 percent of children may suffer from hay fever at some point in childhood. The symptoms typically become less severe in adulthood and may go away completely.

Is Hay Fever Contagious?

The most noticeable symptoms of hay fever are a stuffy or runny nose, sneezing, and teary or watery eyes. Some people also have coughing, headaches, fatigue, and drowsiness. These symptoms are easily confused with the symptoms of a cold. Unlike colds, hay fever is not contagious. It does, however, appear to run in families. It is possible for several members of a family to be affected by hay fever at the same time if they are all allergic to the same type of weed or tree pollen, but this fact does not mean that the disorder can be spread from one person to another like a cold does.

How Do People Know They Have Hay Fever?

Many people who get the runny nose, watery eyes, and other symptoms of hay fever think at first that they just have a cold. One way to tell the difference is that colds usually clear up in about a week. Another difference is that hay fever is usually worse during certain months of the year or at certain times of day during pollen season. Hot, dry, and windy days are more likely to trigger the symptoms of hay fever than cool or rainy days. The pollen count is also likelier to be higher early in the morning than later in the day.

The symptoms of hay fever are not caused by viruses like those that cause colds. They develop when plant or weed pollen enters the person's airway and the tissues that line the eyelids. Then white blood cells in the immune system* produce antibodies* to the plant allergens. These antibodies are stored in special cells in the mucous membranes lining the nose and eyelids known as mast cells. When the allergen comes in contact

* **allergens** are substances that provoke a response by the body's immune system or cause a hypersensitive reaction.

* **eczema** (EG-ze-mah) an inflammatory skin condition characterized by redness, itchiness, and oozing blisters that become crusty and hard.

* **rhinitis** (rye-NYE-tis) is the medical term for inflammation of the tissues inside the nose.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **histamine** (HIS-tuh-meen) is a substance released by the body during inflammation. It causes blood vessels to expand and makes it easier for fluid and other substances to pass through vessel walls.

* **antihistamines** (an-tie-HIS-tuh-meens) are drugs used to combat allergic reactions and relieve itching.

* **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.

* **anticholinergics** (AN-ti-koll-in-ER-giks) are medications given to counteract a chemical in the central nervous system that controls muscles, sweat glands, and some glands that secrete mucus.

with the mast cells, a compound called histamine* is released. Histamine is responsible for the runny nose, itchy and watery eyes, and sneezing of hay fever.

How Do Doctors Diagnose and Treat Hay Fever?

Diagnosis The first step in diagnosing hay fever is to take a history of the patient's symptoms. The doctor will ask when the symptoms began; whether they appear during the same time of year every year; whether the symptoms are continuous or come and go; and whether they are worse at specific times of day. In most cases the doctor will ask whether there is a family history of allergies and whether the patient also has asthma or eczema.

The next step is a series of skin tests to find out which specific pollens are causing the patient's runny nose and other symptoms. The doctor takes a small amount of material extracted from a specific type of pollen and injects it under the patient's skin or applies it to a tiny scratch on the arm or upper back. If the patient is allergic to the material, the skin will develop a wheal, or flat-topped reddish swelling.

Treatment There are three parts to treating hay fever: avoiding the specific trigger(s); using medications to relieve such symptoms as itching eyes and a runny nose; and taking allergy shots to reduce one's sensitivity to triggers.

The doctor may recommend one or more of the following types of medications in treating hay fever:

- **antihistamines***. These drugs counteract the effects of histamine in causing the watery eyes and runny nose associated with hay fever. Some are available over the counter whereas others require a prescription. The older antihistamines often make people drowsy; patients who use these medications should not drive or operate machinery while taking them. The later antihistamines are more expensive but do not make people drowsy as a side effect.
- **Decongestants**. These are nasal sprays or tablets taken by mouth that clear up stuffiness in the nose. People with high blood pressure, however, should avoid oral decongestants because they can raise blood pressure.
- **Nasal corticosteroids***. These sprays reduce the inflammation of the tissues lining the nose and eyes. They may take about a week to start to work but are safe for long-term use.
- **Anticholinergics***. These prescription drugs work by drying up secretions from the glands that line the nasal passages. They are used as nasal sprays two or three times per day. These sprays may, however, dry out the nose too much and lead to nosebleeds.
- **Gargling and rinsing out the nasal passages with salt water**. Patients can purchase premixed sprays or make their own rinse by adding one-fourth teaspoon of salt to two cups of warm water.

Can Hay Fever Be Prevented?

The most common strategy for preventing hay fever is avoiding the plants that trigger the patient's symptoms. Staying indoors when the pollen count is high, filtering the air inside the house, avoiding grassy fields or large forested areas, or moving to a part of the country with a dry desert climate are some ways people lower their exposure to airborne pollens.

Another approach is desensitization*, also called immunotherapy (im-you-no-THER-a-pee). In desensitization therapy, individuals are given a series of injections of their specific allergen under the skin, with the concentration of pollen in the shots being gradually increased. It takes an average of 8 to 12 months for people to see benefits, however, and the shots must be taken for at least three years and sometimes closer to five years.

A later possibility for preventing hay fever is a vaccine* that was first tested in patients in Canada, Europe, and the United States in the summer of 2007. If the vaccine were to pass all its safety tests and be approved for use, people with hay fever would have to have only four shots—one per week for one month.

▶ See also **Allergies • Asthma • Sinusitis**

Resources

Books and Articles

Brostoff, Jonathan, and Linda Gamlin. *Hay Fever: The Complete Guide*. Rochester, VT: Healing Arts Press, 2002.

Parker, Steve. *Allergies*. Chicago: Heinemann Library, 2004.

Organizations

American Academy of Allergy, Asthma, and Immunology. 555 East Wells Street, Suite 1100, Milwaukee, WI, 53202-3823. Telephone: 414-272-6071. Web site: <http://www.aaaai.org>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-6612. Telephone: 301-496-5717. Web site: <http://www3.niaid.nih.gov>.

Headache

Headache is a pain or discomfort felt in the head. It is not a disease but a symptom of some other problem in the body, and there are many possible causes. When someone gets a headache it usually is temporary, and only very rarely is it a sign of serious illness.

* **desensitization** (de-sens-ih-tih-ZAY-shun) a method for reducing a person's reaction to an allergen.

* **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

- * **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.
- * **chronic** (KRAH-nik) lasting a long time or recurring frequently.
- * **glaucoma** is a group of disorders that cause pressure to build in the eye, which may result in vision loss.
- * **sinusitis** (sy-nyoo-SY-tis) is an infection in the sinuses, which are hollow cavities in the facial bones near the nose.
- * **withdrawal** a group of symptoms that occurs when a drug that causes physical or psychological dependence is regularly used for a long time and then suddenly discontinued or decreased in dosage.

What Are Headaches?

Headaches are one of the most frequent local pain complaints; most people experience a headache at least once in their lives. Although there are dozens of causes of headaches, most headaches are due to tension or stress. About 12 percent of people in the United States at some point in their lives may have a recurrent, often severe type of headache known as migraine.

Up to 50 million people in the United States annually seek medical help for migraine and other severe headaches. Every 10 seconds, someone in the United States goes to the emergency room with a migraine or other type of headache. The lost work hours due to migraine and other headaches costs an estimated \$13 billion every year in the United States. It has been estimated that more than \$1 billion are spent each year for over-the-counter remedies to relieve headaches.

A large percentage of women's headaches are related to their menstrual cycle*. Chronic* headaches may accompany emotional disturbances such as depression. Many times, headaches are just one of a number of symptoms, such as fever or dizziness, that are brought on by various diseases or injuries. Migraine headaches frequently are accompanied by nausea and other symptoms that are characteristic of it.

What Are the Causes and Types of Headaches?

The pain of headache may be mild, extremely severe, or anywhere in between. It may involve the entire head, one side only, the forehead, the base of the skull, or it may seem to move around. The pain may be sharp, a dull ache, or throbbing. A headache may last a few minutes or hours. It may recur from time to time, or it may become chronic, coming back many times over an extended period.

Many people believe that the brain itself is involved in headaches, but neither the brain nor the skull has nerves that register pain. The sources of head pain are the nerve endings in the blood vessels and muscles in and around the head. Pain may be felt when these tissues become stretched, inflamed, or damaged. Headaches can arise in blood vessels within the brain, as well as in the meninges (me-NIN-jeez), which are the sensitive membranes that cover the brain.

Mild headaches may arise from a change in the weather and from hunger. Common causes of mild to severe headache pain include disorders of the eyes, ears, and sinuses. For example, eyestrain and diseases such as glaucoma* can produce pain in the front of the head and around the eye. Mastoiditis, an inflammation of the bone behind the ear, can cause severe pain on the affected side of the head. Sinusitis* can cause sharp headaches in the front of the head (often called sinus headaches). A jaw or bite that does not close properly can also cause headache.

Many types of infection with fever, such as influenza (flu), cause headache. Other causes include drinking too much alcohol, heavy smoking, withdrawal* from caffeine, or inhaling a noxious gas, such as carbon

AN ANCIENT, AND DRASTIC, TREATMENT

Prehistoric people are known to have surgically cut holes in the skull of living persons, presumably to relieve some ailment. This procedure is called trephining (tre-FAN-ing). The purpose of this operation is not known with certainty. Perhaps it was carried out to relieve the pressure of a blood clot* under the skull caused by a blow to the head. However, it is believed that in some instances it may have been done in an attempt to cure headaches by releasing evil spirits. Stone Age patients who underwent this surgery apparently often survived, because many of the skulls found by scientists showed new growth of bone around the holes.

* **blood clot** is a thickening of the blood into a jelly-like substance that helps stop bleeding. Clotting of the blood within a blood vessel can lead to blockage of blood flow.

* **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **vascular** refers to veins and arteries (the blood vessels).

monoxide. Contrary to popular belief, high blood pressure rarely is a direct cause of headache.

Headache is one of the symptoms of concussion and sometimes becomes chronic following this injury.

Rarely, headaches may be caused by brain abscesses, brain tumors*, bleeding into the brain, and meningitis (an inflammation of the membranes covering the brain).

Physicians often classify headaches as those caused by disease or injury (described above); tension headaches; and vascular* headaches. Vascular headaches include migraine and a type called cluster headaches. Tension and migraine headaches are very common.

What Are Tension Headaches?

Headaches that are associated with emotional stress or muscular tension are called tension headaches. The muscular tension may be in the neck, face, or scalp. It may be the result of poor posture or of constantly bending over one's work. These headaches are extremely common, and almost everyone has them at one time or another. A person may have one after working on the computer too long or bending over while doing homework.

Pressures from school, friends, or family may play a role. Adults may develop tension headaches because of stress at work. Tension headaches may be mild to moderate and occur in various parts of the head. The feeling has been described as a steady ache or as a tight sensation.

The pain of tension headaches can be chronic or recurrent, sometimes coming on every day. Muscles near the site of the pain, such as at the back of the neck or on the sides of the head, are often tense and tender. Sometimes chronic tension headache is a symptom of depression.

What Are Migraine Headaches?

Migraine is a moderate to severe headache that can interfere with a person's activities. The pain is typically, although not always, in one side of the head, at least at the beginning, and may last from hours to days.

Migraine headaches occur every so often, usually beginning in adolescence or early adulthood. They tend to become less frequent with age and tend to be rare or absent after the age of 40 to 50.

Migraine is one of the most common types of headaches, affecting about 20 million people in the United States alone. Women are four times more likely to experience migraine than men. People in all walks of life have been afflicted, including Sigmund Freud (psychologist), Thomas Jefferson (U.S. president), Charles Darwin (geologist and evolutionary biologist), and Lewis Carroll, the author of *Alice in Wonderland*. Modern sufferers include Princess Diana of Great Britain and basketball player Kareem Abdul-Jabbar.

The cause of migraine headaches was not known as of 2009. They are classified as vascular headaches because blood vessels in the head dilate (expand) during an attack. It is believed that certain chemical substances in the nerve cells surrounding the vessels are involved in the attack. The precise mechanism was not fully understood.

Migraine headaches tend to run in families. However, one does not catch this type of headache from someone else.

Most migraine attacks begin without warning. Typically, the pain is throbbing, often growing in intensity. It usually is accompanied by nausea and sometimes vomiting. The slightest noise or movement can make it worse. Ordinary light coming through a window may be unbearable.

The aura In about 15 percent of people who get migraines, the headaches are preceded by a distinctive type of warning called an aura (OR-uh). An aura can be a blank spot in the vision bordered by zigzag and flashing lights or numbness or weakness in parts of the body. After several minutes, the aura goes away and the pain of the headache begins. Migraine preceded by an aura has been called a classic migraine or migraine with aura.

Triggers In a number of individuals, certain factors, or triggers, can bring on a migraine attack. Common examples include red wine and foods such as cheese, nuts, chocolate, and citrus fruits. Nitrites, which are used as meat preservatives in products such as bacon or cold cuts, are

HOW DID MIGRAINE GET ITS NAME?

Aretaeus of Cappadocia, a medical writer in Greece in the 2nd century C.E., is believed to have been the first to recognize migraine as a one-sided headache with stomach and visual disturbances. Galen, a contemporary of Aretaeus, gave this affliction the name *hemikrania*, meaning “half of the head,” referring to the way it typically affects people. In Old English, the term became *megrin*, and that evolved over the centuries to “migraine.”

another recognized trigger. Other triggers include excessive sleep, relaxation after exercise, fatigue, and stress. Still others are related to hormonal changes, such as those that occur at the onset of menstruation. Sometimes the trigger is not known.

What Are Cluster Headaches?

Intensely painful headaches that occur one or more times daily are called cluster headaches. These headaches may recur for weeks or months, then not return for years. The pain is centered on one side of the head around the eye. Besides pain, the symptoms include a watery eye on the affected side and a runny nose.

Cluster headaches occur in men more often than in women and usually first appear when people are about 40 years of age. The cause was unknown as of 2009.

Should People with Headache See a Doctor?

Most headaches, although unpleasant, are not signs of serious health problems. A person should see a doctor if the headaches are unusually persistent or severe, if there are any changes in vision or speech, or if there is weakness or numbness in any body part. A doctor or other medical professional should be consulted whenever a headache is accompanied by neck stiffness, a high fever, loss of consciousness, or confusion. Treatment should not be delayed for any headache that is sudden and severe or that occurs after a head or neck injury. Children that experience recurrent headaches should be seen by a doctor. People with established chronic headaches that experience any sudden change in headache pattern or intensity should consult with a doctor. These changes are a cause for concern and should be investigated.

How Are Headaches Treated?

Over-the-counter pain-relieving drugs, such as acetaminophen* or ibuprofen*, may ease mild headaches. Relief also may come from such simple measures as getting some fresh air, taking a hot bath, getting a muscle massage, or lying down for a while. Tension headaches can be dealt with by addressing the cause of the emotional or physical stress.

For severe headaches, such as migraine, the best approach is prevention, that is, avoiding the factors that the individual knows are most likely to trigger an attack. Once an attack begins, pain-relieving drugs may help to ease symptoms. The doctor can also prescribe medicines that will narrow the blood vessels in the brain that have dilated during an attack. If migraine attacks occur frequently, the doctor can prescribe medications to prevent the migraine. Biofeedback, a relaxation technique, has proven helpful in relieving and avoiding some headaches.

Cluster headache attacks may be over before pain-relieving drugs can take effect. However, some prescription medicines may be useful in prevention.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **ibuprofen** (eye-bew-PRO-fin) is a nonsteroidal anti-inflammatory drug (NISAD) used to reduce fever and relieve pain or inflammation.

Many common headaches can, of course, be prevented by maintaining a healthy lifestyle, including regular eating and sleeping habits, not using any products containing tobacco, and avoiding excess alcohol and caffeine intake.

▶ *See also* **Concussion • Glaucoma • Otitis (Ear Infections) • Sinusitis • Temporomandibular Joint (TMJ) Syndrome**

Resources

Books and Articles

- Cobb, Allan B. *Migraines and Headaches*. New York: Rosen, 2009.
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- Kunkel, Robert S. *Headaches: A Cleveland Clinic Handbook*. Cleveland, OH: Cleveland Clinic Press, 2007.
- Marcus, Dawn A. *10 Simple Solutions to Migraines: Recognize Triggers, Control Symptoms, and Reclaim Your Life*. Oakland, CA: New Harbinger, 2006.
- Silberstein, Stephen. *Wolff's Headache and Other Pain*, 8th ed. New York: Oxford University Press, 2008.

Organizations

- American Academy of Family Physicians.** P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org>.
- American Academy of Neurology.** 1080 Montreal Avenue, St. Paul, MN, 55116. Telephone: 651-695-1940. Web site: <http://www.aan.org>.
- American College of Physicians.** 190 N. Independence Mall West, Philadelphia, PA, 19106. Toll free: 800-523-1546. Web site: <http://www.acponline.org>.
- American Council for Headache Education.** 19 Mantua Road, Mt. Royal, NJ, 08061. Telephone: 856-423-0258. Web site: <http://www.achenet.org>.
- American Headache Society.** 19 Mantua Road, Mount Royal, NJ, 08061. Telephone: 856-423-0043. Web site: <http://www.americanheadachesociety.org>.
- National Headache Foundation.** 820 N. Orleans, Suite 217, Chicago, IL, 60610. Toll free: 888-643-5552. Web site: <http://www.headaches.org>.

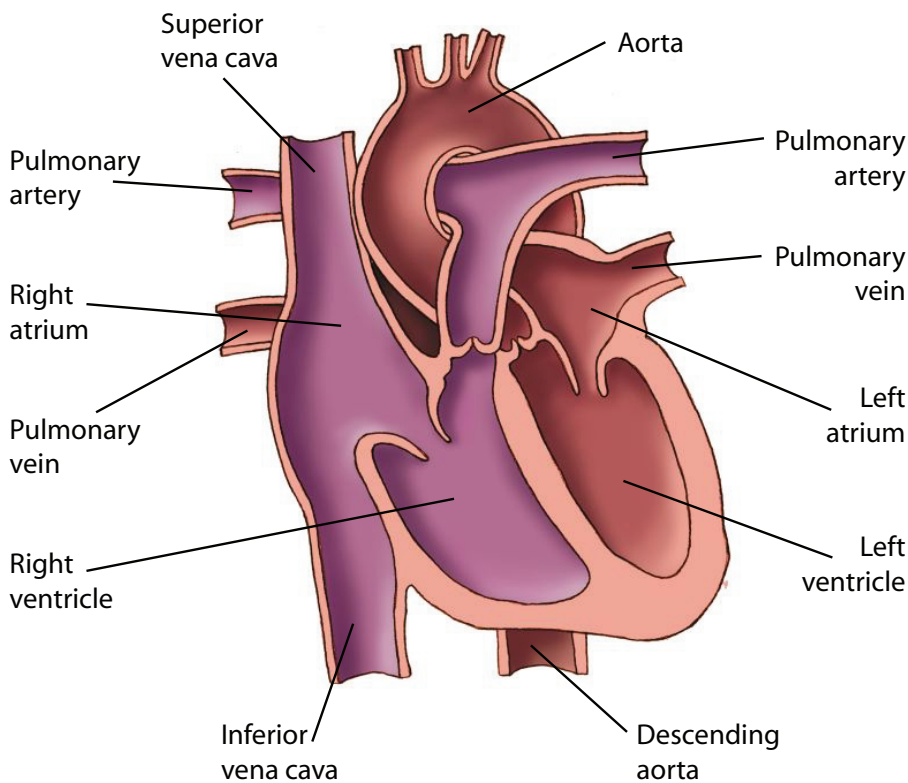
Hearing Loss See *Aging; Deafness and Hearing Loss.*

Heart Disease

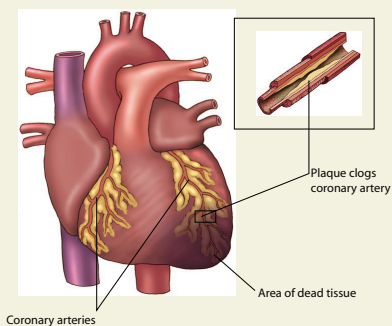
Heart disease is a broad term covering many conditions that prevent the heart from working properly and prevent it from pumping blood throughout the body.

Max's Story

Fourteen-year-old Max and his grandfather, Harry, often shared a Saturday morning ritual: breakfast at their favorite diner, followed by a brisk game of tennis. On this occasion, they both ordered the special: two fried eggs, four strips of bacon, hotcakes, and a side of hash browns. Plates cleared, they hit the tennis courts, but only ten minutes into their game, Harry, breathing hard and sweating heavily, stopped and complained of a squeezing pain in his chest. Although his grandfather protested that it was most likely indigestion, Max went for help. At the emergency room, his grandfather was given aspirin and placed on a heart monitor that showed



◀ Anatomy of the heart. Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



During a heart attack, the flow of blood to the heart is blocked by atherosclerotic plaque or clots, causing tissue death in the areas deprived of oxygen. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

The United States and the World

According to the American Heart Association (AHA), cardiovascular disease was the leading cause of death in the United States every year between 1900 and 2008, except the year 1918. The following statistics come from the AHA *2008 Heart and Stroke Statistical Update*:

- 80 million Americans have some form of cardiovascular disease. The most common condition is high blood pressure, which affects 73 million Americans.
- About 38 million of these people are 60 years old and older.
- Heart disease killed 869,700 people in the United States in 2004, making it the leading cause of death. It accounts for nearly 40 percent of all deaths each year.

he had experienced a heart attack. A nurse told Max that his quick action had probably saved his grandfather's life.

What Is Heart Disease?

Heart disease includes a group of diseases that prevent the heart from working as well as it should. It is the leading cause of death in developed countries, including the United States.

Only a little larger than a fist, a normal, healthy heart is at the center of the body's cardiovascular system*. Each day the average heart beats, or expands and contracts, about 100,000 times. In a 70-year lifetime, an average human heart beats more than 2.5 billion times.

The circulatory system* is responsible for providing nourishment to the body's cells and removing wastes from them. The arteries take oxygenated blood from the heart to the cells; the veins take blood from right side of the heart where it is pumped through the pulmonary arteries to the the cells to the lungs for reoxygenation and recirculation by the left side of the heart.

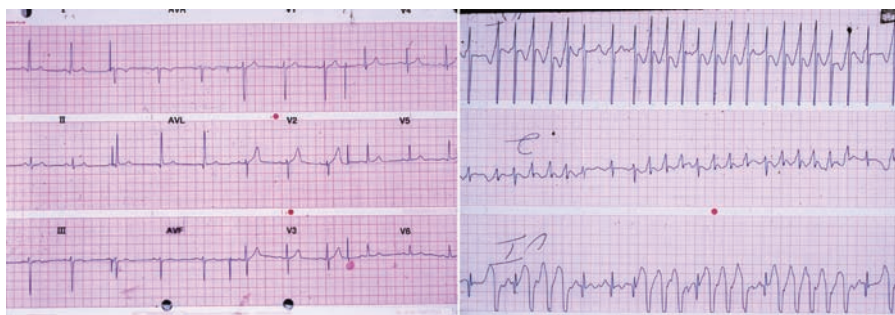
The coronary arteries supply the heart muscle itself with oxygenated blood. At birth, these coronary arteries are usually healthy, open, and clear, permitting a maximum flow of blood to the heart, but as people age, these vessels can become clogged with a thick combination of lipids (fats), including cholesterol, calcium, and other substances. As these layers accumulate inside the arteries, they can lead to arteriosclerosis (ar-teer-e-o-skle-RO-sis), a condition also known as "hardening of the arteries," since this buildup eventually stiffens the inner artery walls. Arteriosclerosis (ath-er-o-skle-RO-sis), a buildup of plaque* on the innermost portion of the vessel, is the most common cause of arteriosclerosis. Over time, plaque continues to accumulate inside the blood vessels, much like grease that clogs a kitchen drainpipe. The result is a narrowing of the inside diameter of the vessel.

What Are the Different Types of Heart Disease?

Coronary arteries affected by atherosclerosis will eventually develop coronary artery disease, a condition in which the vessels are so narrow that they can no longer provide adequate nutrients or oxygen to nourish the heart. Blood flow is blocked either partially or totally.

Heart attacks are injuries to the heart muscle that occur when blood flow through a coronary artery is interrupted, cutting off the vital supply of oxygen to the heart. Blood can be kept from the heart by narrowing of the arteries from atherosclerotic plaque, by a blood clot* blocking the narrowed vessel, or by a contraction (spasm) of the artery in response to a lack of oxygen or blood. The part of the heart muscle affected by the blockage is usually slowly starved of oxygen. The longer the heart muscle goes without nourishment, the more muscle tissue deteriorates or dies. Quick action, like that taken by Max, is essential. Healthcare workers use the phrase "time is muscle" to illustrate how crucial it is to seek immediate medical attention in the case of a suspected heart attack.

Whereas blocked arteries are the most common cause of heart attacks, there are many factors that contribute to this dangerous condition, such



Doctors use electrocardiograms to monitor heart rhythms. Compare the healthy heart rhythm (left) to heart rhythm during a heart attack (right).

Martin M. Rotker/Photo Researchers, Inc.

as high blood pressure. Pumping blood against high pressures inside the blood vessels (as occurs in people with uncontrolled hypertension) can put too much strain on the heart. Abuse of alcohol, viral infections, tuberculosis, parasites, or other vascular (blood vessel) diseases can also lead to heart disease.

Diseased valves can also put abnormal strain on the heart. There are two valves between the atria (upper chambers) and ventricles (lower chambers) of the heart, and two valves between the ventricles and their outflow tracts. These valves open and close like tiny camera shutters to make sure that blood flows in the right amount and in the right direction. If a valve is scarred and cannot open completely, the heart has to work harder to pump enough blood through the obstruction. A valve that does not close completely can allow blood to go backward through the heart chambers, making the heart work harder by having to pump the same blood twice.

Bacterial endocarditis*, or inflammation of the endocardium (the inner surface of the heart), is an infection that can cause the heart valves to malfunction. Such an infection may rarely occur following oral surgery or dental work, when the normally harmless bacteria are released into the bloodstream. This problem generally affects valves that were previously damaged from rheumatic heart disease or other conditions.

Heart failure occurs when the heart can no longer sufficiently pump blood throughout the body. While the heart is still working, it cannot do its job properly. While heart failure can affect any part of the heart, the problem usually occurs on the left side. When the left side of the heart fails, the chambers cannot keep up with the amount of oxygenated blood that is coming in, and blood can back up in the lungs, making it difficult for the person to breathe. In right-sided heart failure, the deoxygenated blood backs up in the veins, causing swelling in the legs, fatigue, and sometimes, difficulty breathing. Heart failure can often be treated through diet, exercise, smoking cessation, medication, and sometimes, surgery.

Various forms of heart disease can also cause dysrhythmias (dis-RITH-me-as), or disturbances in the normal heartbeat pattern. Although some dysrhythmias are harmless, many may cause severe problems. For example, ventricular fibrillation (ven-TRIK-yoo-lar fib-rill-AY-shun) is a type of heart rhythm in which pumping is uncoordinated and ineffective and can cause sudden death.

* **cardiovascular system** (kar-dee-o-VAS-ku-lur) is made up of heart and blood vessels.

* **circulatory system** (SIR-ku-la-tor-ee) is made up of the heart, arteries, veins, capillaries, and circulating blood.

* **plaque** (PLAK) is a raised patch or swelling on a body surface. Arterial plaque occurs on the inner surface of an artery and is produced by fatty deposits.

* **blood clot** is a thickening of the blood into a jelly-like substance that helps stop bleeding. Clotting of the blood within a blood vessel can lead to blockage of blood flow.

* **endocarditis** (en-do-kar-DYE-tis) is an inflammation of the valves and internal lining of the heart, known as the endocardium (en-doh-KAR-dee-um), usually caused by an infection.

* **risk factors** are any factors that increase the chance of developing a disease.

* **menopause** (MEN-o-pawz) is the end of menstruation.

* **aerobic exercise** (air-O-bik) is exercise designed to increase oxygen consumption by the body; it helps keep the heart and lungs in shape.

What Causes Heart Disease?

Risk factors Heart disease is not contagious and, to a large extent, can be prevented, controlled, and, in some cases, even reversed. When looking at what causes heart disease, researchers divide the risk factors* into those that people can control and those that they cannot. Among the factors that cannot be changed are the following:

- **Age.** As people age, their cholesterol levels usually increase and hardening of the arteries appears and progresses in many people.
- **Gender.** Men have higher cholesterol levels than women until around age 45. Women catch up after menopause*.
- **Heredity.** People with a family history of heart disease are at an increased risk.

The good news is that some risk factors can be controlled. These include the following:

- **Smoking.** Smokers' risk of heart attack is almost twice that of nonsmokers, and their risk of sudden cardiac death is two to four times that of nonsmokers. Quitting (or never starting) is definitely a heart-healthy decision.
- **High blood pressure.** Hypertension puts extra stress on the heart. Taking medication to lower high blood pressure, maintaining healthy body weight, avoiding salt, and increasing exercise can help people reduce blood pressure.
- **Blood lipids.** Lowering fats in the blood, such as cholesterol, can reduce the risk of heart disease. Individuals who come from a family with heart disease; who have other risk factors such as smoking, diabetes, hypertension, obesity, or physical inactivity; or who have a parent with a high cholesterol level should have their lipid levels monitored by a doctor.
- **Diabetes.** Many people with diabetes have high blood pressure or are obese. Diabetes can also increase lipid levels and accelerate the development of atherosclerosis, heart attack, and stroke.
- **Obesity.** Obesity is generally defined as having an adult body mass index greater than 30. About one-third of American adults are obese, even though maintaining a healthy weight throughout life seems to be one of the best ways of living longer and healthier. In a famous 30-year study of 5,127 adults in Framingham, Massachusetts, between 1948 and 1978, those who maintained their weight from age 25 on had a lower risk of heart disease. Those who lowered their weight over this time reduced their risk even further.
- **Physical activity.** People who frequently exercise have a lower rate of cardiovascular disease; those who are inactive have a higher rate. Aerobic exercise* lowers the heart rate, lipid levels, and blood pressure and decreases body fat. Such activities include brisk walking, running,

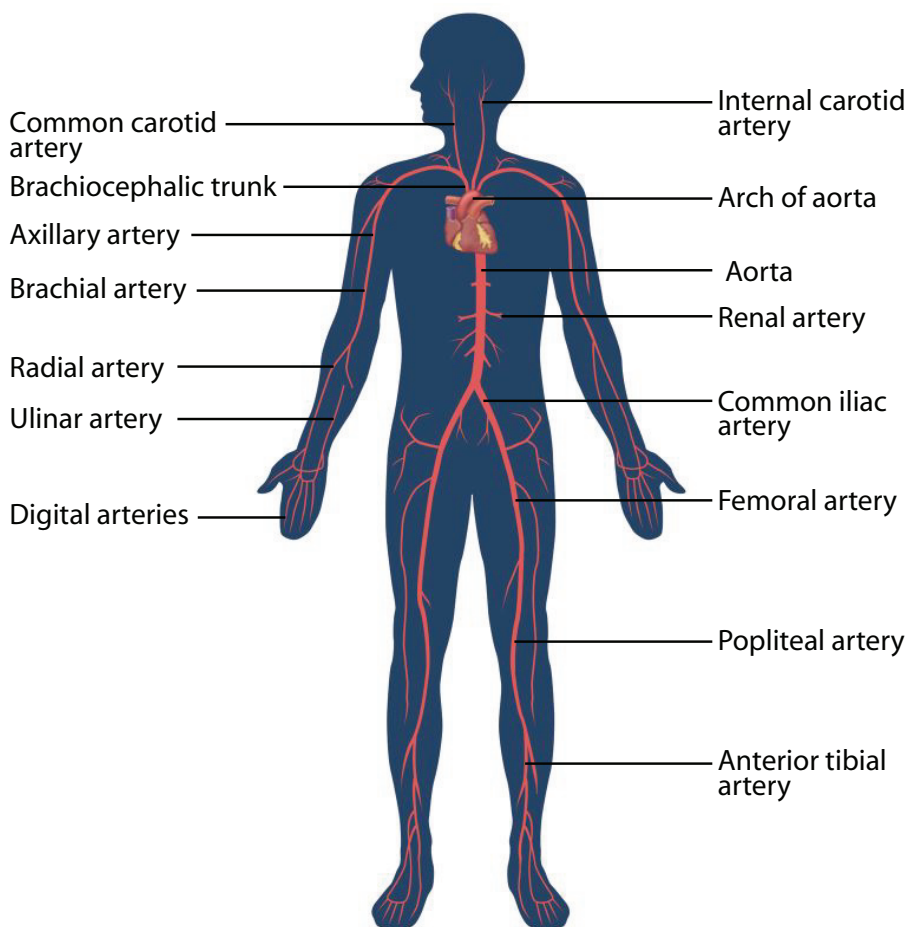
swimming, rowing, and jumping rope for at least 10 to 15 minutes. It is estimated that 59 percent of American adults get no aerobic exercise.

Heart disease is also a leading cause of death worldwide. The World Health Organization (WHO) reported that in 1998, for example, 32 percent of all deaths (16.7 million) resulted from heart disease. It was the number one cause of death in all regions of the world, except Africa (where it was ninth) and the western Pacific (where it was third).

WHO predicted that worldwide heart disease death rates would climb from 2008 until 2028, if developing nations continued their trend toward increased smoking and more westernized diets.

Other risk factors that can be controlled include drinking too much alcohol too often and having too much stress.

The fat connection Cholesterol (ko-LES-ter-ol) is a soft, waxy substance that circulates in the blood and is found in every cell of the body. It is an important building material for cells and nerves and is used for the production of certain hormones. Cholesterol is used by the liver to make bile acids, which help digest food. Triglycerides (try-GLIS-er-ides) are fats in the blood that, like cholesterol, can come from either the diet or can be produced by the liver. Triglycerides are different from cholesterol, but like



Body Mass Index

The body mass index (BMI) has been used since the early 1980s as a medical standard for obesity measurement. The steps for calculating BMI are as follows:

1. Multiply weight in pounds by 703
2. Divide that number by height in inches
3. Divide that number by height in inches again

The recommended BMI for adults is 18.5 to 25. The overweight range is 25 to 30. Any adult with a BMI over 30 is considered obese. While these guidelines are accurate, they are not definite indicators of overall health.

Arteries in the circulatory system.
Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

Did You Know?

- Coronary heart disease is the most frequent killer of American men and women. Every 26 seconds someone suffers a coronary problem; every minute someone dies from one.
- In 2008, it was estimated that heart disease costs about 448 billion dollars annually in the United States alone.
- About 2,500 heart transplants are performed each year, with thousands of other patients waiting in line.

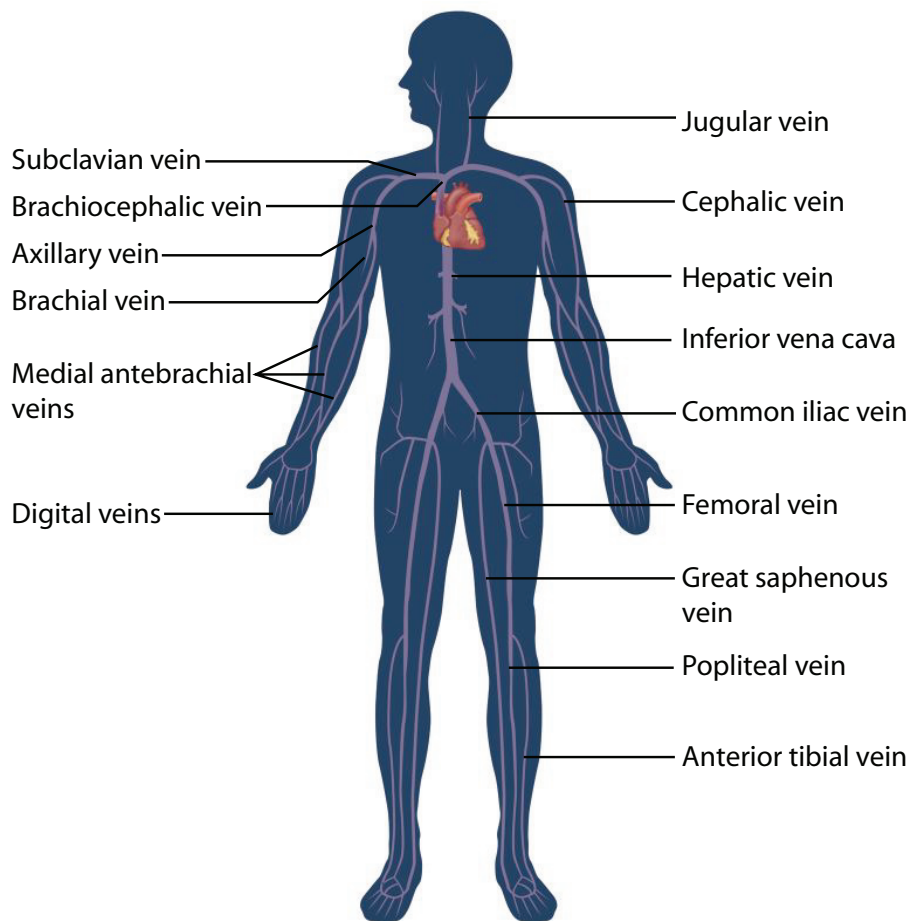
* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

cholesterol, they are normally present in the blood. Elevated triglycerides may be associated with certain illnesses.

The body makes all the cholesterol it needs, but people also get cholesterol from their diets, particularly when they eat foods made from animal and dairy products. High blood cholesterol levels can have many causes, including genes* (heredity) and lifestyle choices (diet). Too much cholesterol can lead to coronary heart disease. Hyperlipid disorders, in which there is too much cholesterol or too much triglyceride in the blood, are some of the most common inherited conditions, affecting one in every 500 people. In people with such disorders, risk factors such as obesity, cigarette smoking, and high blood pressure can increase the chance of coronary heart disease even further.

How Do People Know They Have Heart Disease?

Heart disease is the number one killer in developed countries, and heart attacks are recognized as the most obvious sign of heart disease. Each year, 1.2 million Americans have heart attacks. But one problem with heart disease is that in 20 to 40 percent of people (like Max's grandfather), a heart attack is the first symptom of the disease. By then, plaque may have narrowed one or more arteries, limiting their ability to supply an area of the heart muscle with the oxygen and nutrients it needs.



Veins in the circulatory system.
 Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

Because a heart attack can cause severe damage by robbing the heart of oxygen, a quick reaction to the earliest signs of a heart attack is essential. Angina pectoris (an-JY-na PEK-to-ris), a squeezing, tightness, or heaviness in the chest that can extend to the left arm, neck, jaw, or shoulder blade, is often the first sign that someone with atherosclerosis is at risk for a heart attack. Physical exercise, a heavy meal, strong emotions, or extreme temperatures can bring it on. If angina occurs when a person is at rest, this means that the heart is starving for oxygen even when it is not working hard. Besides chest pain, weakness, fainting, profuse sweating, nausea, and vomiting can accompany a heart attack, although a heart attack that arrives without angina—a “silent” heart attack—may not be revealed until a patient shows up in the physician’s office for an unrelated condition.

Valve disease can cause related symptoms of dizziness, fatigue, weakness, shortness of breath, and chest pain when exercising. These same signs, along with edema (e-DEE-ma), an accumulation of fluid that occurs when the heart cannot keep the circulation moving properly, can indicate heart failure*. Gravity often pulls the fluid downward, causing swelling in the feet, ankles, and legs.

Diagnosis

Depending on the type of heart disease, a physician can use a number of different tests to help pinpoint heart problems. They are divided into invasive tests done internally and noninvasive tests that can be performed externally.

Noninvasive procedures include the following:

- **Electrocardiogram** (ECG or EKG). A recording of the heart’s electrical activity to help a doctor diagnose and monitor irregular heart rhythms, heart attacks, or other abnormalities. A portable ECG machine worn by a patient called a Holter monitor can also test the effectiveness of drug therapy for dysrhythmias and monitor pacemaker* functions for 12, 24, or 48 hours.
- **Stress test.** An ECG performed during exercise to determine the cause of chest pain and other symptoms related to physical activity.
- **Echocardiogram.** Ultrasonic waves, or high-frequency inaudible sound waves, are bounced off the surfaces of the heart and converted into an image that can be displayed on a monitor to diagnose congenital* heart disease, valve disease, congestive* heart failure, and other conditions.
- **Ultra-fast computed tomography.** Scanning that employs electron beams to detect calcium deposits in the coronary arteries.

Invasive procedures include cardiac catheterization, which is used to evaluate coronary artery disease, causes of angina, complications following a heart attack, heart defects, and other internal disorders. A catheter, or long, thin tube, is inserted into the cardiovascular system, usually through an arm or leg artery. A contrast solution (a dye that will show up on film) is then injected to visualize the blood vessels on film (angiography). Depending on

Common Symptoms of a Heart Attack

Common symptoms of a heart attack include (but are not limited to):

- uncomfortable pressure, fullness, or a squeezing sensation in the center of the chest that lasts more than a few minutes or reoccurs
- chest discomfort that spreads to the shoulders, neck, jaw, arms, or back
- chest discomfort with fatigue, dizziness, nausea, clammy skin, anxiety, and breathlessness

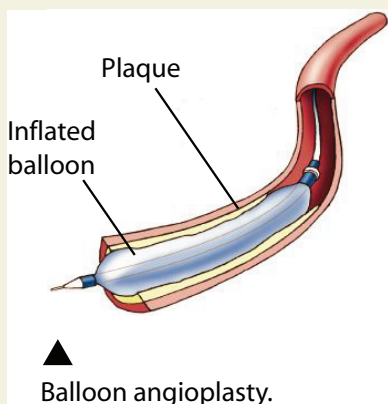
Interestingly, some people never feel chest pain with a heart attack.

* **heart failure** is a medical term used to describe a condition in which a damaged heart cannot pump enough blood to meet the oxygen and nutrient demands of the body. People with heart failure may find it hard to exercise due to the insufficient blood flow, but many people live a long time with heart failure.

* **pacemaker** a device whose function is to send electrical signals that control the heartbeat. The heart’s natural pacemaker is the sinoatrial node, a special group of cells. Sometimes it is necessary to implant a battery-powered pacemaker that sends small electrical charges through an electrode placed next to the wall of the heart.

* **congenital** (kon-JEH-nih-tul) means present at birth.

* **congestive** (kon-JES-tiv) means characterized by accumulation of too much fluid.



▲ Balloon angioplasty. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Microwave Ovens

Convenience stores, cafeterias, and snack bars used to post warnings near their microwave ovens for people with pacemakers. Electromagnetic radiation emitted from the microwave ovens sometimes caused current variations in the pacemakers. Pacemakers in the early 2000s are shielded from stray electromagnetic forces and have a backup mode in case of disruption of the main circuit's programming.

* **aorta** (ay-OR-ta) is the major large artery that carries blood from the heart to the rest of the body.

its position, the catheter can help doctors diagnose the extent of coronary artery plaque buildup or abnormalities of the aorta* and valves.

How Is Heart Disease Treated?

Although many heart conditions cannot be cured, they can be controlled with lifestyle changes, medication, or surgery, or a combination of these strategies.

Medications Irregular heartbeats, heart failure, and angina are often treated with a combination of changes to create a healthier lifestyle and medications. One of the most common medications used is nitroglycerine (ny-tro-GLIS-er-in), in the form of a tiny pill dissolved under the tongue, which acts to open the heart's blood vessels and permit more oxygen to flow to the heart muscle. Beta-blockers decrease the heart's demand for oxygen by slowing down the heart rate. Studies have shown that aspirin can help to prevent recurring heart attacks by thinning the blood, which can prevent clots and make it easier for the blood to travel through narrowed vessels. At the time of a heart attack, patients may be given special clot-dissolving medications intravenously (injected into a vein) to help unclog the diseased coronary arteries. Medications are also used to control high blood pressure.

Surgical procedures Angioplasty (AN-je-o-plas-tee), also called balloon angioplasty, opens up vessels blocked by plaque buildup. A specially designed balloon is threaded through an artery. Once positioned, the balloon is set at the narrowest portion of the blocked artery and inflated, pumping up and widening the channel. After the artery is opened, the balloon is withdrawn.

One problem is that coronary arteries opened by angioplasty often close within three to six months. To prevent this closing, surgeons often place a stent, a one-inch tube of wire-like stainless steel shaped like a tiny coiled spring, into the vessel, where it is expanded. The stent props the vessel open like scaffolding supporting a tunnel. Stents can also be life-saving for patients whose arteries suddenly collapse or become spastic (contracts) and close during angioplasty, setting off a heart attack.

A pacemaker is a device that can be inserted under the skin in the chest or abdomen to restore a regular heartbeat. Advanced devices can sense and respond to changes in body movement, temperature, and breathing rate.

Bypass surgery is a procedure in which a segment of vein taken from the leg or an artery from the chest is grafted to an opening in the side of the normal coronary artery above the obstructed (blocked) segment and then to the normal portion of the artery below the obstruction. Blood then "bypasses" the obstructed segment, much like a road that serves as a route around a construction site.

Damaged valves can be replaced with mechanical valves made of plastic or Dacron or a biological valve taken from a pig, cow, or human donor.

Cardiac transplantation is the most dramatic means of treating patients with severe heart failure. Although still filled with challenges, the surgical

FROGS' LEGS AND GALVANOMETERS

The sophisticated electrocardiograph (ECG or EKG) used in the early 2000s began with the study of frogs' legs.

During the 1700s, scientists Luigi Galvani (1737–1798) and Alessandro Volta (1745–1827) used frogs to study muscle action. Their work led to development of the galvanometer (gal-va-NOM-e-ter), which measures current by electromagnetic action.

In 1903, William Einthoven (1860–1927) introduced the string galvanometer. Einthoven's galvanometer evolved into the modern EKG machine, one of the fundamental tools that cardiologists use to monitor the heart's rhythms.

procedure is well accepted around the world and is being performed more often. However, not enough human hearts are available from organ donors.

Living with Heart Disease

Heart disease often represents a turning point in a person's life. People who formerly led unhealthy, mainly inactive lives may be inspired to change the way they live by eating more healthy foods, exercising regularly, and quitting smoking.

In the case of a heart attack, full recovery generally takes about four to six weeks, depending on the extent of the injury, the patient's overall health, and the condition of the rest of the heart. Most people are able to resume regular activities within a few weeks or months. Like all patients with heart disease or damage, those who have had heart attacks need to adopt a healthier lifestyle, including eating a low-fat diet. Most go on to recover and enjoy many more productive years of life.

▶ See also **Dysrhythmia • Heart Murmur • Hypertension • Metabolic Syndrome • Obesity • Stroke**

Resources

Books and Articles

American Medical Association Guide to Preventing and Treating Heart Disease: Essential Information You and Your Family Need to Know about Having a Healthy Heart. Hoboken, NJ: American Medical Association, 2008.

Organizations

American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org>.

Wise Modifications in Diet

Experts suggest that it is a good idea for all healthy Americans above the age of two years to modify their diets. Among specific suggestions are the following:

- Reduce total dietary fat to no more than 30 percent of total daily calories.
- Eat a variety of fruits, vegetables, and whole grains.
- Reduce dietary saturated fat and cholesterol: switch from whole to skim milk; reduce the number of egg yolks eaten; avoid solid cooking fats such as lard; give up foods containing certain vegetable oils such as palm, coconut, and partially hydrogenated oils; and substitute frozen yogurt, sherbet, or ice milk for ice cream.

* **congenital** (kon-JEH-nih-tul) means present at birth.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: <http://www.nhlbi.nih.gov/health/public/heart/index.htm>.

Heart Disease, Congenital

Congenital heart disease refers to various conditions present at birth that prevent the heart from working properly. Most of these are malformations that prevent the heart from pumping blood throughout the body.

David's Story

Six-year-old David liked everything about the first grade. He especially liked his gym class, even though he always ended up feeling tired and worn out after only a few minutes of dodge ball or relays. One day after a game of dodge ball, David collapsed on his way back to the bench. After he was rushed to the hospital, a doctor discovered that he had a hole in his heart.

The doctor explained to David and his parents that the small hole located between the two chambers of David's heart was called a septal defect and that oxygenated blood was mixing with deoxygenated blood. This condition deprived David's organs of the oxygen that they need, which caused his collapse.

What Is Congenital Heart Disease?

Congenital heart disease refers to congenital* (present at birth) heart defects that affect the ability of a person's heart to function properly. Congenital heart defects occur while a fetus* is still developing and can be attributed to many causes. About 36,000 infants are born with heart defects every year. It is the most common congenital cause of infant death.

To understand the different types of congenital heart defects, one needs to understand how the heart works to pump blood through the body. The heart is a muscle made of four chambers. There is a left side and a right side. Two atria sit on top of two ventricles. The atria and ventricles are separated by one-way valves that keep blood flowing in one direction so it can get to the places in the body that need it. Each vein that carries blood to the heart and each artery that carries blood from the heart has a specific job.

Every time the heart contracts, all of these parts work together to keep the blood flowing throughout the body. The following statements describe the direction of blood flow through the heart:

- Deoxygenated blood returns to the right atrium through the superior and inferior vena cava.
- The blood goes down through the tricuspid valve into the right ventricle.

- Blood passes through the pulmonary valve and artery to the lungs, where it is reoxygenated.
- Reoxygenated blood returns to the left atrium by way of the pulmonary veins.
- Blood goes down through the mitral valve to the left ventricle.
- The blood leaves the left ventricle through the aortic valve and is pumped throughout the body via the aorta.

It is very important that all of these parts work properly. When one or more of these important parts of the heart has a defect, the heart cannot do its job.

What Are the Different Types of Heart Defects?

There are various types of defects that can be present at birth. Sometimes, a doctor, nurse, or technician will notice during a routine exam that the infant's heartbeat sounds abnormal. This abnormal sound is called a murmur. At other times, the condition may not be detected until the child is much older. Some congenital heart defects are more common than others. These include the following.

Septal defects Septal defects, sometimes called a “hole in the heart,” are the most common types of congenital heart defects. When the septum (the muscular wall that separates the right and left sides of the heart) has a defect, proper blood flow is interrupted, causing a number of problems. The symptoms of septal defects vary depending on how much blood goes through the septal defect and, therefore, to the wrong chamber of the heart. Sometimes, minor holes close spontaneously. Other times, a doctor must repair them surgically. Depending on the type and severity, unrepaired septal defects may result in malnourishment, cyanosis (a bluish discoloration of the lips and skin), hypertension (high blood pressure), hypertrophy (enlarged heart), pulmonary edema (fluid in the lungs), congestive heart failure (CHF), and infections.

There are several types of septal defects:

- Atrial septal defect is an opening between the upper chambers of the heart. This defect allows oxygenated blood to flow from the left atrium back into the right atrium (a left-to-right shunt) instead of through the aorta and to the body. Most septal defects cause left-to-right shunts because the pressure on the left side of the heart is usually higher than on the right. This condition dilutes the oxygenated blood and puts a strain on the heart and lungs because more blood must be pumped through the lungs and back around the body.
- Ventricular septal defect is an opening between the bottom chambers of the heart, which allows oxygenated blood to flow from the left back into the right ventricle. When this happens, the heart needs to work harder to pump enough blood through the body. The

* **cyanosis** (syeh-uh-NO-sis) is a bluish or purplish discoloration of the skin and mucous membranes due to a lack of oxygen in the blood.

added work may cause the heart to enlarge (hypertrophy). Some cases result in pulmonary hypertension (high blood pressure in the lungs). This condition may cause a reversal in the direction of blood flow with a right-to-left shunt, a combination called Eisenmenger's complex.

- **Atrioventricular septal defect** is a large hole that involves the atria and ventricles, as well as improperly formed valves. This defect sends the oxygenated blood back to the lungs to be oxygenated again and creates too much blood volume in the lungs.

Patent ductus arteriosus Patent ductus arteriosus is similar to a septal defect in that it involves a “hole” in the heart. The fetus receives oxygen from its mother, not from its lungs. To make this process possible, there is an artery (ductus arteriosus) in the heart that bypasses the lungs and sends oxygenated blood directly to the body. Normally, this ductus closes soon after the baby is born. Certain problems may cause it to remain open. Medicine may be given to the baby to close the ductus, but in some cases, surgery is required.

Patent foramen ovale A patent foramen ovale (PFO) happens when the septum between the two upper chambers of the heart develops normally in the uterus but the flap does not completely seal after birth. All people have a PFO before birth, but it seals correctly in 80 percent of people. If PFO is diagnosed by a cardiologist (heart specialist), a patient may be given medication to correct the problem.

Transposition of the great arteries Transposition of the great arteries makes up 10 to 11 percent of all congenital heart defects. In this condition the position of the two major vessels that carry blood away from the heart—the aorta and the pulmonary artery—is switched (transposed). When this happens, the aorta is connected to the incorrect (right) ventricle, and the blood that it pumps to the body has not yet passed through the lungs for oxygenation; the pulmonary artery is connected to the left ventricle, so the blood that is sent to the lungs has already been oxygenated. As a result, the baby develops cyanosis* (the skin and mucous membranes take on a bluish tint due to hypoxia, or inadequate oxygen). Unless surgery is performed soon after birth, infants who are born with this defect do not survive.

Tetralogy of Fallot Tetralogy of Fallot (fal-LOW) (TOF) is a combination of four different problems and occurs in 9 to 14 percent of all congenital heart defects. TOF results in the following:

- **Pulmonary stenosis** is narrowing of the pulmonary artery, which impedes the passage of blood from the right ventricle to the lungs. When this happens, it is difficult for the blood to get to the lungs, and the right ventricle must work much harder to try to push it through. As a result, the muscular walls of the right ventricle get

too thick (hypertrophy), and there may not be enough oxygen in the blood that is pumped to the body, causing cyanosis (a bluish tint to the skin).

- **Right ventricular hypertrophy** is enlargement of the lower right chamber of the heart. It occurs when defects in the heart cause the chamber to work much harder than normal, making the muscular walls grow bigger.
- **Ventricular septal defect** (a hole between the lower heart chambers) allows oxygenated blood from the left ventricle to flow into the right ventricle. When this happens, the extra (already oxygenated) blood “backs up” in the lungs and can cause pulmonary hypertension. It also puts additional strain on the heart, which can lead to an enlarged heart (hypertrophy).
- A **misplaced aorta** is positioned just above the ventricular septal defect and, therefore, is connected to both the right and left ventricles. When this happens, the heart receives and pumps deoxygenated blood to other organs in the body.

TOF is usually repaired surgically during infancy.

Coarctation of the aorta Coarctation of the aorta accounts for 9 to 11 percent of all congenital defects. The aorta is one of the major vessels of the heart and is responsible for delivering the oxygenated blood

HELEN B. TAUSSIG: A PIONEER IN PEDIATRIC CARDIOLOGY

Helen B. Taussig (1898–1986) was a brilliant physician who made many discoveries in the field of congenital heart defects, especially cyanotic congenital heart disease. She founded the field of pediatric cardiology. Taussig wrote *Congenital Malformations of the Heart* (1947) and received the 1954 Albert Lasker Award for Clinical Medical Research for her work. Taussig was instrumental in developing the Blalock-Taussig shunt, the cardiac surgery that is used to treat conditions such as tetralogy of Fallot and hypoplastic left heart syndrome. In 1944 Taussig and Alfred Blalock performed the first shunt operation on an 11-month-old baby.

Taussig was the first female president of the American Heart Association, and in 1959 she was promoted to full professor at Johns Hopkins University. She also played a large role in preventing thalidomide, a drug known to cause birth defects, from reaching U.S. markets. In 1964, President Lyndon Johnson awarded Taussig the Medal of Freedom. Johns Hopkins University named the Helen B. Taussig Children’s Pediatric Cardiac Center in her honor, and in 2005 the School of Medicine named one of its four colleges after her as well.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

from the heart to the rest of the body. Sometimes, babies are born with a defect that leaves part of their aorta very narrow. When this happens, the heart has to work much harder to pump the blood through the narrowed opening. This defect can be mild or severe, and it can be repaired surgically. There are a few options for repairing coarctation of the aorta. Doctors can replace the narrowed section entirely. They can also cut out the section and sew the normal sized ends together, or they can try to widen the vessel with a balloon (angioplasty).

Hypoplastic left heart syndrome Hypoplastic left heart syndrome occurs in 4 to 8 percent of all congenital heart defects. It is a complex condition in which the left side of the heart, which is responsible for pumping oxygenated blood throughout the body, has not developed properly. The structures that are affected include the left ventricle, the mitral valve, the aorta, and the aortic valve. In babies with this condition, the left ventricle of the heart is so small that the heart cannot pump blood needed by the body. The mitral and aortic valves are very narrow or closed, and the aorta is also very narrow. This creates a situation in which the right side of the heart has two jobs, instead of one. First, it must send the blood to the lungs to be oxygenated. Second, it must pump blood to the rest of the body via a patent ductus arteriosus, which typically closes soon after birth. This condition is often fatal if not treated shortly after birth.

THE DELAYED DIAGNOSIS AND TREATMENT OF HEART DEFECT

In 2008, 23-year-old Louise Banks of the United Kingdom made headlines when she underwent surgery for a massive congenital septal defect that had gone undetected until that year. Although Banks had various symptoms during her childhood and early adulthood, doctors missed identifying the congenital heart problem that was the underlying cause.

As a child, Banks suffered from episodes of fainting, but her condition was misdiagnosed. As a teenager, a gym trainer grew concerned about her low heart rate during exercise and encouraged her to see a doctor. Again, her problem was misdiagnosed. Even when her heart rate became erratic during the birth of her son, the underlying condition was still undetected.

At the age of 23, Banks consulted another doctor who performed an ultrasound* on her heart, and it was only then that the one-and-a-half inch hole was discovered.

Banks underwent surgery to have the hole repaired, which was completely successful. Thereafter her heart functioned normally.

What Are the Symptoms of Congenital Heart Disease?

Babies who are born with heart disease may or may not show symptoms of the defect right away. Sometimes, children may not show symptoms until they are much older. In very few cases, individuals may not learn of their condition until adulthood. Specific symptoms depend on the severity of the defect. These may include an odd skin color (gray or cyanotic, commonly called blue baby syndrome); swelling (edema) in the legs, feet, or abdomen; shortness of breath; difficulty feeding; and immediate fatigue during play or sports.

What Causes Congenital Heart Disease?

As of 2009, causes for congenital heart defects were not fully understood. Researchers believed that both environmental and genetic factors played a role. Several specific gene mutations were identified between 1985 and the early 2000s.

Scientists also suspected that viral infections may play a key role in the development of congenital heart defects. These infections include rubella (German measles) and the flu. Pregnant women should make certain that they are vaccinated against rubella and the flu; they should avoid coming in contact with people who are sick; and they should avoid all forms of alcohol, tobacco, drugs (both legal and illegal), and toxic chemicals.

According to the March of Dimes, researchers identified certain medications as potential causes of congenital heart defects. These include some anti-seizure medications, the acne medication Isotretinoin, and Thalidomide.

Is Congenital Heart Disease Preventable?

Many congenital heart defects, such as those attributed to heredity, are not preventable. Still, there are several precautions that women can take that may prevent certain complications during pregnancy. There are specific steps that women can take in preparation for and during pregnancy. Women should do the following:

- Take a folic acid supplement of at least 400 micrograms. Folic acid is a B vitamin that has been shown to prevent many major birth defects, especially those that affect the brain and spine. Folic acid supplements need to be taken before pregnancy to be effective.
- Avoid contact with toxic chemicals, including many cleaners, paints, and solvents.
- Have their doctor ensure that they are vaccinated and immune to rubella (German measles), a viral infection, and the flu.
- Discuss all medications and supplements that they are taking with their doctor.
- Avoid alcohol, tobacco, and drugs (both legal and illegal), during pregnancy.

Congenital Heart Disease Deaths Decrease

According to the American Heart Association, the death rate among those born with congenital heart defects has declined by 39 percent since 1979. In fact, from 1994 to 2004, the death rate declined more than 31 percent.

* **electrocardiogram** (e-lek-tro-KAR-dee-o-gram), also known as an EKG, is a test that records and displays the electrical activity of the heart.

* **echocardiogram** (eh-ko-KAR-dee-uh-gram) is a diagnostic test that uses sound waves to produce images of the heart's chambers and valves and blood flow through the heart.

* **catheter** (KAH-thuh-ter) is a small plastic tube placed through a body opening into an organ (such as the bladder) or through the skin directly into a blood vessel. It is used to give fluids to or drain fluids from a person.

How Is Congenital Heart Disease Diagnosed?

In most cases, congenital heart defects are diagnosed in early infancy after a baby shows outward signs of problems. These may include shortness of breath, difficulty eating, or ashen or cyanotic skin tones. Other times, problems may not arise until childhood, as in David's case. More rarely, defects are discovered during routine examinations before birth or during adulthood.

In all of these cases, doctors will conduct further testing to identify and treat whatever problem is present. These routine tests include:

- An x-ray that reveals the appearance of the heart and lungs. It can reveal if the heart is too large or small, in the wrong position, or whether there is a problem with the lungs.
- An electrocardiogram* (EKG or ECG) involves the placement of electrodes on the chest. It tells doctors about the electrical activity of the heart and whether it is beating properly.
- An echocardiogram* is an ultrasound of the heart. Physicians can watch the heart working in real-time. This helps them to assess whether the heart is working properly.
- Blood and urine tests can tell the doctor if the proper measures of oxygen, gases, and enzymes are present in the body. Sometimes, certain variations indicate potential cardiac problems.
- Cardiac catheterization is a more invasive test that doctors can perform to assess cardiac problems. A long catheter* is inserted into the heart, usually through the femoral artery or vein in the groin. This allows doctors to insert a special dye that helps reveal any blockage or defect.

What Are the Treatment Options?

Most congenital heart defects can be repaired or improved surgically. Because of advances in cardiology over the last century, children who are born with serious cardiac defects can go on to live happy, healthy lives.

Often babies who are born with heart defects undergo surgery immediately, and the defects that they were born with never interfere with their lives. Other times, the surgery may only provide temporary improvement, not a solution. These are cases in which the defect is so severe that the only way to completely fix the problem is through a heart transplant. According to the United Network for Organ Sharing, 2,536 children age 17 and under received heart transplants in 2007.

Resources

Books and Articles

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Kramer, Gerri Freid, and Shari Maurer. *The Parent's Guide to Children's Congenital Heart Defects: What They Are, How to Treat Them, How to Cope with Them*. Three Rivers, MI: Three Rivers Press, 2001.

Organizations

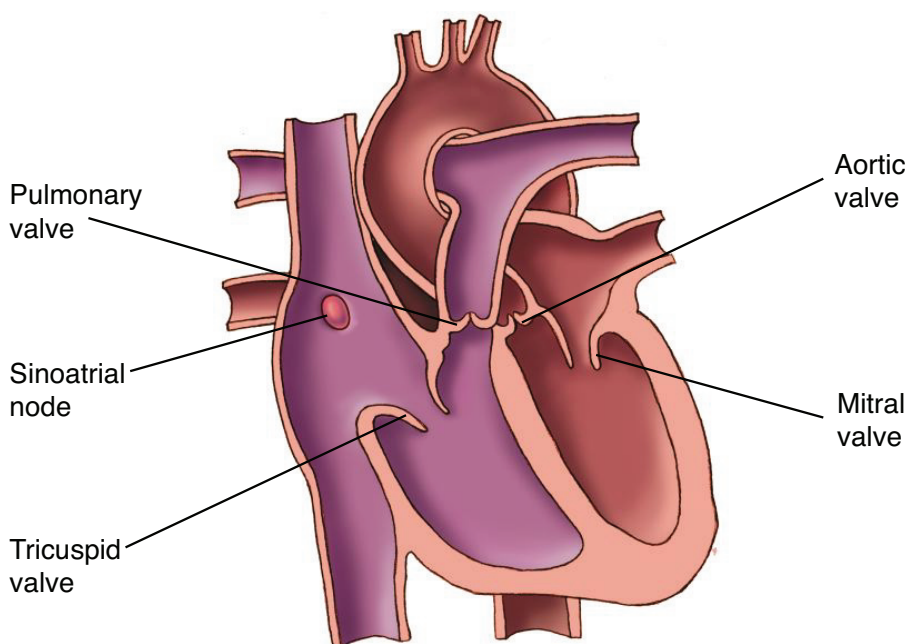
American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org>.

Cleveland Clinic. 9500 Euclid Avenue, Cleveland, OH, 44195. Toll free: 800-223-2273. Web site: <http://my.clevelandclinic.org/heart/disorders/congenital>.

Congenital Heart Information Network. 600 North Third Street, Philadelphia, PA, 19123. Telephone: 215-627-4034. Web site: <http://www.tchin.org>.

Heart Murmur

A heart murmur is an extra sound that occurs during a heartbeat and is caused by turbulence in blood flow through the heart. Most heart murmurs are innocent, which means they do not cause health problems and may disappear with age. But some heart murmurs require medical treatment because they are a sign of a problem in the heart's walls, lining, or valves, or are indications of other diseases or conditions.



◀ Anatomy of the heart showing heart valves and sinus node. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

- * **endocarditis** (en-do-kar-DYE-tis) is an inflammation of the valves and internal lining of the heart, known as the endocardium (en-doh-KAR-dee-um), usually caused by an infection.
- * **rheumatic fever** (roo-MAH-tik) is a condition associated with fever, joint pain, and inflammation affecting many parts of the body, including the heart. It occurs following infection with certain types of strep bacteria.
- * **prophylactic** (pro-fih-LAK-tik) refers to something that is used to prevent an illness or other condition, such as an infection or pregnancy.
- * **heart failure** is a medical term used to describe a condition in which a damaged heart cannot pump enough blood to meet the oxygen and nutrient demands of the body. People with heart failure may find it hard to exercise due to the insufficient blood flow, but many people live a long time with heart failure.

Is a Heart Murmur Always a Problem?

The sound of a heart murmur may occur as the heart is filling with blood or as it is contracting to send blood to other parts of the body. Sometimes the murmur indicates a defect in the heart or in one of its valves. Many times doctors also find “innocent” heart murmurs, which do not require any special treatment. Innocent murmurs are common in babies and children. The murmurs often disappear as a child gets older, and they are not a sign of heart disease.

Heart murmurs may also occur when one or more of the heart’s four valves is operating abnormally. Sometimes the valves do not close completely, which may allow blood to leak back from one chamber to another, which should not occur. Valves also might not open completely, which causes blood to rush through a smaller opening than normal. The murmur can result from a hole, usually in the wall between the left and right sides of the heart.

Consequences of a Heart Murmur

Some people are born with valve defects or with holes that cause heart murmurs. Others develop a heart murmur after bouts with endocarditis* or rheumatic fever*. Both of these infections may damage heart valves. For these patients, doctors may advise prophylactic* (preventative) antibiotic treatment to be taken before a surgical or dental procedure because bacteria entering the bloodstream during the procedure may adhere to abnormal or damage heart valves, causing infection inside of the heart.

Anemia and other medical conditions such as an irregular heartbeat (arrhythmia) may be associated with murmurs even when the heart valves are perfectly normal. A heart murmur may be found in individuals who have heart failure*. If the heart becomes enlarged (a condition called cardiomegaly), a murmur may be heard as the blood flow throughout the heart decreases.

What Does the Doctor Hear and Do?

Diagnosis A doctor listens to a patient’s heart as part of the physical exam. That is how murmurs usually are detected. Certain defects cause particular sounds, which help doctors make their diagnosis. For example, if a valve fails to close properly between the upper and lower chambers on the heart’s left side, doctors may hear a distinctive murmur that aids in diagnosing the problem.

Doctors can also use an echocardiogram to examine the heart and determine a murmur’s cause. This test is done with a device that uses sound waves to create an image of the heart. It is similar to the ultrasound machine that creates images of the fetus (unborn developing baby) inside a pregnant woman.

Treatment If the murmur is innocent, nothing special needs to be done. People with innocent heart murmurs can play sports, eat the same foods, and engage in all the same activities as their schoolmates.

Murmurs that indicate valve disease may need to be treated with medication or surgery. Such surgery may involve either replacing the valves or closing a hole in the wall in the heart. Although it is important to find and treat those murmurs caused by valve abnormalities or other medical conditions, most murmurs detected during childhood or adolescence are innocent.

▶ See also **Heart Disease • Rheumatic Fever**

Resources

Books and Articles

Chilnick, Lawrence D. *The First Year: Heart Disease: An Essential Guide for the Newly Diagnosed*. Cambridge, MA: Da Capo Press, 2008.

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American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: http://www.amhrt.org/Heart_and_Stroke_A_Z_Guide/hmur.html. Web site: http://www.amhrt.org/Heart_and_Stroke_A_Z_Guide/imurm.html.

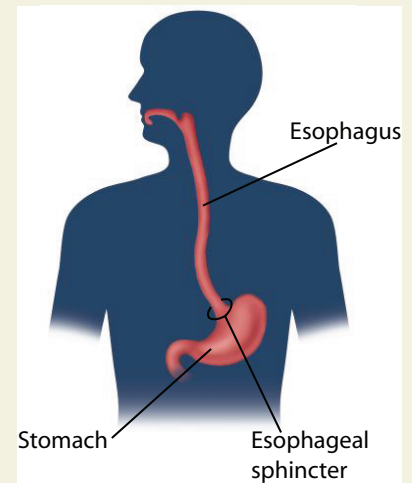
National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: http://www.nhlbi.nih.gov/health/dci/Diseases/heartmurmur/hmurmur_what.html.

Heartburn (Dyspepsia)

Dyspepsia (dis-PEP-see-a) is a broad term used to describe painful or otherwise uncomfortable feelings in the abdomen and sometimes extending into the chest and throat that occur after eating. Heartburn is one type of dyspepsia. Symptoms of heartburn may include a burning sensation in the chest that moves toward the back of the throat after eating. The burning chest pain may especially occur when lying down after eating or when bending forward. The burning pain may be accompanied by a bothersome feeling that food is stuck partway down the food pipe, or esophagus.

Does the Heart Burn When Someone Has Heartburn?

Sarah's grandfather always comes to her house for Sunday dinner. For several weeks in a row, he seemed uncomfortable after eating and did not lie down for his usual nap. Sarah heard him talking to her father about heartburn. This scared Sarah, who thought that her grandfather was having heart problems.



▲ Heartburn occurs when the contents of the stomach move backward through the muscular valve called the lower esophageal sphincter and up into the esophagus. The stomach's acid and digestive enzymes irritate the lining of the esophagus, causing a burning feeling in the chest and a bitter, sour taste in the throat and mouth. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Before or After?

Antacids, acid blockers, and proton-pump inhibitors are three types of dyspepsia medications that individuals can buy without a doctor's prescription. These over-the-counter (OTC) medications work in different ways.

Antacids, which should be taken after a meal, neutralize the acids already present in the stomach. People usually feel better right away, but relief lasts only a few hours.

Histamine Type 2 receptor blockers interfere with the action of histamine that signal stomach cells to produce acid.

Proton-pump inhibitors are especially effective, because they destroy the enzyme that is responsible for making stomach acids in the first place. Because of action, they can prevent heartburn from developing. Individuals usually take proton-pump inhibitors daily.

* **enzymes** (EN-zimes) are proteins that help speed up a chemical reaction in a cell or organism.

When Sarah asked her grandfather what was wrong with his heart, he explained that people with heartburn, which is also called acid indigestion, often complain of a burning feeling in the chest, close to where the heart is located. Usually, however, heartburn has nothing to do with the heart. The discomfort in the chest and throat occurs when the stomach contents, which include acid and digestive enzymes*, move backward into the esophagus, or food pipe. This stomach juice escapes into the food pipe when the muscular valve between the stomach and esophagus relaxes. The acidic juice irritates the lining of the esophagus and results in a burning feeling in the chest. People sometimes mistake the feeling for a heart attack. The backup of stomach juice, which doctors call gastroesophageal reflux, can also cause a bitter, sour taste in the throat and mouth. Heartburn usually occurs after a meal and can last for several hours, often becoming worse when the individual is lying down.

What Is Dyspepsia?

Dyspepsia comes from the Greek words for “bad digestion,” and it covers a wide range of stomach-related symptoms, including a burning and/or aching in the upper abdomen, heartburn, bloating, nausea, and vomiting. Symptoms typically return again and again.

Stomach ailments are some of the most common reasons why people visit their doctors. Some estimates suggest that one of every 20 patients that enters a doctor's office is there for a stomach problem. In all, up to 40 percent of adults in the United States and other Western countries experience dyspepsia, and elderly people are especially prone to it. Pregnant women commonly experience heartburn because of the pressure that the developing fetus puts on the mother's stomach and intestines. This pressure can force stomach juices into the esophagus.

While dyspepsia is quite widespread among adults, children rarely get it. They might feel indigestion after overeating, but children usually do not have heartburn or other types of dyspepsia.

By itself, dyspepsia is not a disease. Instead, it is a collection of uncomfortable symptoms that may arise because a person eats or drinks too much or is feeling stressed, anxious, or depressed. Nonetheless, a person who has recurring or frequent bouts of dyspepsia should see a doctor, because this may be a sign of other disorders, including the following:

- **Appendicitis** is inflammation of the appendix, a small tube connected to the large intestine.
- **Peptic ulcer** is a sore in the lining of the stomach or small intestine.
- **Hiatal hernia** occurs when part of the stomach pushes up into the chest through an opening in the diaphragm, the muscle between the chest and the abdomen.
- **Lactose intolerance** is a problem in digesting lactose, a sugar found in milk and other dairy products.
- **Gallbladder disease** is inflammation or blockage in the gallbladder, a small organ of the digestive system.

- **Gastroesophageal (gas-tro-e-sof-a-JEE-al) reflux disease (GERD)** is a digestive condition in which the muscular valve (lower esophageal sphincter) between the esophagus (food pipe) and stomach does not work properly, allowing stomach acid to flow backward into the esophagus.
- **True heart pain**, which is also called angina pectoris (an-JY-na PEK-tor-is), is a symptom that suggests something is wrong with the heart.

How Is Dyspepsia Diagnosed, Treated, and Prevented?

Dyspepsia is diagnosed in part by the patient's history of discomfort after eating. Doctors also use various tests to confirm dyspepsia. Some of these help the doctor to rule out other possible conditions, while others test specifically for dyspepsia. With respect to heartburn and acid reflux*, x-ray studies may show the reflux of swallowed material from the stomach into the esophagus. A pH probe may be placed within the esophagus to directly demonstrate that gastric acid is entering into the esophagus. Also, a flexible endoscope* may be passed into the esophagus to observe the inflammation, or esophagitis, that has resulted.

Most people with heartburn find that over-the-counter antacid medications, dietary changes, and lifestyle changes can help them feel better. When heartburn is frequent or chronic, it can lead to an inflammation of the esophagus (esophagitis). In this case, a doctor may prescribe antibiotics or other medications to help treat the inflammation. These medications include histamine blockers because histamine stimulates specialized stomach cells to secrete acid, and an enzyme inhibitor, which keeps the acid secreting cells from making any acid at all.

Guidelines for preventing heartburn include the following:

- Avoiding chocolate, coffee, and alcohol
- Passing up greasy or spicy foods
- Quitting smoking
- Losing weight
- Avoiding eating right before bed
- Finding ways to deal with stress

▶ See also **Appendicitis • Gallstones • Hernia, Gastrointestinal • Lactose Intolerance • Pancreatitis • Peptic Ulcer**

Resources

Books and Articles

Rinzler, Carol Ann, with Ken DeVault. *Heartburn & Reflux for Dummies*. Hoboken, NJ: Wiley, 2004.

- * **acid reflux** is a condition in which stomach acid flows upward into the esophagus, often causing a burning sensation (so-called heartburn) in the upper abdomen or chest.
- * **endoscope** (EN-doh-skope) is a tool for looking inside parts of the body. It consists of a lighted tube and optical fibers and/or lenses.

Having a Heat Wave!

A heat wave is a long period of very high heat and humidity. The National Weather Service uses a heat index (HI) to indicate when people should be warned about such conditions. The HI, given in degrees Fahrenheit, is a measure of how hot it feels when the actual air temperature is combined with the relative humidity (which is a measure of the amount of moisture in the air compared to the greatest amount of moisture the air could hold at the same temperature). For example, if the air temperature is 95 degrees Fahrenheit and the relative humidity is 55 percent, the HI, or how hot it feels, is 110 degrees Fahrenheit. The National Weather Service issues alerts when the HI is expected to be greater than 105 to 110 degrees Fahrenheit for at least two days in a row.

Rubin, Jordan, with Joseph Brasco. *The Great Physician's Rx for Heartburn and Acid Reflux*. Nashville, TN: Thomas Nelson, 2007.

Organizations

American Gastroenterological Association. 4930 Del Ray Avenue, Bethesda, MD, 20814. Telephone: 301-654-2055. Web site: <http://www.gastro.org>.

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/gerd/index.htm>.

Heat-Related Injuries

Heat-related injuries, including heat cramps, heat exhaustion, and heat stroke, are problems that occur when the body's cooling system is overloaded.

Too Hot to Handle

Texas was in the grip of a severe heat wave in August just as students were heading back to school after summer break. The extreme heat forced schools around the state to take action. Schools in Plano, for example, kept their children inside for recess on very hot days. In Irving, the football coach cut short afternoon practices and had the players take extra water breaks. In Arlington, some football scrimmages were canceled, and others were scheduled after 7 p.m.

School officials were trying to prevent heat-related injuries, which are health problems that occur when the body's cooling system is overloaded. The body normally cools itself by sweating. Under some conditions, though, this system can start to fail. In such cases, a person's body temperature may rise quickly. Very high body temperatures can damage the brain and other vital organs.

What Are Heat-Related Injuries?

Heat-related injuries are divided into three types:

- **Heat cramps.** These are painful muscle cramps, usually in the stomach, arms, or legs, that may occur during heavy activity. Heat cramps are the least serious type of heat-related injury. They can, however, be dangerous if ignored because they are an early warning sign that the body is having trouble with heat.
- **Heat exhaustion.** This is the body's response to losing too much water and salt in sweat. It often occurs in people who exercise heavily or work in a hot, humid place, which makes them sweat a lot. Elderly

people and those with high blood pressure are also prone to heat exhaustion. As the body overheats, blood flow to the skin increases, and this decreases blood flow to other organs. As a result, an individual can experience weakness and confusion and may collapse. If heat exhaustion is left untreated, the person may suffer heat stroke.

- **Heat stroke.** This is the most serious type of heat-related injury. Heat stroke, also known as sun stroke, occurs when the body becomes unable to cool down. The body's temperature may rise to 106 degrees Fahrenheit or higher within minutes. Unless heat stroke is treated quickly, brain damage or death can result.

Who Is at Risk?

Several factors affect the body's ability to cool itself during very hot weather. One of the main ways the body cools itself is by sweating. The evaporation of sweat from the skin cools the body. When humidity (the amount of moisture in the air) is high, the sweat does not evaporate from the skin. Other factors that can limit the body's ability to control its temperature include fever, heart disease, sunburn, alcohol or drug use, and dehydration*, which is excessive loss of water from the body due to illness or not drinking enough liquids.

Some people have a high risk of heat-related injuries:

- **Babies and children under four years of age.** Babies and young children are very sensitive to the effects of high temperatures. They become dehydrated quickly because of their small size. They are also unable to help themselves if they start to get overheated.
- **People age 65 or older.** An older person's body may not control its own temperature as well as a younger person's. Older people are also less likely to notice and respond to changes in temperature.
- **People who are overweight.** An overweight person's body may tend to hold onto more body heat than a the body of a person who has a more normal weight.
- **People who are ill or taking certain medicines.** Any illness or medicine that leads to dehydration raises the risk of heat-related injuries.

What Are the Symptoms?

Heat Cramps

- Painful muscle cramps, usually in the stomach, arms, or legs
- Heavy sweating

Heat Exhaustion

- Heavy sweating
- Cold, clammy skin
- Paleness
- Tiredness

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

When Heat Kills

An extreme heat wave settled on the city of Chicago in July 1995, bringing soaring high humidity paired with seven consecutive days of air temperatures of at least 90 degrees. On two of those days, the thermometer soared to 102 and 106 degrees Fahrenheit. The 106-degree mark was a record. On that day the humidity was also very high and made the temperature feel like at least 120 degrees Fahrenheit. For hundreds of residents, the extreme heat was fatal. Many of the victims were elderly individuals who either had no air conditioners in their homes or who were unable to afford the cost to run their air-conditioning systems. A power outage in parts of the city made the problem even worse. By the end of the heat wave, an estimated 500 to 700 local people had died from the heat.

- Weakness
- Dizziness
- Headache
- Fainting
- Muscle cramps
- Nausea
- Vomiting
- Fast, weak pulse
- Fast, shallow breathing

Heat Stroke

- Very high body temperature (above 103 degrees Fahrenheit as measured by mouth)
- No sweating
- Red, hot, dry skin
- Dizziness
- Headache
- Confusion
- Nausea
- Vomiting
- Fast, strong pulse
- Unconsciousness

What Is the Treatment?

Heat Cramps Heat cramps usually occur during heavy activity. Medical professionals advise a person experiencing heat cramps to stop activity, sit quietly in a cool place, and sip water, clear juice, or a sports drink. Firm pressure on the muscles or a gentle massage of them will help to relieve the muscle cramps. Even after the cramps have disappeared, the individual should avoid returning to heavy exercise for a few hours, because this level of activity might lead to heat exhaustion or heat stroke. An individual whose cramps have not gone away within an hour should call a doctor.

Heat Exhaustion If the symptoms are severe, or if the person has heart disease or high blood pressure, someone should call for medical help immediately and either move the victim to a shaded area and fan the person's body or, if possible, move the person into an air-conditioned room. The individual should lie down and remove heavy clothing. Sips of water and placing cool, wet cloths on the skin are helpful. A cool shower or bath may also be beneficial.

Heat Stroke Heat stroke is a serious medical emergency, and onlookers should summon medical help right away. While waiting for

assistance, caregivers can help the person cool off by getting him or her out of the sun and fanning the patient or by moving the person into an air-conditioned room. There, the person should lie down and remove clothing. Applying cool, wet cloths, or putting the person in a cool bath or shower will help. If the humidity is low, another solution is to wrap the person in a cool, wet sheet. If the person is outside, spraying the person lightly with a garden hose can be effective. Those providing first aid should take the person's temperature regularly and continue the cooling efforts until the person's temperature drops to 101 to 102 degrees Fahrenheit. Sometimes the person's muscles may start to twitch wildly as a result of heat stroke. If this happens, the caregiver's job is to keep the person from getting hurt. The caregiver should not, however, put anything in the person's mouth or give anything to the person to drink. If vomiting occurs, the caregiver should keep the airway open by turning the person onto his or her side.

How Can Heat Injury Be Prevented?

The best ways to prevent heat-related injuries are to keep cool and use common sense. The following tips may help on hot summer days:

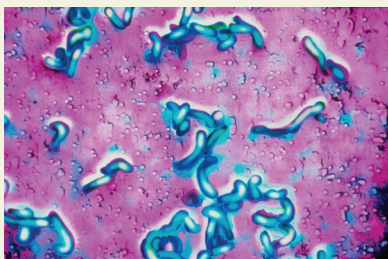
- Consume plenty of fluids, regardless of thirst. During heavy exercise in hot weather, individuals should drink at least two to four glasses of cool fluid each hour. Water is always a good drink choice. Avoid very cold drinks, which can cause stomach cramps; salt tablets; and caffeine-containing drinks, such as iced teas and colas, that cause the body to lose more fluid.
- Slow down the pace. During hot weather, cut back on heavy exercise, or move it to the coolest time of day, usually early in the morning.
- Stay indoors if possible. An electric fan can make the inside space more comfortable, but a fan alone may not be enough during a severe heat wave. Air conditioning is much more effective, so remaining in an air-conditioned home or spending a few hours at an air-conditioned mall or public library can help.
- Wear lightweight, loose-fitting, preferably light-colored clothing. Light-colored fabrics reflect away some of the sun's energy.
- Eat smaller, more frequent meals to avoid generating the extra body heat associated with digesting large meals.

▶ See also **Cold-Related Injuries • Fever**

Resources

Organizations

American Red Cross National Headquarters. 2025 E Street NW, Washington, DC, 20006. Telephone: 703-206-6000. Web site: <http://www.redcross.org/services/hss/tips/heat.html>.



▲
Scanning electron micrograph of *Helicobacter pylori* bacteria. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **ulcers** are open sores on the skin or the lining of a hollow body organ, such as the stomach or intestine. They may or may not be painful.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.bt.cdc.gov/disasters/extremeheat/heat_guide.asp.

Federal Emergency Management Agency. 500 C Street SW, Washington, DC, 20472. Toll free: 800-621-FEMA. Web site: <http://www.fema.gov/hazard/heat/index.shtm>.

National Weather Service, Office of Climate, Water, and Weather Services. 1325 East West Highway, Silver Spring, MD, 20910. Web site: http://www.nws.noaa.gov/om/brochures/heat_wave.shtml.

Helicobacter Pylori Infection

Helicobacter pylori (HEEL-ih-ko-bak-ter pie-LOR-eye) is a bacterium that can cause inflammation of the stomach and is associated with the development of peptic ulcers* and some types of stomach cancer.

What Is *H. pylori* Infection?

H. pylori is a spiral-shaped bacterium that has adapted to living in the stomach under the mucus gel. In order to survive, *H. pylori* burrows into the protective mucus lining the stomach. Once it gets into the mucus, it uses an enzyme to cause a chemical reaction that produces bicarbonate and ammonia. Both of these are strong bases that neutralize any stomach acid that reaches the bacterium. The immune system* responds to the presence of *H. pylori*. This can cause inflammation* of the lining of the stomach, a condition called gastritis (gah-STRY-tis). Some people go on to develop peptic ulcers. A peptic ulcer is a painful open sore that forms in the stomach or the duodenum. *H. pylori* infection is also associated with an increase in the likelihood of developing certain stomach cancers.

How Common Is *H. pylori* Infection?

In the United States, about 10 percent of children under the age of 12 are infected with *H. pylori*. This number increases with age until about half of all Americans over age 60 have the infection. The infection is much more common among African Americans, Hispanics, and Native Americans than among whites. The rate of infection is much higher in the developing world. Even though infection with *H. pylori* is associated with peptic ulcer, most people who are infected with the bacterium never experience any symptoms or develop a peptic ulcer.

Is *H. pylori* Infection Contagious?

H. pylori infection appears to be contagious, but as of 2009 it was not known how it spreads. Researchers suspected that the infection can be spread when an infected person passes the bacterium in feces (FEE-seez),

A VACATION LEADS TO A BREAKTHROUGH

In 1982 (John) Robin Warren (b. 1937), a biologist, and Barry J. Marshall (b. 1951), a physician, were the first researchers to discovered a link between stomach inflammation (gastritis), peptic ulcers, and a bacterium later known as *Helicobacter pylori*.

Originally, Warren and Marshall were unsuccessful in growing the bacterium Warren had found in stomach samples until cultures containing the bacterium were accidentally left to grow for an unusually long time because of a vacation break. It turned out that the *H. pylori* bacterium just took longer to grow than many other bacteria.

Warren and Marshall were able to show a connection between infection with *H. pylori* and peptic ulcers. For their work, they were awarded the Nobel Prize in Medicine and Physiology in 2005.

or bowel movements. When another person is exposed to the infected feces, whether by changing a diaper, cleaning a bathroom, or doing someone's laundry, that person could become infected with the bacterium. Mouth-to-mouth contact may also contribute to the spread of *H. pylori* infection. Some research has found *H. pylori* bacteria in saliva, leading researchers to suggest that kissing is one way that the bacteria spread. In addition, coming into contact with food, water, or vomited material that contains *H. pylori* bacteria may put a person at risk of infection.

What Are the Signs and Symptoms of *H. pylori* Infection?

H. pylori infection can cause a variety of symptoms, but the most common one is abdominal pain. About 90 percent of people with peptic ulcer disease are also infected with *H. pylori*. A person with peptic ulcer disease may feel a gnawing or burning pain below the ribs and above the navel. Abdominal pain from an ulcer usually occurs when the stomach is empty, typically several hours after eating or in the morning or evening hours. Eating food, drinking milk, or taking antacids may make the pain subside for a short time. Nonetheless, the vast majority of people infected with *H. pylori* have no symptoms.

Other symptoms of peptic ulcer disease are as follows:

- Frequently feeling sick to the stomach (nausea, NAW-zee-uh)
- Loss of appetite
- Frequent burping
- Sudden, sharp abdominal pain
- Weight loss
- Vomiting
- Bloody or black stools

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **antagonist** (an-TAG-oh-nist) a chemical that acts within the body to reduce or oppose the effects of another chemical.

Symptoms of stomach cancer are similar to those of peptic ulcer disease.

As of 2009, researchers did not fully understand the relationship between *H. pylori*, gastric inflammation, and peptic ulcers. For example, about 90 percent of people who have peptic ulcers are infected with *H. pylori*, but the vast majority of those infected do not develop an ulcer. About 10 percent of people with ulcers do not have *H. pylori* infections. Also, antibiotic treatment to rid the body of *H. pylori* does not, by itself, cure most ulcers.

How Is *H. pylori* Infection Diagnosed?

If a person has lasting abdominal pain or other symptoms of peptic ulcer disease, there are several methods a doctor can use to make a diagnosis. One of the most common ways to check for ulcers is with endoscopy (en-DOS-ko-pee). For this procedure, a person is given medication to relax and numb the throat. Then a doctor gently inserts an endoscope (a thin, flexible tube with a camera and light on the end) down the throat, through the esophagus, and into the stomach and intestines. The camera on the end of the endoscope allows the doctor to view the digestive system and take pictures of it. In addition, the doctor can perform a biopsy, removing a small amount of tissue for study. The biopsied tissue can be sent to a laboratory for further testing and to check for evidence of *H. pylori* infection.

A person suspected of having *H. pylori* infection might also undergo a breath test. During a breath test, a person drinks a liquid containing a carbon marker known as carbon-13 (^{13}C). The person then provides a breath sample by blowing up a balloon or blowing bubbles. The sample is checked for the presence of the ^{13}C marker. If the person has *H. pylori* infection, there will be traces of ^{13}C present in the carbon dioxide gas molecules of the person's breath.

A person's blood can also be checked for the presence of antibodies* to *H. pylori*, indicating infection.

How Is *H. pylori* Infection Treated?

People who are infected with *H. pylori* are treated for 10 to 14 days with what is called triple therapy. This approach consists of a combination of two or three antibiotic medicines that kill *H. pylori* bacteria and a drug that reduces acid production in the stomach. Two classes of drugs reduce acid production: histamine antagonists* and proton pump inhibitors. Patients may also take an antacid that temporarily helps coat the inside of the stomach. After treatment has been completed, tests sometimes are done to check that *H. pylori* infection has been eliminated. Reinfection is possible.

Although many people who are infected with *H. pylori* never have symptoms and never develop peptic ulcers, if left untreated ulcers can lead to serious problems. In some cases, the ulcer can make a hole all the way through the stomach or duodenum wall. In other cases, the ulcer or acid

breaks a blood vessel and causes serious internal bleeding. It is important to get medical help promptly for the following symptoms, which may signal a peptic ulcer or other serious problem:

- Sharp, sudden, or long-lasting stomach pain
- Bloody or black stools (bowel movements)
- Bloody vomit or vomit that looks like coffee grounds

Are There Complications of *H. pylori* Infection?

A person who has untreated *H. pylori* infection has an increased risk of developing stomach cancer later in life. Long-term loss of blood from the gastrointestinal tract due to ulcers can cause anemia*. Severe untreated ulcers can lead to a perforation, or a hole, when the sore erodes all the way through the lining of the stomach or intestine. Perforations can cause sudden severe bleeding and spread of infection into the abdominal cavity that can be fatal.

Can *H. pylori* Infection Be Prevented?

As of 2009, *H. pylori* infection could not be prevented. Researchers did not fully understand how *H. pylori* spreads or why some infected people develop ulcers and others do not. As a general precaution people should wash their hands thoroughly after going to the bathroom and before eating. They should eat food that has been properly cooked and drink water from a clean, safe source. As of 2009, there was no vaccine against *H. pylori* infection.

▶ See also **Intestinal Infections**

Resources

Books and Articles

Fleming, Shawna L. *Helicobacter Pylori*. New York: Chelsea House, 2007.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ulcer/keytocure.htm>.

Helicobacter Research Laboratory. Room 1.11, L Block QEII Medical Centre, Nedlands, Western Australia, Australia 6009. Telephone: +61 8 9346 4815. Web site: <http://www.hpylori.com.au>.

National Digestive Diseases Information Clearinghouse, National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health. 2 Information Way, Bethesda, MD, 20892. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/hpylori>.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **pancreas** (PAN-kree-us) is a gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.
- * **joints** are places in the body where two bones fit together, usually in such a way as to allow motion.
- * **hemoglobin** (HE-muh-glo-bin) is the oxygen-carrying pigment of the red blood cells.
- * **oxygen** (OK-si-jen) is an odorless, colorless gas essential for the human body. It is taken in through the lungs and delivered to the body by the bloodstream.
- * **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.
- * **metabolism** (meh-TAB-o-liz-um) is the process in the body that converts foods into the energy necessary for body functions.
- * **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.
- * **small intestine** is the part of the intestines—the system of muscular tubes that food passes through during digestion—that directly receives the food when it passes through the stomach.
- * **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

Heller's Syndrome See *Childhood Disintegrative Disorder (Heller's Syndrome)*.

Hemochromatosis

Hemochromatosis (HE-mo-KRO-ma-TOE-sis), also called iron overload disease, is a disorder in which too much iron is absorbed from food and builds up in the body. Hemochromatosis is usually an inherited disorder.

What Is Hemochromatosis?

Iron is an essential mineral obtained from food. The human body normally absorbs about 10 percent of the iron in food. People with hemochromatosis absorb excess iron. Because the body does not have a mechanism for removing the excess iron, it is stored in tissues, particularly in the skin, liver*, heart, pancreas*, and joints*. The iron can damage these organs and, without treatment, eventually cause them to fail, possibly leading to death.

Iron metabolism Most of the iron in the body is contained in hemoglobin* molecules in red blood cells, where it is responsible for transporting oxygen* to body tissues. Iron is also required to store oxygen in muscles as myoglobin and to make DNA*. However, excess iron is a deadly poison. Therefore, the body has an elaborate system for ensuring that the only the correct amount of iron is absorbed.

In normal iron metabolism* about 90 percent of the iron in the diet is taken up by specific cells in the intestinal tract. When these cells are filled with iron, they die and are excreted in the feces*. The other 10 percent of iron is used by the body. Heme iron, the form of iron in hemoglobin and myoglobin, is readily absorbed by the body from dietary meat. However, most dietary iron is non-heme iron. Stomach acid converts non-heme iron into a form that is easily absorbed by the duodenum of the small intestine*. From there it is carried in the bloodstream by a protein called transferrin, which is normally 25 to 35 percent saturated (filled) with iron. If the transferrin is too heavily loaded, it loses its ability to bind iron, resulting in free iron in the blood. Reactions with free iron produce chemicals called free radicals that are very destructive to cells and tissues. In addition, free iron can nourish bacteria* that are normally harmless but that can cause life-threatening infections in people with high iron levels. Cancer* cells also thrive on iron.

Ferritin is a protein that stores unneeded iron in almost every cell of the body. One ferritin molecule can hold up to 4,500 atoms of iron. However, when ferritin is overloaded with iron, it turns into a substance called hemosiderin, which contains ferric oxide or rust. Large amounts of hemosiderin disrupt organ function. For example, if cells in the pancreas are overloaded with hemosiderin, they cannot produce insulin*, resulting in diabetes*.

In addition to transferrin, there are two other transporters of free iron: Divalent metal transporter 1 carries free iron from the bloodstream into cells and ferroportin carries iron out of cells into the bloodstream.

What Are the Types of Hemochromatosis?

Primary or hereditary hemochromatosis is caused by mutations* in genes* that code for the proteins involved in regulating the absorption, transport, and storage of iron in the body. Primary hemochromatosis is categorized according to the age of onset, the genetic* cause, and the mode of inheritance.

Type 1 Type 1 hemochromatosis is one of the most common inherited disorders in the United States, affecting about one million people. It generally affects men between the ages of 40 and 60 and post-menopausal women, probably because women lose iron through menstruation*, pregnancy, and breastfeeding, and, therefore, tend to develop iron-overload symptoms later than men.

Type 1 hemochromatosis is caused by mutations in the hemochromatosis gene—called HFE—which encodes a protein located on the surface of intestinal and liver cells, as well as some immune system* cells. This protein helps the cells regulate the absorption of iron into the small intestine. It also helps control the levels of the protein called hepcidin, which circulates in the blood and prevents excessive iron absorption by the small intestine. More than 20 different mutations that cause type 1 hemochromatosis have been identified in the HFE gene. The two most common mutations prevent the HFE protein from reaching the cell surface.

About 10 percent of the American population are believed to carry at least one of the genes that cause hemochromatosis. However, only people with two defective copies of HFE—one inherited from each parent—will develop type 1 hemochromatosis. In fact, it is estimated that no more than one-half of those with two defective HFE genes actually develop symptoms of hemochromatosis, although they will pass one defective gene on to all of their children.

Other primary hemochromatoses The other types of hemochromatosis are quite rare and had not been studied fully as of 2009.

The iron accumulation and symptoms of type 2 or juvenile-onset hemochromatosis begin in early childhood. They are caused by mutations in either the hepcidin antimicrobial peptide (HAMP) gene or the

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

* **insulin** is a kind of hormone, or chemical produced in the body, that is crucial in controlling the level of glucose (sugar) in the blood and in helping the body use glucose to produce energy. When the body cannot produce or use insulin properly, a person must take insulin or other medications.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **mutations** (mu-TAY-shuns) are changes in a chromosome or a gene.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **menstruation** (men-stroo-AY-shun) is the discharge of the blood-enriched lining of the uterus. Menstruation normally occurs in females who are physically mature enough to bear children. Most girls have their first period between the age of 9 and 16. Menstruation ceases during pregnancy and with the onset of menopause. Because it usually occurs at about four-week intervals, it is often called the monthly period.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **infectious** means able to spread to others.

* **tuberculosis** (too-ber-kyoo-LO-sis) is a bacterial infection that primarily attacks the lungs but can spread to other parts of the body.

* **plague** (PLAYG) is a serious bacterial infection that is spread to humans by infected rodents and their fleas.

* **receptors** are cell structures that form a chemical bond with specific substances, such as neurotransmitters. This leads to a specific effect.

* **neonatal** (ne-o-NAY-tal) means pertaining to the first 4 weeks after birth.

WHY ARE HEMOCHROMATOSIS GENE MUTATIONS SO COMMON?

Type 1 hemochromatosis is very common in people of Northern European descent. In some parts of Europe as many as one in three may carry an HFE gene mutation. These people usually have a slightly increased level of iron in their bodies. Sharon Moalem and his colleagues at Mount Sinai School of Medicine in New York have hypothesized that hemochromatosis may confer protection against some deadly infectious* diseases, such as tuberculosis* and the Black Death or plague*. The bacteria responsible for these diseases sneak into the body in immune-system cells called macrophages where they thrive on iron. However, despite higher levels of iron in their blood and organs, people with hemochromatosis have much lower levels of iron in their macrophages. Thus, hemochromatosis may have conferred resistance to the pandemics of plague that swept through Europe from the 14th to the 18th centuries.

hemochromatosis type 2 (juvenile) gene called HFE2. The HAMP gene produces hepcidin, which was originally identified by its ability to fight bacterial infections. There are at least eight mutations in HAMP that lead to type 2 hemochromatosis. The HFE2 gene encodes a protein called hemojuvelin, which regulates the level of hepcidin. More than 20 mutations that cause type 2 hemochromatosis have been identified in HFE2. As with HFE, only those with two defective copies of HAMP or HFE2 develop hemochromatosis.

Symptoms of type 3 hemochromatosis are usually evident by age 30. They are caused by mutations in the TFR2 gene that produces transferrin receptors* on liver cells. This receptor binds transferrin for iron transport into cells. This receptor also helps control the levels of hepcidin. There are at least nine different mutations in TFR2 that cause type 3 hemochromatosis. Again, two defective TRF2 genes are required for the development of type 3 hemochromatosis.

Type 4 hemochromatosis, also called ferroportin disease, usually affects men between the ages of 40 and 60 and post-menopausal women. It is caused by mutations in the SLC40A1 gene that encodes ferroportin 1. These mutations produce abnormal ferroportin 1 proteins that do not correctly transport iron out of cells and release it to transferrin in the blood. About 15 mutations have been identified in SLC40A1 that cause type 4 hemochromatosis. Only one defective copy of SLC40A1 is sufficient to cause type 4 hemochromatosis.

Neonatal* hemochromatosis is a rare condition in which iron accumulation begins before birth. It progresses rapidly and liver damage is apparent at birth. The cause of neonatal hemochromatosis is unknown.

Secondary hemochromatosis Secondary hemochromatosis is iron overload caused by some other disease or condition. These include the following:

- Certain types of anemia*
- African iron overload, which is a combination of heredity and diet
- Other rare inherited disorders
- Chronic liver diseases, such as hepatitis*
- Overloading the body with iron via oral supplements or injected medication, blood transfusions*, or long-term kidney* dialysis*.

How Do People Know They Have Hemochromatosis?

Many people with hemochromatosis never experience symptoms or complications, despite having high levels of iron in their bodies. For example, people who frequently donate blood may be unwittingly treating themselves for hemochromatosis. Other people suffer from serious complications and may die of the disease.

Early symptoms of hemochromatosis are nonspecific and may include the following:

- Fatigue
- Weakness
- Joint pain
- Abdominal pain
- Weight loss
- Palpitations—a fluttering sensation in the chest
- Loss of sex drive

Later symptoms of hemochromatosis may include:

- Severe fatigue
- Skin discoloration
- Arthritis*
- Chronic abdominal* pain
- Heart abnormalities
- Liver disease, including liver enlargement, cirrhosis*, cancer, or liver failure
- Low hormone* production by the pituitary* and thyroid gland*
- Damage to the adrenal glands*
- Diabetes mellitus
- Reproductive organ failure, including shrinkage of the testicles*, infertility*, or early menopause*

The decreased secretion or absence of sex hormones caused by type 2 hemochromatosis becomes evident during adolescence. Females usually

What Is “Bronze Diabetes?”

Hemochromatosis was probably first identified in 1865 by the French physician Armand Trousseau (1801–1867). He called it bronze diabetes because his patients appeared tanned from iron deposits in the skin and had symptoms of diabetes due to pancreatic damage.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

* **hepatitis** (heh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.

* **blood transfusions** (trans-FYOO-zhunz) are procedures in which blood or certain parts of blood (such as specific cells) are given to a person who needs them due to illness or blood loss.

* **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **dialysis** (dye-AL-uh-sis) is a process that removes waste, toxins (poisons), and extra fluid from the blood. Usually dialysis is done when a person’s kidneys are unable to perform these functions normally.

* **arthritis** (ar-THRY-tis) refers to any of several disorders characterized by inflammation of the joints.

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

- * **cirrhosis** (sir-O-sis) is a condition that affects the liver, involving long-term inflammation and scarring, which can lead to problems with liver function.
- * **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **pituitary** (pih-TOO-ih-tare-e) is a small oval-shaped gland at the base of the skull that produces several hormones—substances that affect various body functions, including growth.
- * **thyroid gland** (THY-roid GLAND) is located in the lower part of the front of the neck. The thyroid produces hormones that regulate the body's metabolism (me-TAB-o-LIZ-um), the processes the body uses to produce energy, to grow, and to maintain body tissues.
- * **adrenal glands** (a-DREEN-al glands) are the pair of endocrine organs located near the kidneys.
- * **testicles** (TES-tih-kulz) are the paired male reproductive glands that produce sperm.
- * **infertility** (in-fer-TIH-lih-tee) is the inability of females to become pregnant or of males to cause pregnancy.
- * **menopause** (MEN-o-pawz) is the end of menstruation.
- * **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.
- * **impotence** (IM-po-tens) is failure of a man to achieve or to maintain an erection.
- * **heart disease** is a broad term that covers many conditions that prevent the heart from working properly to pump blood throughout the body.

begin menstruation normally, but menses stops after a few years. Male puberty* may be delayed or symptoms of sex-hormone deficiency, such as impotence*, become evident. Untreated, type 2 hemochromatosis leads to heart disease* by the age of 30.

How Do Doctors Diagnose and Treat Hemochromatosis?

Diagnosis Hemochromatosis is diagnosed by a physical exam, medical and family histories, and various tests. Dietary causes—such as iron supplements—must be ruled out. Excessive vitamin C supplements can cause symptoms of iron overload because vitamin C increases the amount of iron absorbed by the body. Genetic* tests can determine the presence of gene(s) responsible for hemochromatosis; however, genetic screening may overlook rarer mutations.

Diagnostic tests include the following:

- Transferrin saturation (TS) that measures the iron load of transferrin in the blood
- Serum ferritin that may indicate the buildup of iron in organs
- The total amount of iron in the blood, although this may be normal even with hemochromatosis

Quantitative phlebotomy—a series of measured blood withdrawals—should lower test results.

Liver damage from hemochromatosis may be determined by the following:

- Blood tests for liver function
- MRI* to visualize the amount of iron in the liver
- A superconducting quantum interference device that can measure the amount of iron in the liver
- A liver biopsy* to measure the iron level in the liver and diagnose liver damage.

Treatment Early diagnosis and treatment can prevent or delay—and sometimes reverse—the complications of hemochromatosis. The goals of treatment are to do the following:

- Reduce the iron in the body to normal levels and maintain these levels over the long term
- Prevent or delay organ damage
- Treat complications

The most common treatment for hemochromatosis is therapeutic phlebotomy, in which blood is periodically withdrawn through a vein*. Treatment usually begins shortly after diagnosis. One or two pints of blood are withdrawn once or twice per week for six months to three years. Once iron levels have returned to normal, phlebotomy may be reduced to about every three months.

People who cannot undergo periodic phlebotomy may be treated with iron chelation therapy. These are oral or injected medications that bind to iron and remove it from the body in the urine or feces.

Hemochromatosis is also treated with dietary measures including the following:

- Avoidance of any iron supplementation
- A limit of 200 milligrams per day of vitamin C supplements
- Limited red meat—the most readily absorbed form of iron
- Increased fiber, which inhibits iron absorption
- If not contraindicated, coffee or tea consumption with meals to inhibit iron absorption
- Abstinence or limited alcohol, because alcohol enhances iron absorption and can exacerbate liver damage
- Fresh fruits and vegetables, which contain antioxidants that help protect against free-radical damage caused by iron

Can Hemochromatosis Be Prevented?

Most people do not know that they have hemochromatosis until organ damage occurs. Genetic testing and counseling can advise parents on the likelihood that they will pass on hemochromatosis genes to their children. Although routine genetic screening can identify most people who are at high risk for hemochromatosis, the majority of these people will never develop the disease. However, close relatives of those diagnosed with hemochromatosis should have their iron levels tested before symptoms and possible organ damage occur.

Although there is no way to prevent hemochromatosis in genetically susceptible people, environmental and lifestyle factors can affect the onset and progression of symptoms. These factors include the following:

- The amount of iron in the diet
- Alcohol consumption
- Infections such as hepatitis, which can increase liver damage
- Uncooked fish or shellfish, which may contain bacteria that cause infection in people with hemochromatosis

Resources

Books and Articles

Garrison, Cheryl, and Richard A. Passwater. *The Hemochromatosis Cookbook: Recipes and Meals for Reducing the Absorption of Iron in Your Diet*. Nashville, TN: Cumberland House, 2008.

Medifocus Guidebook: Hereditary Hemochromatosis. Silver Spring, MD: Medifocus.com, 2008.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **vein** a vessel that carries blood to the heart. Veins have greater capacity and thinner walls than arteries and contain valves that prevent blood from flowing backward and away from the heart.

- * **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.
- * **hemoglobin** (HE-muh-glo-bin) is the oxygen-carrying pigment of the red blood cells.
- * **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.
- * **oxygen** (OK-si-jen) is an odorless, colorless gas essential for the human body. It is taken in through the lungs and delivered to the body by the bloodstream.
- * **sickle-cell anemia** also called sickle-cell disease, is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.
- * **blood transfusion** is the process of giving blood (or certain cells or chemicals found in the blood) to a person who needs it due to illness or blood loss.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.

Moalem, Sharon. "Survival of the Sickest." *New Scientist* 193 (February 17–23, 2007): 42–45.

Organizations

American Hemochromatosis Society. 4044 W. Lake Mary Boulevard, Unit #104, PMB 416, Lake Mary, FL, 32746-2012. Toll free: 888-655-IRON. Web site: <http://www.americanhs.org>.

Iron Disorders Institute. 2722 Wade Hampton Boulevard, Suite A, Greenville, SC, 29615. Toll free: 888-565-IRON. Web site: <http://www.irondisorders.org>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: <http://www.nhlbi.nih.gov/health>.

Hemoglobinopathies

Hemoglobinopathies (he-muy-glo-bin-AH-path-ees) are inherited disorders caused by defects in the genes that code for hemoglobin* (Hb). Hemoglobinopathies are characterized by low levels of hemoglobin protein and/or low production and high turnover of red blood cells, resulting in anemia* and body tissues that are starved for oxygen*. The most common hemoglobinopathies are sickle-cell anemia* and thalassemia (thal-ab-SE-me-ah).*

Sophia's Story

Sophia was resting on the sofa when her teacher called her mother. Sophia had fallen asleep in class again. "I couldn't help it, Mom. I was just so tired and my legs hurt." Sophia's mother reached for the telephone to schedule a blood transfusion*. "No," cried Sophia. "I hate those. And there are other kids who need that blood a lot more than I do." Sophia's mother reminded her that all of their friends had donated blood so that it would be available for Sophia when she needed it.

Initially, her parents had thought Sophia was just small for her age. Then the doctor diagnosed Sophia as anemic and prescribed iron supplements to increase her red-blood-cell (RBC) count. The iron did not help. Sophia's growth was delayed and she tired very easily. Then her liver* and spleen* became enlarged and her skin yellowed with jaundice*.

Her parents were mystified when the specialist diagnosed Sophia with a genetic* disease—beta thalassemia or Mediterranean anemia. No one in either of their large Greek and Italian families had ever had anemia. And Sophia's older brother was perfectly healthy. But blood tests showed that both of Sophia's parents carried a beta thalassemia trait: They each had one normal gene coding for the beta-globin chain of hemoglobin and one abnormal thalassemia gene. Their normal gene made enough beta-globin

so their mild anemia had never been detected. However, Sophia had inherited an abnormal thalassemia gene from each of her parents. Her brother had inherited the two normal genes.

Immediately after her blood transfusion Sophia returned to school and resumed her normal activities. It could have been much worse. Sophia had beta thalassemia intermedia. Her body made enough beta-globin that, with occasional blood transfusions, she could remain healthy and live a normal life. Had she been diagnosed with beta thalassemia major, near-weekly transfusions would have been required to keep her alive.

What Are Hemoglobinopathies?

Hemoglobinopathies cause anemia—the blood does not contain enough properly functioning RBCs to carry enough oxygen to all the cells of the body. Hemoglobinopathies are autosomal dominant* recessive* genetic disorders. Autosomal genes are located on chromosomes other than the X or Y sex chromosomes*. Therefore, defects in these genes affect males and females equally. Recessive traits usually only cause serious problems if two or more of the recessive genes are present.

Hemoglobin Hemoglobin is the protein that is responsible for carrying oxygen from the lungs to cells throughout the body and transporting carbon dioxide* from the cells back to the lungs. RBCs or erythrocytes (e-RITH-ro-sites) are the most abundant cells in the blood, and each RBC contains about 300 hemoglobin molecules.

Normal RBCs survive about 120 days. Dying RBCs are engulfed by cells called macrophages (MAK-ro-fayj-ez) in the spleen. More than 2 million RBCs die every second and must be replaced at exactly the same rate by the bone marrow*.

Hemoglobin is made up of four protein chains called globins—two alpha-globins and two beta-globins. Hemoglobinopathies are caused by defects in the genes encoding these globins. These altered genes result in abnormal hemoglobin proteins that are inefficient at transporting oxygen. They may also slow down the rate of hemoglobin production in the bone marrow and speed up the destruction of RBCs by the spleen, a condition called hemolytic* anemia.

Sickle-cell anemia Sickle-cell anemia is the most familiar hemoglobinopathy. HbS makes the RBCs sickle- or crescent-shaped rather than disc-shaped. These cells carry less oxygen than normal RBCs. They are fragile and more easily destroyed than normal RBCs, with a lifespan of only 10 to 20 days. The destruction of RBCs causes accumulation of the hemoglobin breakdown product bilirubin*, resulting in jaundice. The bone marrow cannot replace the RBCs fast enough. In addition, their sickle shape prevents the RBCs from flowing easily. They tend to bunch up and clog small blood vessels. Oxygen starvation and blockage of blood vessels can cause severe inflammation*, pain, and tissue damage, precipitating sickle-cell crises.

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **autosomal dominant** mode of inheritance in which only one copy of an abnormal gene is necessary to cause disease.

* **recessive** describes a gene that is not dominant, one that requires a second identical recessive gene in order for the trait to show in the individual. When a recessive gene is paired with a dominant one, the individual is said to be a carrier of the trait.

* **chromosomes** (KRO-mo-somz) are threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.

* **carbon dioxide** (CAR-bon dy-OK-side) is an odorless, colorless gas that is formed in the tissues and breathed out through the lungs.

* **bone marrow** is the soft tissue inside bones where blood cells are made.

* **hemolytic** (he-mo-LIT-ik) refers to destruction of red blood cells with the release of hemoglobin into the bloodstream.

- * **bilirubin** (bih-lih-ROO-bin) is a substance that the body produces when hemoglobin, an iron-containing component of the blood, is broken down.
- * **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.
- * **malaria** (mah-LAIR-e-uh) is a disease spread to humans by the bite of an infected mosquito.

WHAT ARE UNUSUAL HEMOGLOBINS?

Normal adult hemoglobin is designated HbA or AA. People with sickle-cell anemia have only hemoglobin S (HbS or SS). In the late 1940s, using a procedure called electrophoresis (e-lek-tro-fo-REE-sis), Linus Pauling and Harvey Itano showed that in an electric field HbS moves more slowly toward the positive electrode than HbA. They concluded that HbS was slightly less negatively charged than HbA. Later, Vernon Ingram demonstrated that HbS differs from HbA in a single amino acid of its beta-globin, with an uncharged amino acid replacing a negatively charged amino acid. Electrophoresis continued to be used in the early 2000s to identify different types of hemoglobin.

Hundreds of unusual hemoglobins are now known. The most common are:

- HbS (sickle)
- Hb β Thal (beta thalassemia)
- HbH
- HbC
- HbE
- HbD (Punjab)

Only those who inherit two *HbS* genes (SS), one from each parent, have sickle-cell anemia. Those with one *HbS* gene and one normal *HbA* gene (SA) have sickle-cell trait. Only about 45 percent of their hemoglobin is HbS and only about 1 percent of their RBCs undergo sickling. SA individuals are not only usually healthy, they have increased resistance to malaria*, an often fatal disease in Africa where *HbS* is common.

Thalassemias Whereas sickle-cell anemia is a well-defined disorder, thalassemias are a range of disorders in which the rate of Hb production in the bone marrow is low and the turnover of RBCs is excessive. Alpha thalassemias are caused by defects in genes encoding alpha-globins. Beta thalassemias are caused by defects in genes encoding beta-globins. Thalassemias are classified as minor or major, depending on the degree of deficiency in the affected globin and the resulting severity of the anemia.

Four genes, two inherited from each parent, are required to make sufficient alpha-globin. Therefore, there are multiple types of alpha thalassemias:

- *Silent carrier* is the alteration or absence of one alpha-globin gene. The reduction in hemoglobin is so small that it is not usually diagnosed unless the person has a child with thalassemia.
- *Alpha thalassemia trait, mild alpha thalassemia, or alpha thalassemia minor* is the presence of two defective alpha-globin genes. This condition can cause mild anemia.

- *Hemoglobin H disease* is caused by the presence of three defective alpha-globin genes. HbH is the abnormal hemoglobin formed by the remaining beta chains. It destroys RBCs, causing severe anemia and other health problems.
- *Alpha thalassemia major* or *hydrops fetalis* is the most severe thalassemia in which all four alpha-globin genes are defective. It usually causes death before or shortly after birth.

Beta thalassemia minor or beta thalassemia trait, with one defective beta-globin gene, can result in mild anemia. If both beta-globin genes are altered, the severity of the condition depends the specific genetic changes. It may be referred to as one of the following:

- Beta thalassemia intermedia
- Beta thalassemia major
- Cooley's anemia
- Mediterranean anemia
- Beta-zero thalassemia
- Beta-plus thalassemia

The distinction between beta thalassemias intermedia and major is usually based on the latter's requirement for regular life-sustaining blood transfusions.

Rare hemoglobinopathies Hemoglobin C and hemoglobin E diseases are rare hemoglobinopathies in which abnormally shaped RBCs are subject to excessive destruction, resulting in chronic* hemolytic anemia. Whereas hemoglobin C disease is similar to sickle-cell anemia, hemoglobin E disease rarely causes symptoms other than anemia. *HbE* is common among Southeast Asians.

Other hemoglobinopathies result from rare combinations of abnormal hemoglobins:

- HbE plus Hb β Thal causes hemoglobin E disease or E beta thalassemia, a moderately severe anemia.
- HbS plus Hb β Thal causes sickle beta thalassemia, a sickle-cell disease of varying severity, depending on the amount of beta-globin produced. It usually occurs in people of Mediterranean ancestry.
- HbS plus HbC causes hemoglobin S-C disease or sickle-hemoglobin C disease.
- HbS plus HbD causes a rare form of sickle-cell disease.

How Common Are Hemoglobinopathies?

Most hemoglobinopathies are relatively rare. However, sickle-cell disease affects millions of people worldwide. In West and Central Africa 25 percent of the population has sickle-cell trait and 1 to 2 percent of babies are born with sickle-cell disease. In the United States more than 70,000 people have sickle-cell disease and 2 million carry sickle-cell trait. One in every

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

500 African Americans is born with the disease and one in 12 has sickle-cell trait.

Thalassemia affects about 1,000 Americans. Alpha thalassemias occur most often in Chinese and Southeast Asians. Beta thalassemias occurs most often in people of Mediterranean origin and, to a lesser extent, in Chinese and other Asians and in blacks.

Hemoglobin C disease is most common among blacks and about 2 to 3 percent of African Americans carry one copy of the *HbC* gene. However, hemoglobin S-C disease is more common than hemoglobin C disease.

What Are the Symptoms of Hemoglobinopathies?

The symptoms of serious hemoglobinopathies usually develop in infancy, as the bone marrow switches production from fetal to adult hemoglobin. Symptoms depend on the severity of the anemia caused by the specific genetic defect. Other symptoms, such as jaundice and enlargement of the spleen, reflect the excessive destruction of RBCs.

Common symptoms of sickle-cell disease include the following:

- Delayed growth and puberty*
- Paleness
- Shortness of breath
- Fatigue
- Rapid heart rate
- Fever
- Abdominal* pain
- Bone pain
- Ulcers on the lower legs
- Frequent infections

Thalassemia minor does not necessarily produce symptoms, although the RBCs are small. However, babies with hemoglobin H disease or beta thalassemia major develop severe anemia during the first year of life, resulting in slow growth, abnormal bone development, especially of the facial bones, and enlarged liver and spleen. Other symptoms may be similar to those of sickle-cell disease.

How Are Hemoglobinopathies Diagnosed and Treated?

Severe hemoglobinopathies are usually diagnosed in early childhood. The primary diagnostic is hemoglobin electrophoresis, which measures the amounts of the different types of hemoglobin in the blood. Other tests for hemoglobinopathies may include:

- Complete blood cell count (CBC)
- Peripheral blood smear for examining the size and shape of RBCs, since their appearance is often diagnostic for a specific hemoglobinopathy

- Serum hemoglobin to measure of the amount of hemoglobin in the blood outside of the RBCs, which may be elevated with hemoglobinopathy
- DNA testing to determine the specific genetic defect

Treatments Severe hemoglobinopathies require intensive lifelong medical care. Bone marrow transplants*, especially in children, can sometimes cure sickle-cell disease and thalassemias. However, it is often very difficult to find a suitable bone marrow donor. Other treatments for hemoglobinopathies include:

- Folic acid supplements to stimulate RBC production
- Antibiotics* and vaccines* to prevent infections
- Drugs to stimulate RBC production
- Blood transfusions
- Hydroxyurea, which can help prevent sickling and reduce the frequency of sickle-cell crises. It may also increase the amount of fetal hemoglobin that is produced, thereby reducing the need for blood transfusions to treat thalassemia.

Other treatments for sickle-cell and hemoglobin E diseases are directed at managing and controlling symptoms and preventing crises. These include:

- Medications for pain
- Intravenous fluids to offset dehydration* and help keep cells from sickling
- Oxygen therapy

Periodic RBC transfusions alleviate symptoms and improve the quality of life for those with beta thalassemia intermedia. Treatment of beta thalassemia major requires transfusions as often as every two to four weeks throughout life. Because frequent blood transfusions can lead to a dangerous accumulation of iron in the body, patients must undergo iron chelation therapy with chelating drugs that bind the iron and remove it from the body. In the past this procedure was difficult and painful, and many thalassemia patients shortened their lives significantly by failing to comply with the therapy. Fortunately, the use of oral chelating drugs replaced older chelation therapies.

Complications of sickle-cell disease Sickle-cell disease and other hemoglobinopathies render people very susceptible to infections. In the United States, babies are tested for HbS as part of routine newborn screening, regardless of their ethnic background. Before screening became commonplace, many infants with sickle-cell disease died from infections. The use of preventative antibiotics and a full immunization regimen significantly reduced this infant mortality.

In addition to the symptoms and complications of anemia, most people with sickle-cell disease experience critical illnesses called crises. These

* **transplants** (TRANS-plantz) are organs or tissues from another body used to replace a poorly functioning organ or tissue.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

* **vaccines** (vak-SEENS) are preparations of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

- * **gene therapy** is a treatment that works by altering genes.
- * **remission** is an easing of a disease or its symptoms for a prolonged period.
- * **gallstones** (GAWL-stonz) are hard masses that form in the gallbladder or bile duct.
- * **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.
- * **pulmonary** refers to the lungs.
- * **hypertension** (HI-per-ten-chen) is abnormally high arterial blood pressure.
- * **heart attack** is a general term that usually refers to a sudden, intense episode of heart injury. It is usually caused by a blockage of a coronary artery, which stops blood from supplying the heart muscle with oxygen.
- * **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

CAN GENE THERAPY CURE HEMOGLOBINOPATHIES?

In the late 20th century and early 2000s, scientists hoped to eventually cure hemoglobinopathies by replacing the defective genes with normal ones. Because they were among the best understood genetic disorders, sickle-cell disease and thalassemia were early targets of gene therapy* experiments. In 1980 Martin Cline, the California scientist who created the first transgenic mouse, performed unauthorized gene therapy experiments on two individuals with hemoglobinopathy. In addition to censure by the scientific community and public alarm over the consequences of genetic experimentation, Cline's attempts demonstrated that these diseases were not amenable to simple gene therapy cures.

begin suddenly when clumping of sickled RBCs obstructs the normal flow of blood, depriving tissues and organs of oxygen. Specific types of sickle-cell crises are as follows:

- Hemolytic crisis from the breakdown of damaged RBCs
- Splenic sequestration crisis due to enlargement of the spleen from trapping RBCs
- Aplastic crisis from an infection that prevents the bone marrow from producing new RBCs

Sickle-cell crises can last for hours or days. Many people experience long periods of remission* during which they may feel relatively well. Others experience pain on a daily basis and may be hospitalized with crises several times per year.

Sickle-cell crises can damage almost any part of the body. People with sickle-cell disease are particularly susceptible to the following:

- Gallstones*
- Liver problems
- Kidney* failure
- Bone disease
- Pulmonary* hypertension*
- Heart attack*
- Stroke*

In the past most people with sickle-cell disease died from organ failure between the ages of 20 and 40; however, with better treatment and disease management, their life expectancy in the United States rose to over 50 years.

Complications of thalassemia Beta thalassemia major has a great many potential complications, including the following:

- Impaired growth
- Delayed puberty
- Liver problems
- Gallstones
- Osteoporosis*

Iron accumulation from transfusions and increased iron absorption from food damages glands* and organs, especially the heart. Heart failure* at a young age is the leading cause of death among people with thalassemia. Infections are also a major cause of death. However, with improved medical treatments, children with beta thalassemia major are living well into adulthood.

Can Hemoglobinopathies Be Prevented?

Prospective parents who may be carrying a hemoglobinopathy gene can choose to be tested and receive genetic counseling before having children. Prenatal* screening is also available for fetuses at high-risk for hemoglobinopathies.

Couples at risk for these genetic diseases can also use preimplantation genetic diagnosis as a method for reproducing without transmitting their genetic disorder. Designed in the early 1990s, this technology is an established reproductive option worldwide at centers specializing in it. The process involves *in vitro** fertilization and *in vitro* embryo culture*. The fertilized egg goes through cell division over the next several days and when a blastocyst (a clump of cells destined to develop into a fetus) has formed, a biopsy* is performed to test it for the genetic condition. Unaffected embryos (not more than two) are transferred to the mother's uterus.

HOW ARE HEMOGLOBINOPATHIES INHERITED?

If "A" represents a normal hemoglobin gene and "X" represents a gene causing a hemoglobinopathy, normal adults are designated AA, with two normal hemoglobin genes. Carriers can be designated AX, with one gene encoding a normal hemoglobin and one gene encoding an abnormal hemoglobin. Carriers may have no symptoms and may be unaware that they have some abnormal hemoglobin. Among the children of an AA adult and an AX adult, 50 percent will be AA and 50 percent will be AX. Among the offspring of two AX adults, 25 percent will be AA, 50 percent will be AX, and 25 percent will be XX and have a serious hemoglobinopathy. All of the children of an AA adult and an XX adult will be AX carriers. All of the children of two XX adults will be XX and have a hemoglobinopathy.

* **osteoporosis** (os-te-o-por-O-sis) is the loss of material from the bone. This makes the bones weak and brittle.

* **glands** are organs that produce substances such as hormones and chemicals that regulate body functions.

* **heart failure** is a medical term used to describe a condition in which a damaged heart cannot pump enough blood to meet the oxygen and nutrient demands of the body. People with heart failure may find it hard to exercise due to the insufficient blood flow, but many people live a long time with heart failure.

* **prenatal** (pre-NAY-tal) means existing or occurring before birth, with reference to the fetus.

* **in vitro** in the laboratory or other artificial environment rather than in the living body.

* **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.

▶ See also **Anemia, Bleeding, and Clotting • Genetic Diseases • Sickle-cell Anemia**

Resources

Books and Articles

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Bain, Barbara J. *Hemoglobinopathy Diagnosis*, 2nd ed. Malden, MA: Blackwell, 2006.

Peak, Elizabeth. *Sickle Cell Disease*. Detroit, MI: Lucent Books, 2008.

Organizations

Cooley's Anemia Foundation. 330 Seventh Avenue, No. 900, New York, NY, 10001. Toll free: 800-522-7222. Web site: <http://www.thalassemia.org>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: <http://www.nhlbi.nih.gov/health>.

Sickle Cell Disease Association of America. 231 East Baltimore Street, Suite 800, Baltimore, MD, 21202. Toll free: 800-421-8453. Web site: <http://www.sicklecelldisease.org>.

Hemophilia See *Anemia, Bleeding, and Clotting*.

Hemorrhage See *Anemia, Bleeding, and Clotting*.

Hemorrhoids

Hemorrhoids (HEM-o-roids), sometimes called piles, are enlarged veins in the rectum, which is the lower portion of the digestive tract. They are similar to varicose veins of the legs. Hemorrhoids may bleed and cause pain.

Where Do People Get Hemorrhoids?

Hemorrhoids occur in two places. When they are located in the upper part of the rectum*, the hemorrhoids are called internal hemorrhoids. In the lower part of the rectum, they are called external hemorrhoids.

Hemorrhoids are said to be prolapsed if they have slipped down from their usual position and extend outside of the anal* opening.

What Causes Hemorrhoids?

Hemorrhoids have a number of different causes. They occur often in women who are pregnant or who have just given birth. People with chronic constipation are at risk for hemorrhoids because of added pressure to the anorectal (pertaining to the anus and rectum) area when they pass stools (solid waste matter, feces) that are hard and dry.

What Are the Symptoms of Hemorrhoids?

Pain during bowel movements and blood in the stool are the usual symptoms that accompany hemorrhoids. Sometimes there is a discharge of mucus, and there may also be itching, burning, or pain in the area. The enlarged vein in the rectum sometimes develops a clot, which can be very painful. People with hemorrhoids sometimes develop iron deficiency anemia* from the bleeding that occurs.

How Are Hemorrhoids Diagnosed and Treated?

The doctor first examines the anal area through a viewing tube called an anoscope to rule out other conditions that cause similar symptoms. For mild cases of hemorrhoids, doctors may recommend the following:

- a diet with adequate amounts of fiber (whole grains, vegetables, and fruit) to prevent constipation
- drinking lots of liquids to prevent constipation
- sitz baths, which are shallow baths of warm water
- medicines that soften stools and make them easy to pass
- creams that can be applied to the hemorrhoids to reduce pain, swelling, and itching.

When the hemorrhoids are internal, they can be removed in the doctor's office by a simple procedure. Tiny rubber bands are wrapped tightly around the hemorrhoids. Following this procedure, the hemorrhoids wither away and drop off without causing pain.

Internal hemorrhoids that stay prolapsed (outside the body), or external hemorrhoids that have clotted, are often removed surgically. This method of removal is usually done on an outpatient* basis with local anesthesia*.

▶ See also **Constipation • Varicose Veins**

Resources

Organizations

American Gastroenterological Association. 4930 Del Ray Avenue, Bethesda, MD, 20814. Telephone: 301-654-2055. Web site: <http://www.gastro.org/wmspage.cfm?parm1=850>.

* **anal** refers to the anus, the opening at the end of the digestive system through which waste leaves the body.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

* **outpatient** a medical procedure that is conducted in a doctor's office or hospital but does not require an overnight stay in a hospital bed.

* **local anesthesia** (an-es-THEE-zha) means using medicine to block or numb pain in one part of the body while patients remain awake. General anesthesia blocks pain over the entire body while patients sleep.

- * **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.
- * **chronic** (KRAH-nik) lasting a long time or recurring frequently.
- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.
- * **virus** (VY-rus) is a tiny infectious agent that can cause infectious diseases. A virus can only reproduce within the cells it infects.
- * **fulminant** (FUL-mi-nant) means occurring suddenly and with great severity.

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/hemorrhoids/index.htm>.

Hepatitis

Hepatitis (hep-a-TY-tis) is inflammation of the liver*, an abnormal condition that harms liver cells. Hepatitis may be acute* or chronic*, mild or extremely serious. It has many causes. These include infection with the hepatitis A, B, or C viruses, or other germs and exposure to toxic chemicals, including alcohol and certain medications.*

What Is Hepatitis?

The liver, a red-brown, wedge-shaped organ in the upper abdomen, is the largest internal organ in the body. It has many jobs. It gets rid of harmful substances in food, disposes of old blood cells, helps digest fat, produces chemicals to make the blood clot, and makes sure the blood carries the right balance of fat, sugar, and amino (a-ME-no) acids (the building blocks of proteins) to all the cells of the body.

Hepatitis is a general term that means the liver is inflamed. Many conditions can cause hepatitis. These include:

- Excessive drinking of alcohol
- Overdoses or side effects of medication
- Inhalation of toxic chemicals
- Problems with the immune system*
- Infection with a range of microbes, including viruses

Hepatitis frequently results from infection with a hepatitis virus*, usually the hepatitis A, B, or C virus. Each one can cause acute viral hepatitis, a condition that usually lasts four to six weeks. Typically, people who have acute viral hepatitis feel exhausted and have jaundice (JAWN-dis), which is a yellowish tint to their skin and the whites of their eyes. In rare cases, acute viral hepatitis can develop into a life-threatening illness called fulminant* hepatitis. Usually, however, it is milder, and the person recovers without needing special care. Often, viral hepatitis causes no symptoms at all.

Hepatitis B and C can do long-term damage as well. About 75 to 85 percent of people infected with hepatitis C and 5 to 10 percent of those infected with hepatitis B cannot fight off the virus; they become infected chronically, meaning the virus remains active in their body for more than six months. In most cases, the infection lasts for decades.

Because the liver is large and resilient, it usually keeps working well despite the virus. In fact, most people with chronic hepatitis live a normal life

span and do not even realize that they have the infection. After 10, 20, 30, or more years, however, some people with chronic infections eventually have serious liver damage, such as cirrhosis*, or scarring of the liver, that is frequently fatal. Some people with chronic hepatitis require a liver transplant*, and hepatitis C is the leading reason people get such transplants. People who have chronic hepatitis also have a much greater than normal risk of developing a kind of liver cancer*, called hepatocellular carcinoma (hep-a-to-SEL-yoo-lar kar-si-NO-ma). Liver cancer is a serious, often fatal disease.

According to the World Health Organization, the hepatitis C virus (called HCV) infects about 3 percent of the worldwide population, and health officials fear it will cause major public health problems in the 21st century. Scientists are still learning about hepatitis C, which was not even identified until 1988. Research has shown that alcohol consumption is especially dangerous to people who have hepatitis C, because it makes the virus spread even faster.

In addition to the hepatitis A, B, and C viruses, scientists have identified two less-common hepatitis viruses, called D and E. Hepatitis D is only found in people who already have hepatitis B. Hepatitis D makes their illness worse. Hepatitis E occurs only in the developing world. It resembles hepatitis A in that it usually causes only a short-term illness, but it can be more dangerous, especially to pregnant women. It typically spreads through water that has been contaminated by sewage, often after flooding. At one time, researchers believed they had found two other hepatitis-causing viruses: F and G. As of 2009, however, other scientists had been unable to show that F and G lead to the illness.

Hepatitis A: How Does It Spread?

Every now and then, local news reports announce an outbreak of hepatitis. Often, the report states that people who ate in a certain restaurant or attended a certain nursery school in recent weeks should see their doctor about preventing infection. The culprit in these outbreaks is hepatitis A. Sometimes called infectious hepatitis, this type is highly contagious*, but it almost never does permanent damage, which means that it does not become chronic and lead to cirrhosis. On very rare occasions, however, it does cause fulminant hepatitis and death. In the United States, hepatitis A outbreaks are most common in daycare centers, where it typically spreads by eating food, drinking water, or putting something else into the mouth that has been contaminated with feces* from someone who is infected. This method of infection, called the “fecal-oral route,” occurs if caregivers fail to wash their hands after changing a diaper and then prepare or serve food, or if a toddler forgets to wash after using the toilet and then handles another child’s cup or pacifier. Hepatitis A can also spread when water supplies are contaminated with sewage or when people eat raw or undercooked shellfish from contaminated waters.

Once people have recovered from hepatitis A, it is over. They are not “carriers” of the virus and cannot infect anyone else.

* **cirrhosis** (sir-O-sis) is a condition that affects the liver, involving long-term inflammation and scarring, which can lead to problems with liver function.

* **transplants** (TRANS-plantz) are organs or tissues from another body used to replace a poorly functioning organ or tissue.

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

Hepatitis A: How Is It Prevented?

Good hygiene, including washing hands after using the toilet and before handling food, can prevent hepatitis A.

Vaccination* against hepatitis A is available. Medical professionals recommend it for children and adults traveling to developing countries where sanitation is poor; for children in communities with high rates of hepatitis A; and for children who live in states with above-average levels of the disease.

A preventative measure is also available for people who have already been exposed to the virus. An injection of immune globulin (GLOB-yoo-lin), a substance that helps the immune system, can often prevent infection. For the globulin to be effective, the individual must receive it within two weeks of exposure to the virus.

Hepatitis B and C: How Do They Spread?

People with chronic hepatitis B and C are “carriers,” meaning their blood can transmit the virus to others even if they have no symptoms of illness. The chief method of spreading hepatitis B and C is through contact with infected blood. In the United States, these viruses spread most commonly when drug users share the needles that they use to inject their drugs. More than 80 percent of people who inject street drugs, for instance, are believed to be infected with hepatitis C.

The spread of these viruses can also occur when a healthcare worker is accidentally pricked with a needle used on a patient who has hepatitis,

HEPATITIS AT A GLANCE

Hepatitis A

- Spread by fecal-oral route
- Has a vaccine
- Cannot become chronic
- Spreads through food or water
- Does not spread through the air

Hepatitis B

- Spread by blood
- Has a vaccine
- Can become chronic
- Does not spread through food or water
- Does not spread through the air

Hepatitis C

- Spread by blood
- Does not have a vaccine

- Can become chronic
- Does not spread through food or water
- Does not spread through the air

Hepatitis D

- Spread by blood
- Does not have a vaccine
- Can become chronic
- Does not spread through food or water
- Does not spread through the air

Hepatitis E

- Spread by fecal-oral route
- Does not have a vaccine
- Cannot become chronic
- Spreads through food or water
- Does not spread through the air

when a person uses improperly sterilized equipment to perform a body piercing, tattooing, or circumcision*; and when two people share razors, toothbrushes, or other objects that may have small amounts of blood on them. An organ transplant can also be a source of hepatitis infection.

The transfusion* of infected blood was once the most common source of infection. People with hemophilia (he-mo-FIL-e-a), a blood-clotting problem, were at particular risk because they received frequent transfusions. After 1992, however, blood banks in the United States screened donated blood for hepatitis B and C viruses, and the risk of infection from a transfusion dropped sharply. Anyone who received a transfusion before July 1992, however, should see a medical professional to be tested for hepatitis.

Compared to hepatitis C, hepatitis B is more contagious and spreads much more readily through sexual contact. Individuals who have sex with many partners are at increased risk. Hepatitis C seldom spreads through sexual contact. Hepatitis B, and more rarely hepatitis C, can also spread from infected mothers to newborns. Occasionally, medical professionals can find no obvious source of infection with hepatitis C. They do know that a person cannot catch it by working, going to school, or swimming with infected people, or simply by being near or even hugging infected individuals.

How Is Hepatitis B Prevented?

A vaccine can prevent hepatitis B. After 1991, U.S. health officials recommended it for all newborns. Doctors also advise it for all children aged 11 or 12 if they did not get the shots as babies. In addition, medical professionals recommend the vaccine for everyone at high risk, including health-care workers, people who have had sex with multiple partners, and anyone who lives with, has sex with, or takes care of a person who has hepatitis B.

Once a person has been exposed to hepatitis B, speedy treatment with hepatitis B immune globulin (HBIG), coupled with vaccination, sometimes can prevent infection in adults. When mothers have hepatitis B, immediate treatment of their newborns can prevent the babies from developing chronic hepatitis.

People who have not been vaccinated can also prevent hepatitis B by refusing to have unprotected sex, by using condoms, and by staying away from illegal intravenous drugs. In addition, people should avoid contact with blood. They should not share razors, toothbrushes, or any items that might be contaminated with even the slightest amount of blood. Infected people should cover any wounds they may have and should dispose of or wash anything that may contain any of their blood.

Hepatitis C: How Is It Prevented?

As of 2009, no vaccine existed for hepatitis C, and no reliable treatment was available after a person is exposed. Prevention is like that for hepatitis B: refusing to share needles, avoiding contact with blood, limiting sexual contact, and using condoms.

The United States and the World

In the United States, an estimated 4 million people have chronic hepatitis C, and 8,000 to 10,000 people per year die from related liver disease. About 1 million to 1.5 million people have chronic hepatitis B, which results in about 5,000 deaths each year.

Worldwide, hepatitis B is more common, and at least 350 million people have the chronic infections. This disease is especially common in most of Asia, sub-Saharan Africa, and the Pacific, where 8 to 10 percent of all people are chronically infected. Many of these individuals also develop hepatocellular carcinoma, the liver cancer linked to chronic hepatitis. Worldwide, an estimated 180 million people have chronic hepatitis C.

In the United States, hepatitis B is most common in young adults, especially among intravenous drug users, health-care workers, prison inmates, and people who have sex with many partners. In developing countries, hepatitis B is most common in infants and young children, who get it from their mothers or within the family. When hepatitis B infects a child, the disease is much more likely to become chronic.

* **circumcision** is a surgical procedure in which the fold of skin covering the end of the penis is removed.

* **transfusion** (trans-FYOO-zhun) is a procedure in which blood or certain parts of blood, such as specific cells, is given to a person who needs it due to illness or blood loss.

- * **incubation** (ing-kyoo-BAY-shun) is the period of time between infection by a germ and when symptoms first appear. Depending on the germ, this period can be from hours to months.
- * **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.
- * **esophagus** (eh-SAH-fuh-gus) is the soft tube that, with swallowing, carries food from the throat to the stomach.
- * **toxins** are substances that cause harm to the body.
- * **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

What Are the Symptoms of Hepatitis?

Depending on the virus, the time from infection to the appearance of symptoms can be two weeks to six months. The incubation* period is 15 to 45 days for hepatitis A, 15 to 150 days for hepatitis C, and 50 to 180 days for hepatitis B.

The symptoms for acute hepatitis include loss of appetite, nausea, vomiting, fatigue, fever, jaundice, darkening of the urine, abdominal pain, arthritis (ar-THRY-tis; joint pain), and skin rash. Bowel movements may look pale in color, and urine may become dark, so that it looks like tea. Often, however, symptoms are absent or so mild they go unnoticed.

Chronic hepatitis can cause loss of appetite, tiredness, low-grade fever, and a general sense of “not feeling well” that doctors call malaise (ma-LAZE). Like people with acute hepatitis, those with chronic hepatitis often experience no symptoms.

If the illness causes liver damage, additional symptoms can include weakness, weight loss, itching of the skin, enlargement of the spleen*, fluid in the abdomen, and a pattern of red blood vessels showing through the skin. In severe cases, massive bleeding can occur in the stomach and the esophagus*, and this condition requires emergency treatment. If the liver is no longer able to remove toxins* from food, the brain can feel the impact, causing the person to become drowsy or confused, and perhaps lapse into a coma*.

How Is Hepatitis Diagnosed?

In many cases, the first hint of hepatitis comes when a routine blood test shows signs of abnormalities in the liver. In other cases, individuals may try to donate blood and be rejected after their blood is tested.

Some individuals go to the doctor because they have one or more symptoms. Doctors will typically ask about medical history and whether these patients have had any exposure to infectious agents, alcohol and other toxins, or drugs. They will also do a physical examination, which may include taking the patient’s temperature, feeling for swollen glands, and checking for an enlarged spleen or liver.

To diagnose viral hepatitis, doctors may also perform several kinds of blood tests. Liver enzyme tests indicate whether the liver is inflamed. If it is, other blood tests can detect specific evidence of hepatitis B or C, and can help the doctor distinguish between acute and chronic cases.

How Is Hepatitis Treated?

Treatment for hepatitis depends on its cause and how sick the patient is.

Hepatitis A and E People with hepatitis A and E usually recover completely without needing hospitalization. They can take care of themselves at home by making sure they get enough rest and drink plenty of fluids. Doctors advise avoiding alcohol and drugs, because these substances can stress an already inflamed liver.

Hepatitis B and C Most of the time, doctors can monitor patients who have hepatitis B and C through blood tests that both evaluate liver inflammation and measure liver function. In severe cases especially when the liver is damaged and stops working well, a patient may need hospitalization. A doctor will typically only treat a person who has hepatitis B if the patient has active liver disease. The Food and Drug Administration (FDA) approved six drugs for use against hepatitis B. A commonly prescribed medication is alpha interferon, a naturally occurring substance that interferes with the viruses' ability to reproduce. The latest of the six drugs was telbivudine, which received FDA approval in 2006. Telbivudine not only curbs the virus but also fights liver inflammation.

As with hepatitis B, a doctor will decide if a particular patient who has hepatitis C is a good candidate for treatment. Treatment is usually a combination of an interferon drug called pegylated interferon alpha with another drug, ribavirin.

In addition, doctors often recommended that people who have chronic infectious hepatitis live a healthy lifestyle by avoiding alcohol, getting enough sleep, exercising regularly, and eating a nutritious diet. These measures reduce stress on the liver and can prevent or slow the progression of long-term liver disease.

Doctors typically closely monitor people who have chronic hepatitis and may want to see them at least once or twice per year. Doctors will do liver enzyme tests to see how well the liver is functioning and may order blood tests, sonograms*, or even liver biopsies* to check for cancer.

In cases of liver cancer or cirrhosis, sometimes the only treatment is a liver transplant, in which a person's damaged liver is replaced with a healthy organ taken from a newly deceased person. If the person can get a new liver in time, which is not always possible, such transplants usually are successful, although the virus eventually may damage the new liver as well.

Living with Chronic Hepatitis

Most people with chronic hepatitis do fine. They can go to school, engage in sports, work, have children, and live fully like anyone else. They need to make sure, however, that they do not put any extra stress on their liver. In the view of most experts, that means that they should never drink alcoholic beverages. They should not take any medicines, even common over-the-counter or herbal remedies, unless their doctors specifically approve them. They should not use illegal drugs. In many cases, they should be vaccinated against hepatitis A and against hepatitis B.

As with other chronic illnesses, people with hepatitis often struggle with feelings of grief, worry, and isolation. Some feel a stigma because their illness often is associated with drug abuse, even though it can result from many other causes. Because most people know little about hepatitis, friends and even family may have unrealistic fears about catching it and may avoid the infected person. Counseling for the entire family can sometimes help.

Hepatitis A Vaccine

The vaccine for hepatitis A is thought to provide protection for 15 to 20 years, possibly for life. Individuals receive a series of shots within a six-month period. Among those who may be candidates for the vaccine are the following:

- Military personnel
- Employees of daycare centers
- Institutional care workers
- Laboratory workers who handle live hepatitis A virus
- Handlers of primates who may harbor the hepatitis A virus
- Travelers to areas known to have hepatitis
- People living in, or relocating to, areas that have a high rate of infection or are experiencing a hepatitis A outbreak
- People who engage in high-risk sexual activity
- Users of injectable street drugs

* **sonograms** (SON-o-gramz) are images or records made on a computer using sound waves passing through the body.

* **biopsies** (BI-op-seez) are tests in which small samples of skin or other body tissue are removed and examined for signs of disease.

Hepatitis without a Virus

Not all hepatitis is caused by a virus. It can also be caused by toxic chemicals such as carbon tetrachloride, a solvent used in some dry-cleaning fluids, or by some medications. Many common medications, such as phenytoin for epilepsy and isoniazid (i-so-NY-a-zid) for tuberculosis (too-ber-ku-LO-sis), cause hepatitis in a small fraction of the people who take them. Once the person stops taking the drug, the liver recovers. Life-threatening hepatitis can result, however, if a person accidentally or intentionally takes an overdose of many medicines, including the common over-the-counter pain reliever acetaminophen (a-set-a-MEE-no-fen).

Finally, some people experience a chronic condition called autoimmune hepatitis. In such people, it appears, the body's immune system attacks its own liver cells. Although treatment with corticosteroids can improve the condition, it is often fatal unless a liver transplant is performed.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

The illness and sometimes the treatment can also cause fatigue and depression*. Infected people may need to get help from family and friends, seek treatment for depression, or modify their schedules to reduce stress. Many groups offer advice, support, and solidarity for people with chronic hepatitis.

▶ See also **AIDS and HIV Infection • Alcoholism • Cirrhosis of the Liver • Infection • Jaundice • Viral Infections**

Resources

Books and Articles

Bruce, Cara, and Lisa Montanarelli. *The First Year—Hepatitis C: An Essential Guide for the Newly Diagnosed*. New York: Marlowe & Company, 2002.

Everson, Gregory, and Hedy Weinberg. *Living with Hepatitis C: A Survivor's Guide*, 6th ed. New York: Hatherleigh Press, 2006.

Organizations

American Liver Foundation. 75 Maiden Lane, Suite 603, New York, NY, 10038. Telephone: 212-668-1000. Web site: <http://www.liverfoundation.org>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: <http://www.cdc.gov/ncidod/diseases/hepatitis/index.htm>.

Hepatitis Foundation International. 504 Blick Drive, Silver Spring, MD, 20904. Toll free: 800-891-0707. Web site: <http://www.hepfi.org>.

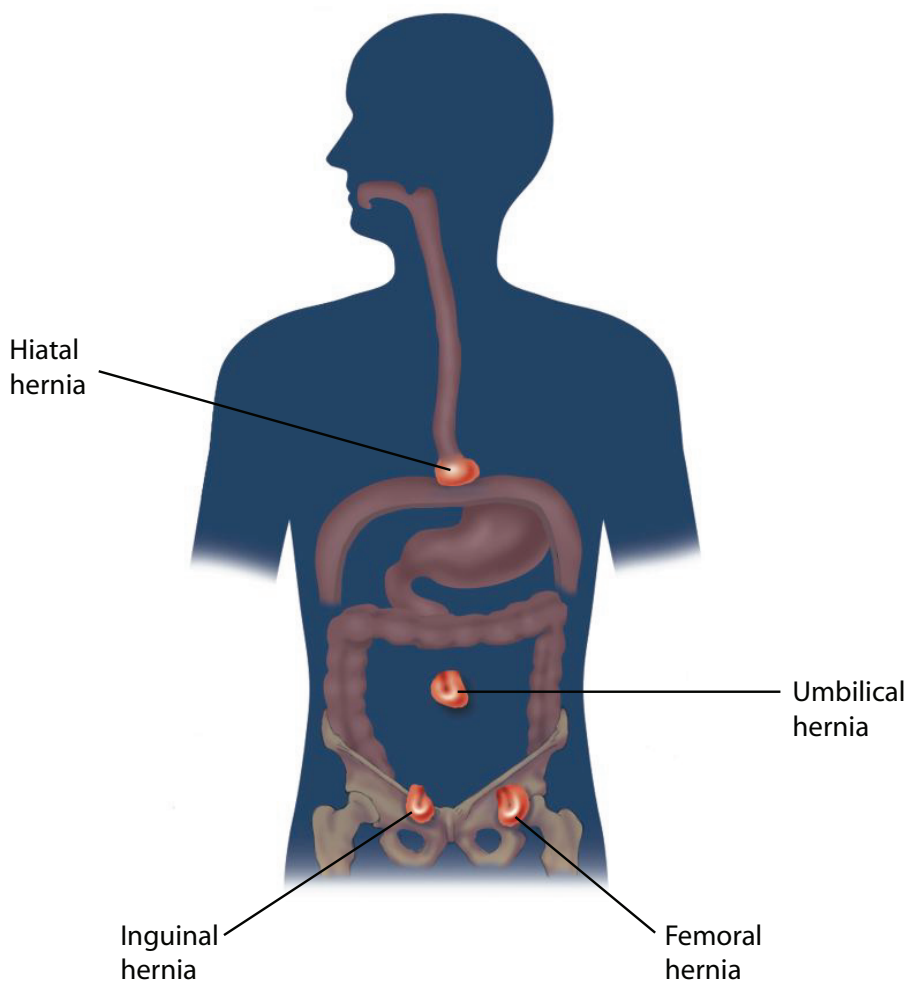
World Health Organization. Avenue Appia 20 1211 Geneva 27, Switzerland. Web site: <http://www.who.int/topics/hepatitis/en>.

Hernia, Gastrointestinal

A hernia is the protrusion of tissue or part of an organ through an opening in the tissue that normally encloses and contains it.

What Does Hernia Mean?

The word “hernia,” in Latin, means “rupture.” A hernia refers to an opening, or separation, in the muscle, tissue, or membrane that normally holds an organ or other tissues in place. This opening allows the normally contained tissues or parts of an organ to poke through the hole. Hernias can occur in many areas of the body, including the brain, but they



usually arise in the area of the body that is involved in digestion. These hernias are collectively known as gastrointestinal hernias, and they may result from muscular weakness, heavy lifting, straining, illness, obesity*, or pregnancy.

Gastrointestinal hernias come in several types:

- Inguinal (ING-gwi-nal) and femoral hernias that occur in the groin
- Hiatal (hi-AY-tal) hernia in the chest
- Umbilical hernia, which is in the naval
- Ventral, or incisional, hernia, which happens at the site of a scar from a previous surgical incision

Inguinal and femoral hernias The wall of the abdomen is made of thick muscle, but it has normally occurring holes in certain places, such as the groin, that provide places for structures, such as blood vessels, to pass. Hernias usually develop when the intestines push out against these built-in weaknesses. Inguinal and femoral hernias are similar, but femoral hernias occur lower in the groin near the upper thigh.

Hernias may develop at different locations in the body, although an individual is unlikely to develop all four kinds of hernia shown here. A hiatal hernia occurs when the stomach pokes above the diaphragm into the chest. An umbilical hernia occurs at the belly button (umbilicus) and is most commonly seen in infants. An inguinal hernia occurs in the groin, where the thigh meets the torso, and happens more often to men than to women. A femoral hernia occurs between the abdomen and the legs, and happens more often to women than to men. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

* **diaphragm** (DY-a-fram) is the muscle that separates the chest and abdominal cavities. It is the chief muscle used in breathing.

* **gangrene** (GANG-green) is the decay or death of living tissue caused by a lack of oxygen supply to the tissue and/or bacterial infection of the tissue.

Inguinal hernias are the most common type of gastrointestinal hernias. They frequently appear as large lumps that bulge just under the skin. Some people with inguinal hernias do not feel any pain from their hernias, but others experience severe pain especially when they cough, bend forward, or lift a heavy object. The only way to fix this type of hernia is to repair it surgically, using stitches or mesh to close the hole. Without surgery, an inguinal hernia usually keeps getting bigger.

Hiatal hernias Another common type of hernia is a hiatal hernia. The esophagus, or food pipe, passes to the stomach through a gap in the diaphragm* called the hiatus (hi-AY-tus). A hiatal hernia occurs when the stomach pokes above the diaphragm into the chest. This type of hernia results in no visible bulge, but people have other symptoms, such as heartburn. Hiatal hernias do not necessarily require surgery. Often, lifestyle changes such as losing weight, avoiding smoking, stopping alcohol consumption, and staying away from hot, spicy foods can make the symptoms go away.

Umbilical hernias Umbilical hernias are common in children. About 10 percent of babies have one, although they are more frequent among babies of certain ethnic groups. This type of hernia usually heals by itself.

Ventral hernias Ventral hernias happen when the intestine pokes through old scar tissue that has been stretched out, which may occur in people who are obese or in pregnant women.

Do Children Get Hernias?

Karen loved taking care of her baby brother. One day when she was changing his diaper, she noticed he had a plum-sized bump along the inside of his thigh where it met his torso (his groin). When he cried, it got bigger, like a small balloon being blown up. It looked pretty strange, but he did not seem to be in any pain. Karen's parents took him to the doctor, who said the baby had an inguinal hernia.

The doctor explained that up to 5 percent of healthy, full-term babies are born with inguinal hernias, and 80 to 90 percent of children with this type of hernia are boys. These hernias occur because certain openings do not close after birth the way they should, allowing the intestine to bulge out. The doctor scheduled an operation to surgically repair the baby's hernia and assured Karen's parents that the surgery was a safe and common procedure.

Are Hernias Dangerous?

In some cases, hernias can be dangerous if the protruding piece of intestine gets incarcerated (trapped) and strangulated (twisted). This condition can interfere with the flow of food and fluid through the intestine and sometimes stops the blood supply to that part of the intestine. When this happens, an individual will be in great pain and should immediately report to a hospital for emergency surgery. The trapped bit of intestine can develop infection and/or gangrene*, which if left untreated can be fatal.

▶ See also **Heartburn (Dyspepsia)**

Resources

Organizations

British Hernia Centre. 87 Watford Way, London, England, NW4 4RS.
Web site: <http://www.hernia.org>.

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/topics/hernia.asp>.

Herniated Disk See *Slipped (Herniated) Disk*.

Herpes Simplex Virus Infections

Herpes simplex viruses can cause several illnesses, the two most common being oral herpes, which cause lesions on the face, usually at the lip line, and the closely related genital herpes, which cause lesions in the genital region.*

What Are Herpes Simplex Virus Infections?

There are two types of herpes simplex virus (HSV): herpes simplex virus 1 (HSV-1) and herpes simplex virus 2 (HSV-2). They are members of the herpesvirus family. Genital herpes is a sexually transmitted disease* (STD). When an HSV infection causes blisters or sores, it is referred to as a herpes outbreak.

Oral herpes causes small, clear blisters on the skin. These are often called cold sores, fever blisters, or sun blisters. Small blisters may combine to form a larger sore. Although they usually occur on the face, especially around the mouth and nose, they can occur anywhere on the skin or mucous membranes*, either singly or in groups. Small HSV sores known as herpetic whitlow can appear on the fingers, especially in children who bite their nails or suck their fingers, thereby spreading the virus from their mouth to their hands. HSV skin infections can occur in other locations where the virus comes in contact with broken skin. The blisters may be painful, and they can break, bleed, and crust over, leaving red spots of healing skin.

Although HSV-1 often causes genital herpes, it is more often the case that HSV-2 is responsible for the sores on the penis in males and on the vulva*, vagina*, and cervix* in females. In genital herpes, both sexes can



Herpes simplex virus type 1 causes small, clear blisters to appear around the mouth and nose. Also called cold sores, fever blisters, or sun blisters, they typically unite to form a larger sore. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.

* **sexually transmitted disease** is an infection, such as the human immunodeficiency virus (HIV) or herpes, that can be passed from person to person by sexual contact.

* **mucous membranes** are the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.

* **vulva** (VUL-vuh) refers to the organs of the female genitals that are located on the outside of the body.

* **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.

* **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.

- * **anus** (A-nus) is the opening at the end of the digestive system, through which waste leaves the body.
- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).
- * **menstruation** (men-stroo-AY-shun) is the discharge of the blood-enriched lining of the uterus. Menstruation normally occurs in females who are physically mature enough to bear children. Most girls have their first period between the age of 9 and 16. Menstruation ceases during pregnancy and with the onset of menopause. Because it usually occurs at about four-week intervals, it is often called the monthly period.
- * **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

develop herpes blisters around the anus* and on the buttocks. HSV-2 occasionally produces sores on other parts of the body, such as the mouth or throat. Having genital herpes increases the risk of contracting HIV* from unprotected sex with an HIV-positive individual. Infection with both genital herpes and HIV can also increase the likelihood that HIV will be transmitted to a sexual partner.

Primary HSV infection occurs when the virus first enters the body. After the initial infection, the virus particles migrate to sensory nerve cells, where they remain in an inactive or dormant state until they are reactivated (during a herpes outbreak). These outbreaks often occur at or near the same area as the primary infection. For example, repeated outbreaks of HSV-1 may cause cold sores in the same spot, along the outer border of the lips, but cold sores also can appear anywhere on the face in the vicinity of the mouth. Sometimes outbreaks, also called recurrent infections, occur for no apparent reason. Emotional and/or physical stresses that can trigger herpes outbreaks. The following are other times when outbreaks can occur:

- During menstruation*
- As a result of exposure to the sun (for oral herpes)
- From poor diet
- From exhaustion
- As a result of fever
- From illness
- As a result of steroidal medication

How Common Are Herpes Simplex Virus Infections?

Some 50 to 80 percent of Americans are infected with HSV-1 by age 30. In addition, at least 45 million Americans—about one in five adolescents and adults—are infected with HSV-2. About twice as many women as men have genital herpes—about one in four women compared with about one in eight men. This rate difference may be because, in cases of sexually transmitted herpes simplex illness, male-to-female transmission of HSV is more likely than female-to-male transmission. Over the decade ending in 2008, the percentage of Americans with HSV-2 infections decreased.

Is HSV Contagious?

HSV-1 and HSV-2 are both contagious* infections, which are spread very often through direct contact with infected skin or saliva. Children often contract HSV-1 through contact with an infected family member. Kissing or sharing dishes or eating utensils can spread HSV-1 infection.

High-school and college wrestlers sometimes develop a condition called herpes gladiatorum, caused by HSV-1, in which herpes blisters develop on the shoulders and back from contact with other wrestlers

and with virus-contaminated mats. Rugby players also transmit HSV-1 through physical contact, developing blisters that have been nicknamed “scrum pox.”

HSV-2 is most often spread via unprotected vaginal, oral, or anal sex. HSV-2 cannot be contracted from toilet seats or hot tubs. HSV-1 infection of the genitals can be transmitted through oral-genital or genital-genital contact with an infected person.

When a person has herpes simplex illness, active disease or a herpes outbreak is not necessary for the transmission of the herpes virus (either HSV-1 or HSV-2). Research suggests that at least 60 percent of new HSV infections are acquired from individuals with no noticeable blisters or sores. However, genital herpes is most easily spread through genital-genital or oral-genital contact during an active outbreak or in the few days preceding an outbreak.

How Do People Know They Have HSV Infection?

With HSV infection (either HSV-1 or HSV-2), most individuals have few or no symptoms of infection and often do not realize that they are infected. They may not become aware of symptoms for years after the primary infection.

HSV-infected individuals often experience itching, tingling, or pain in the area where recurrent lesions develop one or two days prior to the outbreak. These warning symptoms—called a prodrome—signal an early phase in the reactivation of the virus.

Symptoms of active HSV-1 or oral herpes infection include blisters or sores on the lips, face, neck, or shoulders. The blisters are often painful and may be accompanied by fever or other flu-like symptoms.

Symptoms of active HSV-2 or genital herpes infection can include the following:

- Blisters or sores on the genitals or rectum, which are often painful
- Fever or flu-like symptoms
- Swollen glands (lymph nodes*)
- Muscle aches
- A reddish rash
- A burning sensation during urination
- Discharge from the vagina or penis

The length and severity of HSV outbreaks vary greatly. The blisters of a primary infection break, leaving tender sores that may take two to four weeks to heal. Subsequent outbreaks are usually shorter. On average, people with genital herpes experience four to five outbreaks of genital herpes illness each year. Oral herpes outbreaks occur less frequently. Although both HSV-1 and HSV-2 remain in the body indefinitely, over time the frequency and severity of outbreaks of both types usually decrease.

Don't Confuse Canker Sores with Cold Sores

Canker sores are small, red sores inside the mouth. They later turn white. Unlike cold sores, canker sores are not caused by HSV, although they may be caused by stress. Canker sores and cold sores are both painful, but canker sores appear only inside the mouth, not on the face, lips, or neck as cold sores do.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

- * **cultured** (KUL-churd) means subjected to a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.
- * **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.
- * **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.
- * **intravenously** (in-tra-VEE-nus-lee) means given or injected directly through a vein.
- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **immunosuppressants** (im-yoo-no-su-PRES-ants) are substances that weaken the body's immune system.
- * **transplants** (TRANS-plantz) are organs or tissues from another body used to replace a poorly functioning organ or tissue.

How Is HSV Infection Diagnosed and Treated?

Diagnosis Doctors can often diagnose outbreaks of HSV-1 or HSV-2 based on the appearance and location of the sores. Sometimes, however, sores in the genital region can resemble signs of other STDs.

To diagnose HSV infection conclusively, a blister is scraped—preferably on the first day of an outbreak—and cultured* to see if HSV grows. For a quick diagnosis, a preparation from a blister can be examined under a microscope for signs of the virus. In the absence of active blisters, a blood sample can be tested for antibodies* against HSV or for HSV DNA*.

Treatment There is no cure for either HSV-1 or HSV-2. Some over-the-counter ointments or creams may help reduce the pain of cold sores, but they do not necessarily speed healing or prevent the sores from returning. Applying ice to the affected area, drinking cold liquids, or over-the-counter pain medications such as acetaminophen* can ease the discomfort of painful outbreaks. People with cold sores may want to avoid acidic foods—such as tomatoes, lemons, and oranges—that can irritate open sores on the lips or in the mouth. Antiviral medications are occasionally used to treat recurrent cold sores caused by HSV-1.

Antiviral medications such as acyclovir can significantly reduce the frequency, severity, duration, and pain of genital herpes outbreaks. Antiviral drugs can also reduce—but not eliminate—the risk of HSV transmission to sexual partners. Under some circumstances antiviral medications are administered intravenously*:

- Infections of the skin, nose, and mouth in people with a weakened immune system*
- Infections in newborn infants
- Rare—but severe or life-threatening—herpes infections in other parts of the body

Complications Although HSV infections usually are not dangerous, outbreaks of either oral or genital herpes can cause pain, embarrassment, and emotional stress. However, in people with weakened immune systems—such as those with cancer or AIDS* or who are on immunosuppressants* because of organ transplants*—HSV infection can cause serious illness or death:

- HSV can infect the skin surrounding the eye. From there, the virus can invade the cornea* of the eye, causing a condition known as herpes keratitis. If untreated, this condition can lead to scarring of the eye and blindness.
- The virus can spread throughout the body, causing life-threatening infection in the lungs, liver*, and other organs.
- HSV can infect the brain, causing encephalitis*.

A woman who has a primary HSV infection during pregnancy lacks antibodies against the virus and so can transmit HSV to her fetus*, possibly resulting in preterm birth and other complications, especially if the

infection occurs late in pregnancy. Infants born to women with active genital herpes are at risk for HSV infection, which they contract as they pass through the birth canal during delivery. In addition to facial and/or genital herpes, the newborn may have widespread HSV infection involving the eyes, lungs, liver, or brain. Although immediate treatment with antiviral medications may prevent or reduce the damage, severe neonatal* herpes is fatal in at least 50 percent of cases and as many as two-thirds of surviving infants have lifelong disabilities, including brain damage and mental retardation*.

Can HSV Infection Be Prevented?

It is difficult to prevent HSV-1 infection because the virus is so widespread in the human population and can be transmitted even when no visible sores are present. To reduce the risk of contracting oral herpes, people should not kiss anyone with active cold sores. Food, utensils, dishes, drinking glasses, lipstick, razors, and towels should not be shared with anyone, especially with someone who has ever had cold sores.

Using sunscreen, especially on areas prone to blisters, may reduce the likelihood of an oral herpes outbreak. People with active cold sores around the mouth should always wash their hands before touching their genitals or buttocks to reduce the risk of spreading HSV-1 to these areas.

The only way to absolutely ensure against genital herpes infection is to practice sexual abstinence. Because genital herpes is contagious even in the absence of active sores and since people often do not know that they are infected, a latex* condom should always be used during sexual activity. However, condoms do not protect all parts of the genital region. People with genital herpes should refrain from sex during active outbreaks.

Pregnant women with genital herpes may be treated with antiviral drugs to prevent an outbreak prior to delivery. A woman with active genital herpes should deliver by cesarean section* to reduce the risk of transmitting HSV to her infant.

▶ See also **Sexually Transmitted Diseases (STDs) • Varicella (Chicken Pox) and Herpes Zoster (Shingles)**

Resources

Books and Articles

Marr, Lisa. *Sexually Transmitted Diseases: A Physician Tells You What You Need to Know*, 2nd ed. Baltimore, MD: Johns Hopkins University Press, 2007.

Stanberry, Lawrence R. *Understanding Herpes*, revised 2nd ed. Jackson: University Press of Mississippi, 2006.

- * **cornea** (KOR-nee-uh) is the transparent circular layer of cells over the central colored part of the eyeball (the iris) through which light enters the eye.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.
- * **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.
- * **neonatal** (ne-o-NAY-tal) means pertaining to the first 4 weeks after birth.
- * **mental retardation** is a condition in which people have below average intelligence that limits their ability to function normally.
- * **latex** (LAY-tex) is a substance made from a rubber tree and is used in such things as medical equipment (especially gloves), toys, and other household products.
- * **cesarean section** (si-ZAR-ee-an SEK-shun) is the surgical incision of the walls of the abdomen and uterus to deliver offspring in cases where the mother cannot deliver through the vagina.

* **diaphragm** (DY-a-fram) is the muscle that separates the chest and abdominal cavities. It is the chief muscle used in breathing.

Organizations

American Social Health Association. P.O. Box 13827, Research Triangle Park, NC, 27709. Telephone: 919-361-8400. Web site: <http://www.ashastd.org>.

Canadian Paediatric Society. 2305 St. Laurent Boulevard, Ottawa, ON, K1G 4J8, Canada. Telephone: 613-526-9397. Web site: <http://www.cps.ca/english/statements/id/id06-03.htm>.

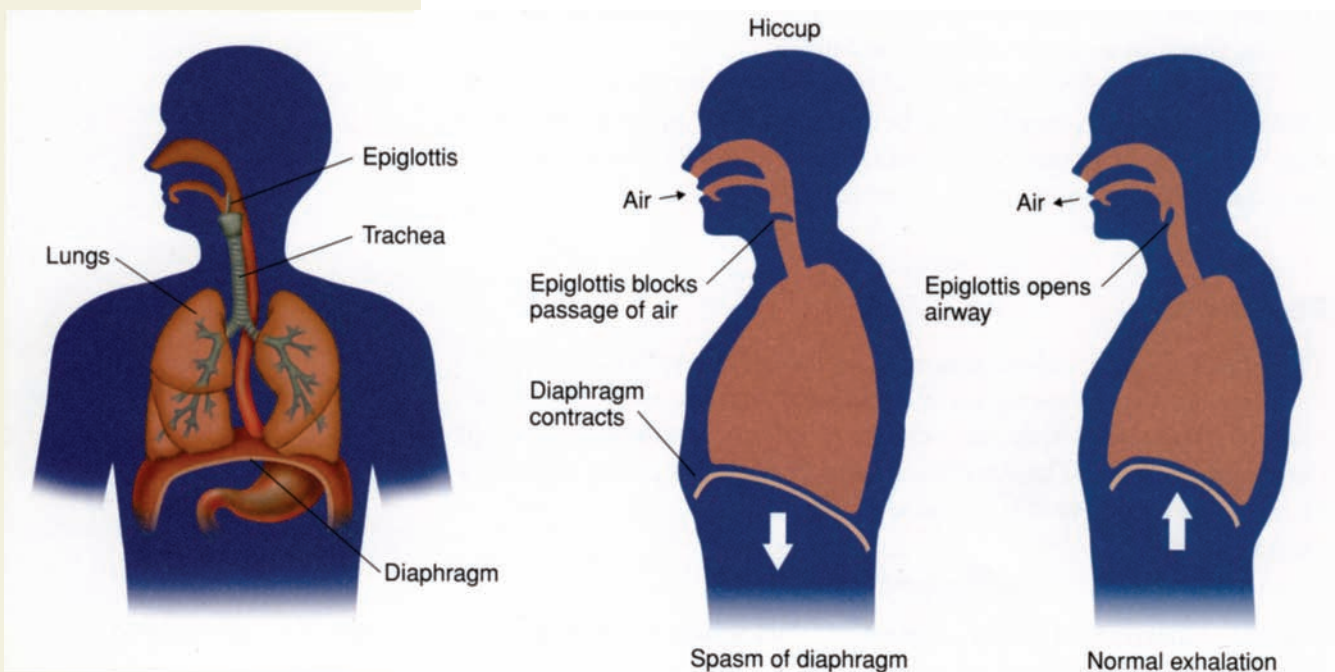
Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-CDC-INFO. Web site: <http://www.cdc.gov>.

Herpes Zoster See *Varicella (Chicken Pox) and Herpes Zoster (Shingles)*.

Hiccups occur when the diaphragm and lungs suddenly contract during breathing. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Hiccups

Hiccups occur when the diaphragm suddenly contracts during breathing. The vocal cords quickly close, and an odd sound comes from the throat. Hiccups are involuntary. Their cause is not known, and hiccups do not seem to serve any useful purpose.*



Are Hiccups Dangerous?

Most hiccups are not harmful. The frequency of most hiccups is usually from 4 to 60 hiccups a minute. Hiccups usually occur in people (even babies and fetuses) for a minute or two and then pass. There are, however, cases of prolonged hiccupping that can be dangerous, especially for people who are ill from other causes and who may become exhausted if they do not seek medical treatment.

What Are the Different Types of Hiccups?

Hiccups are classified into several categories. A hiccup bout can last from several seconds to several days. A persistent hiccup is one that lasts for several days or weeks. Hiccups lasting more than a month are called intractable. In rare cases, intractable hiccups may continue for years.

What Is the Treatment for Hiccups?

Everyone seems to have a favorite cure for hiccups, but usually the hiccups just go away by themselves. In severe cases of hiccups, doctors may try to block the hiccup process (also called the hiccup arc or pathway) by stimulating parts of the respiratory (breathing) system or by prescribing medications to relax the muscles involved. When all else fails, surgery is done to block the nerve signals from the phrenic (FREN-ik) nerve to the diaphragm. The purpose of this procedure is to paralyze part of the diaphragm.

Resources

Books and Articles

Durant, Penny. *Sniffles, Sneezes, Hiccups, and Coughs*. New York: Dorling Kindersley (DK), 2005.

Organization

University of Michigan Health System. 1500 E. Medical Center Drive, Ann Arbor, MI, 48109. Telephone: 734-936-4000. Web site: http://www.med.umich.edu/1libr/aha/aha_hiccupsa_crs.htm.

High Blood Pressure *See Hypertension.*

Hirsutism

Most of the time women do not have noticeable hair on certain parts of their body and face where it is commonly found on men, such as the abdomen, mid-chest, chin, upper lip, inner thighs, and lower back. Such noticeable hair growth is also not normally found on women's*

What Are Various Home Cures for Hiccups?

Everyone seems to have a special way to stop hiccups even though none of these remedies has been proved to work consistently. Here are some of the most common home cures:

- Holding one's breath and then exhaling very slowly
- Holding the nose
- Breathing into a paper bag
- Sucking on ice cubes
- Sucking on hard candy
- Drinking water from the far side of a glass
- Gargling
- Pulling on the tongue
- Biting on a lemon
- Swallowing granulated sugar
- Swallowing hard crusts of bread
- Sneezing
- Peeling onions
- Bending over so that the head is lower than the chest
- Surprising or frightening the person with hiccups
- Slapping the person with hiccups on the back

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

- * **menopause** (MEN-o-pawz) is the end of menstruation.
- * **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.
- * **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.
- * **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **ovaries** (O-vuh-reez) are the sexual glands from which ova, or eggs, are released in women.
- * **insulin** is a kind of hormone, or chemical produced in the body, that is crucial in controlling the level of glucose (sugar) in the blood and in helping the body use glucose to produce energy. When the body cannot produce or use insulin properly, a person must take insulin or other medications.
- * **cortisol** (KOR-ti-sol) is a hormone that helps control blood pressure and metabolism, the process of converting food into energy and waste products. It plays a part in the stress response.

breasts. However, when coarse, thick, dark hair appears in women in such typically masculine (male-pattern) places, the medical profession calls the problem hirsutism, or hypertrichosis. This condition signifies a hormonal imbalance that could be caused by a serious disease. It can be a serious cosmetic and psychological issue for women. Women suffering from this condition should be examined for presence of more serious medical problems.

How Many Women Develop Hirsutism?

Hirsutism occurs in about one out of ten women, but ethnicity can alter that percentage. Women of Mediterranean, South Asian, and Middle Eastern descent are more likely to get this condition. Also, as hormonal levels change after menopause*, about one out of four women have unwanted facial hair. Excessive male-pattern hair growth can become a psychological problem for women, who may feel less feminine and experience bouts of severe stress and anxiety* (or even depression*).

What Causes Hirsutism?

Generally, hirsutism is an inherited trait for women. It is usually caused by increased production of male hormones* (such as testosterone, which induces and maintains male secondary sex characteristics) or by abnormal sensitivity of hair follicles to male hormones. Although women produce primarily female hormones (such as estrogen, which promotes female secondary sex characteristics and the female reproductive system), they do produce small amounts of androgens (male hormones). However, when normal amounts increase drastically, hirsutism can occur.

A common cause of hirsutism is polycystic ovarian syndrome (PCOS), which is a condition that occurs when hormone levels become so erratic, especially during teenage and childbearing years, that cysts form in the ovaries*.

Another cause of hirsutism is high levels of insulin*, or what is called insulin resistance. This condition is observed in women who are exceptionally overweight because obesity forces higher levels of insulin to be produced, which then creates greater production of male hormones.

Other possible medical conditions that may increase the risk of hirsutism are Cushing's disease (excessive production of cortisol*); congenital adrenal hyperplasia (abnormal production of steroid hormones by the adrenal glands); hyperthecosis (abnormal thickening of the inner ovary layer); and cancerous ovarian or adrenal gland tumors.

Medicines (such as anabolic steroids, cyclosporine, danazol, and phenytoin) and testosterone can bring on the condition. Hirsutism can also result from age and pregnancy. In many cases, women first note more hair growth in their late teenage years, which gradually becomes more noticeable with time.

In rare cases, the condition occurs because of a serious problem. If hirsutism occurs along with the presence of acne, balding of the head, deepening of the voice, decreasing of breast size, enlarging of the clitoris, increasing muscle mass, or irregularity of menstrual periods, then a more serious disorder is possible. For instance, the more irregular the menstrual period, the more likely a woman is to develop hirsutism. If such symptoms occur, women ought to consult with their doctor.

How Is Hirsutism Diagnosed?

A common way to diagnose hirsutism is with the use of the Ferriman-Gallwey score, which provides a measurement of the amount of female hair growth at nine locations on the body (chin, upper lip, chest, upper back, lower back, upper abdomen, lower abdomen, upper arms, and thighs).

Diagnostic tests for the following substances are also used to identify hirsutism:

- Dihydroepiandrosterone sulfate (DHEA-S)
- Luteinizing hormone (LH), or lutropin
- Follicle-stimulating hormone (FSH)
- Androstenedione
- Prolactin (PRL) or luteotropic hormone (LTH)
- Free androgen index (FAI)
- Sex hormone-binding globulin (SHBG)
- Free (with total) testosterone
- 17-hydroxyprogesterone (17-OH progesterone, or 17OHP)

Additional tests may be recommended if a menstrual problem is present. If the doctor thinks a serious medical condition is at the root of hirsutism, then other tests may also be recommended, such as an ultrasound* (to detect tumors or cysts in the ovaries or adrenal glands) and a computerized tomography* (CT) scan (to analyze the adrenal

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

BEARDED LADIES AT THE CIRCUS

Circuses in the 19th century and well into the 20th century often featured a bearded lady (or bearded woman) advertised as one of the “freaks” of the big top. Even in the 21st century, Jennifer Miller (b. 1961) was featured as a bearded lady, juggler, and fire-eater in several circuses and at the Coney Island Sideshow. She was also a professor at Pratt Institute in Brooklyn, New York, and the founder of the New York City performance group Circus Amok. No longer advertised as a curiosity of the circus, these bearded ladies only have a hormonal imbalance: the condition known as hirsutism.

* **stimuli** (STIM-yoo-lie) are things in the environment that excite a person to function, become active, or respond. The singular form is stimulus.

glands). Tests to analyze levels of thyroid function, glucose, cortisol, or lipids (cholesterol and triglyceride) may also be used.

How Is Hirsutism Treated?

There is not a medical cure for hirsutism. Therefore, women oftentimes use temporary hair removal methods such as bleaching, depilatories (creams), electric hair removal, electrolysis and thermolysis, hair-retardant medicines, shaving, and waxing and plucking to eliminate excessive hair.

Permanent hair removal methods include anti-androgen drugs, birth control pills, and laser hair removal. Anti-androgen drugs, for instance, usually take at least three to six months to work. However, they should not be taken by women in their child-bearing years because they can harm unborn male fetuses.

In all cases, it is best to seek medical advice and counseling first from a doctor or medical specialist. They can conduct examinations and tests designed to detect the underlying cause of hirsutism.

Resources

Organization

Endocrine Society. 8401 Connecticut Avenue, Suite 900, Chevy Chase, MD, 20815. Toll free: 888-363-6274. Web site: <http://www.endo-society.org/index.cfm>.

HIV See *AIDS and HIV Infection*.

Hives

Hives are itchy wheals (welts) that erupt on the skin and are usually caused by an allergic reaction.

What Are Hives?

Hives, also known as urticaria (ur-ti-KARE-e-a), develop as a reaction to various stimuli*. Certain foods, food additives or dyes, drugs, alcohol, or viral infections can cause hives in susceptible people. Foods that commonly cause hives include milk, eggs, shellfish, strawberries, other fruits, and nuts.

Penicillin and aspirin cause hives in some people. Some viral infections that are known to cause hives are hepatitis (inflammation of the liver), infectious mononucleosis, and rubella (German measles).

Some people develop hives after vigorous exercise that causes them to sweat. Sometimes the sun or cold air can cause hives to appear on people's skin. In some people, diving into cold water can result in severe hives, a condition known as cold urticaria.

Symptoms

The first symptom of hives is itching, after which the wheals appear. Wheals usually are small, white welts with red, inflamed areas surrounding them; in some cases, however, they can be quite large. They usually erupt on the arms, legs, and trunk. Sometimes they develop into a ring, with the center clearing before the outer ring improves. Hives tend to come and go on different areas of the skin, and individual welts can last several hours.

What Is Angioedema?

Angioedema (an-jee-o-e-DEE-ma) also results in swelling, but it is not related to hives. In angioedema, swelling occurs in the deeper portion of the skin known as the dermis. It can occur in the hands, feet, eyelids, lips, genital area, and airway passages. Angioedema sometimes occurs at the same time as hives if the person is experiencing an allergic reaction. Angioedema can be serious, and when it affects the throat, it can be fatal if it is not treated promptly. In some cases, angioedema is a hereditary disorder, and a family history usually is present. In these cases, it is a chronic condition, which means that it recurs from time to time.

Treatment for Hives

Most cases of hives clear up by themselves in one to seven days. Some cases respond to medications such as antihistamines* or corticosteroids*. Antihistamines are used to combat the allergic reaction, and corticosteroids are used to fight the inflammation.

Can Hives Be Prevented?

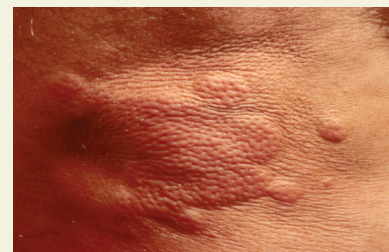
The only way to prevent hives is to avoid a known trigger (the substance that sets off the reaction).

▶ See also **Allergies • Skin Conditions**

Resources

Books and Articles

Middlemiss, Prisca. *What's That Rash? How to Identify and Treat Childhood Rashes*. London: Hamlyn, 2002.



Close-up view of hives, with several wheals surrounded by red, inflamed areas. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **antihistamines** (an-tie-HIS-tuh-meens) are drugs used to combat allergic reactions and relieve itching.

* **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.

Homeless Teens

Young people can become homeless. Some teenagers become homeless with their families when financial problems force them from their homes. Other young people become homeless when they run away from home because of abuse, neglect, or indifference on the part of their families.

- The average age of runaway children is between 14 and 17 years.
- About two million young people living in U.S. households report that they ran away during the previous year.
- Children make up about 40 percent of the overall homeless population, most of them accompanied by at least one parent. One of the fastest growing groups in the homeless population are families with children.
- In cities, about 5 percent of the homeless population consists of unaccompanied children.

Organizations

American Academy of Dermatology. P.O. Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: http://www.aad.org/public/publications/pamphlets/skin_urticaria.html.

DrGreene.com. 9000 Crow Canyon Road, Suite S220, Danville, CA, 94506. Telephone: 925-964-1793. Web site: http://www.drgreene.com/21_1117.html.

Hodgkin's Disease See *Cancer: Overview; Lymphoma.*

Homelessness

Homelessness is the condition of having no fixed, adequate, or secure place to live. In many, although not all cases, homelessness may be a result of mental illness, abuse, or addiction. Even when no associated mental health problem exists, those who are homeless may suffer emotionally because of the lack of the most basic of human needs: safe shelter.

An Eye Opener

Jon and Ryan went for a bike ride one day and were astounded to discover a group of people living in cardboard boxes at the periphery of the county park. Before this, it had never occurred to them that at the edges of their suburban community were people who lived on the streets, dependent on social service agencies, charities, friends, and their own ingenuity to find shelter.

The number of people in the United States who are homeless is difficult to estimate because the population of homeless people is constantly changing as some people find housing and others are displaced. According to the 2006 annual report of the National Law Center on Homelessness and Poverty, 2.5 million to 3.5 million people experience homelessness over a one-year period, and nearly 40 percent of them are children. Homelessness strikes people who live in cities, as well as suburbs and rural areas.

Who Becomes Homeless?

Homelessness can be either temporary, lasting only a few days or weeks, or semi-permanent, lasting for several years. The number of people who

are without shelter is affected by many social factors, including the number of jobs available and how well those jobs pay; the cost of housing; the cost of basic necessities such as food; and the availability of social outreach and assistance programs. According to a fact sheet issued by the National Coalition for the Homeless in 2007, single men are three times as likely to be homeless as single women. The fact sheet also noted a racial disparity among the urban homeless population. Citing a 2004 study by the U.S. Conference of Mayors, it reported that 49 percent of the homeless population was African American, followed by 35 percent Caucasian, and 13 percent Hispanic.

In general, people are more likely to be homeless if they are between the ages of 25 and 54, have less than a high school education, have a history of mental illness, have served in the military, and/or have experienced domestic violence or abuse. Other factors that increase the risk of becoming homeless are time spent homeless, in foster care, or in a group home as a child; childhood physical or sexual abuse; experience as a child runaway; and a history of drug or alcohol abuse.

Health Problems Associated with Homelessness

Most people who are homeless have no health insurance and little access to medical care. In a study issued by the U.S. Department of Housing and Urban Development, almost half of homeless people surveyed had chronic (long-term) health problems such as diabetes*, cancer*, high blood pressure*, or arthritis*, but were not receiving treatment for these conditions. Another one-fourth of the homeless population had an infectious disease such as pneumonia*, tuberculosis, or AIDS*.

According to the U.S. National Center on Family Homelessness, when compared to children with homes, those who are homeless have the following:

- twice the number of ear infections
- four times as many asthma attacks
- five times the number of stomach problems

In addition, about half of school-aged children who are homeless experience anxiety, depression, or other emotional problems, and one in five homeless children require professional care to treat these problems.

In many cases, these health conditions are compounded by other problems that are a direct result of the lack of proper shelter and life on the streets. These may include frostbite, animal bites, insect infestations, leg ulcers, upper respiratory infections, and dietary deficiency. In addition, people who are homeless are sometimes the victims of violent acts that can leave behind both physical and emotional stress.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

* **high blood pressure** also called hypertension, is a condition in which the pressure of the blood in the arteries is above normal.

* **arthritis** (ar-THRY-tis) refers to any of several disorders characterized by inflammation of the joints.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

Some people who are homeless experience difficulties with drug and alcohol abuse, or with mental illness, although many do not.

What Help Is Available to People Who Are Homeless?

The most common programs available to help people who are homeless are those that provide food (e.g., soup kitchens, food pantries) and emergency shelter. Although many people who are homeless are eligible for government programs such as Medicaid, food stamps, veterans' benefits, or welfare benefits, they often have difficulty claiming these benefits because they have no fixed address or lack the organizational skills necessary to follow through with the often-multiple steps involved in participating in the programs.

Nearly half of the people who are homeless work at least part time, but their income is too low to pay for permanent housing or other daily living expenses. Sometimes, they can find other sources of cash, including gifts from friends and families, and money collected from panhandling, although some resort to illegal activities such as drug dealing and prostitution to make money. Numerous agencies offer help by providing job training and assistance in finding steady sources of employment and income.

Reducing homelessness is the target of many social programs. Studies suggest that the most effective programs not only help people find places to live but also help people solve the underlying problems that led to their homelessness in the first place.

Resources

Books and Articles

Gerdes, Louise I., ed. *The Homeless*. Detroit, MI: Greenhaven Press, 2007.

Kaye, Cathryn Berger. *A Kid's Guide to Hunger and Homelessness: How to Take Action*. Minneapolis, MN: Free Spirit, 2007.

Levinson, David, and Marcy Ross, eds. *Homelessness Handbook*. Great Barrington, MA: Berkshire Publishing Group, 2007.

Organizations

National Coalition for the Homeless. 2201 P Street NW, Washington, DC, 20037. Telephone: 202-462-4822. Web site: <http://www.nationalhomeless.org>.

Substance Abuse and Mental Health Services Administration. 1 Choke Cherry Road, Rockville, MD, 20857. Toll free: 877-SAMHSA-7. Web site: <http://homeless.samhsa.gov>.

Hookworm

Hookworm is a type of parasitic roundworm that burrows through the skin, moves through the bloodstream to the lungs, and finally moves into the intestinal tract.

What Is Hookworm?

Hookworm is a type of parasitic* roundworm, known as a nematode (NEM-a-tode), that has hooked mouthparts. The worm uses these mouthparts to fasten itself onto the intestinal walls of various hosts*, including humans. Hookworm larvae (the stage between egg and adult) often enter the body through the skin between the toes in people who go barefoot. Hookworm affects about one-fourth of the world's population, most often in warm, moist areas and in places with poor sanitation.

How Do Hookworms Grow?

Adult hookworms live inside the small intestine of humans and other animals, where they attach to the intestinal wall and feed on the host's blood. Eggs are passed in the host's stools (feces). The eggs hatch into larvae in one to two days under warm, moist conditions out of direct sunlight. The larvae grow in the stools and/or soil for 5 to 10 days until they become filariform (fi-LARE-i-form), or threadlike. During this stage hookworm can cause infection.

Filariform larvae can survive for up to three to four weeks. When they make contact with the bare skin of a human or another animal, they burrow into the skin and enter the host's bloodstream. They then are carried



The United States and the World

- Approximately 3.5 billion people worldwide have some form of infection from intestinal parasites, with about 740 million people in rich and poor countries alike experiencing symptoms of illness.
- Roundworms, including hookworms and pinworms are among the most common intestinal parasites and are a major public health problem.
- Children living in poor regions with tropical climates are especially at risk for roundworm infections.
- Hookworm and other roundworm infections also occur in countries such as the United States, especially from contact with infected pets or their waste or from poor personal hygiene.
- Hookworms are responsible for about 50,000 deaths annually. The large roundworm *Ascaris lumbricoides* (which causes ascariasis) is responsible for another 20,000 deaths worldwide each year.
- Larva migrans is a condition in which larvae from animal hookworm penetrates human skin and causes an itchy rash where the larvae have penetrated. This condition occurs when people walk or lie on beaches where animals have passed infected feces.

◀ The parasitic hookworm *Ancylostoma caninum* uses its hooked mouthpart to attach to the intestinal wall. *Custom Medical Stock Photo, Inc. Reproduced by permission.*



▲ Symptoms of late-stage hookworm infestation are an enlarged abdomen and diarrhea. Worms can live up to 15 years in the human body, and females can lay 10,000 to 25,000 eggs every day. In severe cases the number of parasites may grow so large that the intestines become blocked.

Jan Bradley/Photo Researchers, Inc.

* **parasitic** (pair-uh-SIH-tik) refers to organisms such as protozoa (one-celled animals), worms, or insects that can invade and live on or inside human beings and may cause illness. An animal or plant harboring a parasite is called its host.

* **hosts** are organisms that provide another organism (such as a parasite or virus) with a place to live and grow.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

“THE GERM OF LAZINESS”

In 1902 Dr. Charles W. Stiles (1867–1941) discovered a variety of hookworm indigenous to the United States. At the time, hookworm was a serious problem in the southern United States because of the warm, moist climate and poor sanitation conditions, combined with people’s habit of going barefoot. Hookworm was called the “germ of laziness” by the popular press of the day.

In 1909 oil magnate John D. Rockefeller (1839–1937) established the Rockefeller Sanitary Commission for the Eradication of Hookworm Disease with the gift of a \$1 million grant toward the cure and prevention of hookworm disease. Stiles’s work through the commission became a model used in hookworm eradication programs worldwide.

through the bloodstream to the lungs, where they burrow through the thin walls. Once inside the lungs, they move up the airways to the throat, where they are swallowed. They then pass down the digestive tract to the small intestine. Inside the small intestine, they attach to the intestinal wall, and the cycle begins again.

How Is Hookworm Diagnosed and Treated?

The most common symptom of hookworm is anemia* caused by a loss of iron due to blood loss. Other symptoms include lack of appetite, weight loss, diarrhea*, and vague abdominal pain. When the larvae are in the lungs, there may be a dry cough and mild fever. When the larvae burrow into the skin, there may be mild itching and a rash. It is not uncommon, however, for mild infections to show no symptoms at all.

An infection is confirmed in the laboratory by observing eggs in stool samples under a microscope. Medications can be prescribed to treat the infection. Anemia is treated with iron supplements.

Can Hookworm Be Prevented?

The most effective method of prevention is limiting direct contact between infected soil or sand and skin. In areas where hookworm is common or where human feces may be in the sand or soil, people should avoid walking barefoot or touching the soil or sand with their bare hands.

▶ See also **Ascariasis • Diarrhea • Parasitic Diseases: Overview • Pinworm Infestation • Worms: Overview**

Resources

Books and Articles

Jarrow, Gail. *Hookworms*. San Diego, CA: Kidhaven Press, 2004.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/parasites/hookworm/default.htm>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/hookworm>.

Hormone-Secreting Tumors

Hormone-secreting tumors are benign or malignant* abnormal cell masses that produce and release one or more hormones in an uncontrolled manner. The high levels of the hormone in the bloodstream cause various symptoms, depending on the hormone's effects on the body.*

What Are Hormone-Secreting Tumors?

Hormones are chemical messengers that control many bodily processes. They are produced and released into the bloodstream by specialized glands* of the endocrine* system, including the pituitary*, adrenal glands*, thyroid gland*, and pancreas*. Hormones stimulate responses in their target tissues: other endocrine glands, organs, or cells.

Most endocrine glands continuously secrete small amounts of their particular hormones, so that at any one time there may be minute quantities of more than 50 different hormones circulating in the blood. The human body has elaborate mechanisms for ensuring that enough—but not too much—of each hormone is released by each gland. Most hormones are regulated by negative-feedback mechanisms: Information about the amount of hormone or an affected substance is relayed from the target tissue to the secreting gland, which then adjusts the production and/or secretion of the hormone accordingly. Hormones can also be regulated by counter-regulatory hormones, which counteract or interfere with the hormone's effects.

Hormone-secreting tumors fail to respond to normal regulation and, therefore, produce and release excess hormone. There are almost as many types of hormone-secreting tumors as there are known hormones; the most common are tumors of the pituitary and pancreas.

Pituitary tumors The pituitary gland is located inside the skull above the nasal* passages. The size of a large pea, it is the master hormone-control gland, regulating hormone production of most other glands in

- * **benign** (be-NINE) refers to a condition that is not cancerous or serious and will probably improve, go away, or not get worse.
- * **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.
- * **glands** are organs that produce substances such as hormones and chemicals that regulate body functions.
- * **endocrine** (EN-do-krin) refers to a group of glands, such as the thyroid, adrenal, and pituitary glands, and the hormones they produce. The endocrine glands secrete their hormones into the bloodstream, and the hormones travel to the cells that have receptors for them. Certain hormones have effects on mood and sometimes cause emotional swings.
- * **pituitary** (pih-TOO-ih-tare-e) is a small oval-shaped gland at the base of the skull that produces several hormones—substances that affect various body functions, including growth.
- * **adrenal glands** (a-DREEN-al glands) are the pair of endocrine organs located near the kidneys.
- * **thyroid gland** (THY-roid GLAND) is located in the lower part of the front of the neck. The thyroid produces hormones that regulate the body's metabolism (me-TAB-o-LIZ-um), the processes the body uses to produce energy, to grow, and to maintain body tissues.
- * **pancreas** (PAN-kree-us) is a gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.
- * **nasal** (NA-zal) of or relating to the nose.

- * **hypothalamus** (hy-po-THAL-uh-mus) is a brain structure located deep within the brain that regulates automatic body functions such as heart rate, blood pressure, temperature, respiration, and the release of hormones.
- * **growth hormone** is a chemical substance produced by the pituitary gland that regulates growth and other body functions.
- * **acromegaly** (akro-MEG-al-ee) is a disease in which the pituitary gland secretes too much growth hormone with the effect of gradual and permanent enlargement of flat bones, the hands and feet, abdominal organs, and some facial features.
- * **cortisol** (KOR-ti-sol) is a hormone that helps control blood pressure and metabolism, the process of converting food into energy and waste products. It plays a part in the stress response.
- * **menstruation** (men-stroo-AY-shun) is the discharge of the blood-enriched lining of the uterus. Menstruation normally occurs in females who are physically mature enough to bear children. Most girls have their first period between the age of 9 and 16. Menstruation ceases during pregnancy and with the onset of menopause. Because it usually occurs at about four-week intervals, it is often called the monthly period.
- * **hyperthyroidism** (h-per-THY-royd-ih-zum) is excessive activity of the thyroid gland, characterized by an enlarged thyroid gland, increased metabolic rate, rapid heartbeat, and high blood pressure.
- * **hyperglycemia** (h-per-gly-SEE-mee-uh) is an excess of blood sugar.

the body. The pituitary itself is regulated by the hypothalamus* of the brain, which releases chemicals that stimulate or inhibit pituitary-hormone production. There are five different types of cells in the anterior or front part of the pituitary, each of which makes one or two specific hormones.

Although only about 1,300 pituitary tumors are diagnosed in the United States each year, it is estimated that 15 to 20 percent of all people eventually develop tumors in their anterior pituitary. Of the diagnosed pituitary tumors, almost all are benign glandular tumors called adenomas. Although they do not usually grow beyond the pituitary, their effects can be profound. About 75 percent of pituitary adenomas are functional, meaning that they produce hormones and may not respond to normal feedback signals from the hypothalamus and other glands. Instead they release an excess amount of a specific hormone:

- About 43 percent of pituitary adenomas are prolactinomas. They secrete the hormone prolactin that stimulates milk production in females.
- About 17 percent are growth-hormone or somatotropin-secreting adenomas. These tumors cause gigantism in children. In adults—who normally produce only very small amounts of growth hormone*—somatotropin-secreting tumors cause acromegaly*, meaning “large extremities”—the growth of the bones of the face, hands, and feet.
- About 7 percent are adenomas that secrete adrenocorticotropic hormone (ACTH; corticotropin). ACTH causes the adrenal glands to grow and secrete steroid hormones such as cortisol*. Cushing’s disease is caused by ACTH-secreting tumors.
- About 5 percent are gonadotropin-secreting adenomas. Gonadotropins regulate ovulation and menstruation* in females and testosterone and sperm production in males.
- About 3 percent of anterior pituitary adenomas secrete thyroid-stimulating hormone (TSH), which causes the thyroid to grow and secrete thyroid hormones. TSH-secreting tumors result in hyperthyroidism*. Some pituitary tumors secrete more than one type of hormone, most commonly prolactin and growth hormone.

Pancreatic tumors The amount of glucose (sugar) in the blood is one of the most delicate balances maintained by the body. Too much blood glucose, or hyperglycemia*, can irreversibly damage organs. Too little glucose, or hypoglycemia*, can cause convulsions*, unconsciousness, and even death. When the blood-glucose level rises, beta cells in the islets of the pancreas are stimulated to increase insulin* secretion, which lowers blood glucose. As blood-glucose levels drop, alpha cells in the islets are stimulated to increase glucagon secretion, which raises the concentration of glucose in the blood. Thus insulin and glucagon secretion by the pancreas are both directly regulated by the concentration of

WHAT CAUSES HORMONE-SECRETING TUMORS?

Most hormone-secreting tumors probably result from acquired mutations* in an endocrine cell's DNA* that lead to the loss of a regulatory mechanism that prevents the cells from growing and producing hormones. The only known risk factor for hormone-secreting tumors is an inherited condition called multiple endocrine neoplasia type 1 (MEN1). People with MEN1 are at very high risk of developing pituitary, parathyroid, and pancreatic tumors. However, MEN1 accounts for only about 3 percent of pituitary tumors.

glucose in the blood. Insulin is also controlled by counter-regulatory hormones, including glucagon, growth hormone, adrenalin, and cortisol, which counteract the effects of insulin by raising blood-sugar levels.

There are three main types of hormone-secreting pancreatic tumors:

- Insulinomas are islet-cell adenomas that overproduce insulin, causing hypoglycemia. They are rare and usually occur as single, small tumors in adults. Only 5 to 10 percent are cancerous.
- Glucagonomas are islet-cell tumors that overproduce glucagon, causing glucose intolerance and hyperglycemia. About 60 percent of glucagonomas are cancerous and they commonly spread to the liver*. They also cause a distinctive skin lesion* called necrolytic migratory erythema.
- Zollinger-Ellison syndrome* (ZES) is caused by a single tumor or multiple small tumors called gastrinomas in the pancreas or small intestine*. These secrete high levels of the hormone gastrin, which causes the production of excess stomach acid. One-half to two-thirds of single gastrinomas are cancerous and commonly spread to nearby lymph nodes* and the liver.

What Are the Symptoms of Hormone-Secreting Tumors?

The symptoms of hormone-secreting tumors—as well as their diagnosis, treatment, and prognosis—depend on the physiological effects of the hormones that they secrete.

Pituitary-gland tumors Most pituitary adenomas are completely harmless and cause no symptoms. They are sometimes detected during MRI* brain scans for an unrelated problem. However, some pituitary-hormone-secreting tumors cause symptoms of hormone overproduction. Others may continue growing until they impinge on normal pituitary

* **hypoglycemia** (hi-po-gly-SEE-mee-uh) is a condition that occurs when the amount of glucose, or sugar, in the blood becomes too low. Symptoms can include dizziness, trembling, sweating, and confusion.

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

* **insulin** is a kind of hormone, or chemical produced in the body, that is crucial in controlling the level of glucose (sugar) in the blood and in helping the body use glucose to produce energy. When the body cannot produce or use insulin properly, a person must take insulin or other medications.

* **mutations** (mu-TAY-shuns) are changes in a chromosome or a gene.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **lesion** (LEE-zhun) is a general term referring to a sore or a damaged or irregular area of tissue.

* **syndrome** is a group or pattern of symptoms or signs that occur together.

* **small intestine** is the part of the intestines—the system of muscular tubes that food passes through during digestion—that directly receives the food when it passes through the stomach.

Who Was Harvey Cushing?

Harvey Williams Cushing (1869–1939), a famous American neurosurgeon, developed many of the basic techniques for operating on the human brain. He first reported on “polyglandular syndrome,” which became known as Cushing’s syndrome, in 1912. In 1932 he published a landmark work on pituitary adenomas. Cushing also won a Pulitzer Prize for his biography of Sir William Osler, a father of modern medicine.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **MRI** short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.

* **impotence** (IM-po-tens) is failure of a man to achieve or to maintain an erection.

* **acromegaly** (akro-MEG-al-ee) is a disease in which the pituitary gland secretes too much growth hormone with the effect of gradual and permanent enlargement of flat bones, the hands and feet, abdominal organs, and some facial features.

* **joint** is the structure where two or more bones come together, allowing flexibility and motion of the skeleton.

cells, nerves, or neighboring parts of the brain, causing neurological* symptoms, including headaches and vision problems.

Prolactinomas are most common in young women and in older men. In women they can cause abnormal breast-milk production and the cessation of menstruation. In men they can cause loss of sexual interest or impotence*.

Growth-hormone-secreting tumors can cause children to grow very tall—sometimes over seven feet—in a very short time. Although the arm and leg bones of adults cannot grow, overproduction of growth hormone can cause the bones of the hands, feet, skull, jaws, and face to grow and become distorted. Other symptoms of acromegaly* include:

- Deepening of the voice
- Thickening of the tongue, roof of the mouth, and skin
- Increased body hair
- Headaches

Both gigantism and acromegaly can cause increased sweating and joint* pain. Acromegaly can lead to kidney stones*, diabetes* mellitus, and heart disease.

Cushing’s syndrome refers to symptoms caused by cortisol overproduction for any reason. Cushing’s disease is the overproduction of ACTH by a pituitary adenoma, which leads to excessive release of cortisol by the adrenal glands. Although symptoms of Cushing’s disease are similar to those of acromegaly, they appear much more rapidly and may include the following:

- Weight gain in the chest and abdomen*
- Fat deposits at the base of the neck
- Face swelling
- Easy bruising
- Irregular or absent menstruation
- high blood pressure*
- Moodiness or depression*
- Osteoporosis*

Symptoms of hyperthyroidism caused by TSH-secreting tumors include the following:

- Rapid heartbeat
- Tremors
- Anxiety
- Insomnia
- Increased appetite
- Weight loss
- Frequent bowel movements
- An enlarged thyroid

Pancreatic tumors Symptoms of hypoglycemia from insulinomas may be as mild as anxiety or hunger or as severe as seizures*, coma*, or death. Other symptoms include:

- Sweating
- Tremors
- Rapid heart rate
- Dizziness
- Headache
- Clouded vision
- Behavioral changes
- Confusion

Symptoms of glucagonoma include:

- Skin rashes
- An inflamed mouth and tongue
- Thirst
- Increased appetite
- Weight loss
- Frequent urination

Symptoms of gastrinomas include:

- Abdominal pain
- Diarrhea*
- Stomach or intestinal ulcers*
- Vomiting blood

How Are Hormone-Secreting Tumors Diagnosed and Treated?

Diagnosis Hormone-secreting tumors are diagnosed by measuring hormone levels in the blood and/or urine. A low blood-glucose level after fasting may indicate an insulinoma, whereas a high glucose level may indicate a glucagonoma. High blood levels of insulin or C-peptide, a byproduct of insulin production, may also indicate insulinoma. High glucagon levels in the blood or an abnormal glucose-tolerance test may suggest a glucagonoma. A high level of gastrin may indicate a gastrinoma.

Imaging techniques such as CT scans*, MRI, or ultrasound* are used to visualize hormone-secreting tumors. A biopsy* generally confirms the diagnosis of a tumor. However, hormone tests for some types of pituitary adenomas are accurate enough that a biopsy is not necessary.

Treatment of pituitary tumors Many hormone-secreting tumors can be successfully treated by surgical removal. More than 80 percent of small pituitary adenomas, called microadenomas, are cured by surgery. The cure rate is lower for larger macroadenomas.

* **kidney stones** are hard structures that form in the urinary tract.

These structures are composed of crystallized chemicals that have separated from the urine. They can obstruct the flow of urine and cause tissue damage and pain as the body attempts to pass the stones through the urinary tract and out of the body.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

* **high blood pressure** also called hypertension, is a condition in which the pressure of the blood in the arteries is above normal.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **osteoporosis** (os-te-o-por-O-sis) is the loss of material from the bone. This makes the bones weak and brittle.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

- * **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).
- * **ulcers** are open sores on the skin or the lining of a hollow body organ, such as the stomach or intestine. They may or may not be painful.
- * **antibody** (AN-tih-bah-dee) is a protein molecule produced by the body's immune system to help fight a specific infection caused by a microorganism, such as a bacterium or virus.
- * **enzyme** (EN-zime) is a protein that helps speed up a chemical reaction in cells or organisms.
- * **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.
- * **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.
- * **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- * **radiation therapy** is a treatment that uses high-energy radiation from x-rays and other sources to kill cancer cells and shrink cancerous growths.
- * **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

HOW ARE HORMONE LEVELS MEASURED?

Most hormones are tiny molecules that are present at very low concentrations in the blood and urine. Until the 1960s no effective method for determining hormone levels existed. At the Bronx Veterans Administration Hospital in New York, Rosalyn Yalow (b. 1921), a nuclear physicist, and Dr. Solomon A. Berson (1918–1972) experimented with using radioactive isotopes to measure hormones. In 1960 they published their radioimmunoassay (RIA) for measuring the concentration of insulin in the blood of diabetes patients.

An RIA mixes a known amount of radioactively labeled hormone with an antibody* that specifically binds to that hormone. When human serum containing the hormone is added to the mixture, the hormone in the serum also binds to the antibody, displacing some of the radioactive hormone. By measuring the amount of radioactive hormone that remains bound to the antibody, the tiny amount of hormone in the serum can be determined.

Yalow and Berson applied RIAs to the measurement of other hormones, including corticotropin and growth hormone. Soon RIAs were measuring hundreds of substances, revolutionizing the study of hormones and hormone-secreting tumors. Despite its commercial potential, Yalow and Berson refused to patent their method. In 1977 five years after Berson's death, Yalow was awarded the Nobel Prize in Physiology or Medicine. Eventually the widespread use of RIAs was superseded by enzyme*-linked immunosorbent assays (ELISAs), which use fluorescence rather than radioactivity to measure hormone concentrations.

Medication that controls prolactin levels can successfully treat 80 to 90 percent of prolactinomas. Medications that reduce growth-hormone levels began in the early 2000s to replace surgery as the treatment-of-choice for somatotropin-secreting tumors.

ACTH-, gonadotropin-, and TSH-secreting adenomas are treated surgically. If the tumor persists or returns, a second surgery or radiation therapy* is used. If possible, stereotactic radiosurgery or proton-beam radiation therapy is used instead of conventional radiation. These techniques deliver an intense radiation beam directly at the tumor and have fewer potential undesirable effects. However, the benefits from radiation therapy may not be evident for months or even years. Medications are used if surgery and radiation both fail to control cortisol production caused by ACTH-secreting tumors. In severe cases the adrenal glands may be removed following pituitary radiation.

Treatment of pancreatic tumors Insulinomas are usually cured by surgery. Multiple tumors may require partial removal of the pancreas. If surgery is not possible or is ineffective, medication can be used to lower or suppress insulin secretion. Glucagonomas are usually surgically removed. Cancerous glucagonomas do not respond to chemotherapy*.

ZES is usually treated with medications called proton-pump inhibitors, which reduce stomach-acid production, promote ulcer healing, and relieve abdominal pain and diarrhea. Surgery may remove a single tumor if the cancer has not spread to other organs. Although the cure rate for ZES is relatively low, the tumors are slow-growing. Patients may live for many years following diagnosis and the medications are very effective at relieving symptoms.

▶ See also **Tumor**

Resources

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Organizations

National Endocrine and Metabolic Diseases Information Service.

6 Information Way, Bethesda, MD, 20892-3569. Toll free: 888-828-0904. Web site: <http://endocrine.niddk.nih.gov>.

Pituitary Disorders Education & Support. P.O. Box 571,

Brighton, MI, 48116. Telephone: 810-923-3379. Web site: <http://www.pituitarydisorder.net>.

Pituitary Network Association. P.O. Box 1958, Thousand Oaks, CA,

91358. Telephone: 805-499-9973. Web site: <http://www.pituitary.org>.

HPV See *Human Papilloma Virus (HPV); Warts*.

Human Immunodeficiency Virus See *AIDS and HIV Infection*.

Human Papilloma Virus (HPV)

Human papilloma virus (HPV) is a group of more than 100 related viruses that can cause warts on the hands, feet, genitals, and other parts of the body.

* **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. Viruses can only reproduce within the cells they infect.

* **genital** (JEH-nih-tul) refers to the external sexual organs.

* **sexually transmitted disease** (STD) is an infection, such as the human immunodeficiency virus (HIV) or herpes, that can be passed from person to person by sexual contact.

* **vaginal** (VAH-jih-nul) refers to the canal in a woman that leads from the uterus to the outside of the body.

* **anal** refers to the anus, the opening at the end of the digestive system through which waste leaves the body.

Katy's Story

Katy was embarrassed. The warts on her fingers had gotten worse, and she hated the thought of anyone seeing them. At dinner that night, her mother asked her what was wrong with her hands.

"Nothing," Katy said. But at her mother's frown, she raised her right hand above the table. "They're gross," she said, bursting into tears.

"They're warts," her mother said. "That's no big deal. You've got a virus, that's all."

"You mean, a virus like one that gives you a cold?"

"Exactly. Although we'll need to take you to the dermatologist to take care of them," her mother said.

Katy sighed with relief. The warts weren't permanent, after all.

What Is Human Papilloma Virus?

Human papilloma virus (HPV) is the name of a group of more than 100 related viruses* that can cause warts on the hands, feet, genitals, and other parts of the body.

What Is a Wart?

A wart is an irregular but harmless growth of skin triggered by HPV. There are several different kinds of warts. Common warts, like Katy's, usually appear on the hands. Plantar warts grow on the soles of the feet. Periungual warts grow near the nails and can affect nail growth. Filiform warts appear on the face, as can flat warts, which also appear on the arms and legs. Common warts and periungual warts are rough; flat warts are flat, and plantar warts look like calluses. Filiform warts have thin, thread-like growths sticking out.

Genital* warts may take one of several shapes or may not be visible at all. Genital HPV is the most common sexually transmitted disease* and can affect both men and women. There are more than 40 types of genital HPV, which infects the skin and the mucous membranes.

How Is HPV Transmitted?

HPV thrives in warm, moist places, such as locker rooms, swimming pool areas, and showers. HPV is very contagious and can easily be spread from place to place on a person's body or between people. For example, sharing a razor can allow the virus to spread from one person to another. Or a person can spread the virus from one spot to another on his own body by scratching at a wart, picking up viruses, and then scratching another spot, which introduces the virus. Viruses enter the skin through a scratch, cut, or abrasion; swimmers often pick up the virus that causes plantar warts through a scrape caused by the concrete surfaces used around swimming pools. However, it may take two to nine months before the new wart grows.

People get HPV through genital contact, usually vaginal* or anal* sex. Because most people who have HPV do not realize they are infected, they can unknowingly pass the virus to their sex partners. About 20 million

Americans have HPV, and more than six million people get the virus each year.

How Are HPV and Warts Treated?

There are several methods of treating warts. One of them is to freeze the wart with liquid nitrogen (cryotherapy). Warts can also be removed surgically, with lasers, electricity, or cutting tools. Some people have success treating warts with home remedies, such as putting tape over the wart. Over-the-counter remedies containing salicylic acid are also useful.

No treatment is 100 percent effective. Most warts will go away on their own, although it may take years.

No treatment is available that can eliminate genital HPV. However, the body's natural defenses eliminate the infection; 70 percent of HPV infections are gone within a year, and after two years, 90 percent are eliminated. Nonetheless, some individuals with genital warts ask their doctor to remove them.

Medications Warts may be treated with the application of medication. Salicylic acid, sold under several brand names, works by softening the layers of skin that make up the wart. Once softened, the layers can be rubbed off. Because salicylic acid is both safe and effective (although it may take months to work), it is generally considered the most desirable first treatment for warts.

Prescription medications are also available for removing warts. Cantharidin blisters the skin under the wart, lifting it off. Bichloroacetic acid (BCA) destroys the proteins in the wart's cells. Both cantharidin and BCA must be applied by a health professional. The medication retinoid cream disrupts the cell growth in the wart; it can be applied by a patient at home.

Less commonly used in treating warts are the medications bleomycin, interferon, and the immunotherapy medications imiquimod and contact sensitizers. Each has drawbacks. Bleomycin is expensive, toxic, and painful upon injection; its effectiveness is questionable. Imiquimod is expensive and can cause skin irritation; little is known about its efficacy on non-genital warts. Interferon was an experimental treatment as of 2009. Contact sensitizers can cause severe allergic reactions and are considered dangerous for the health professionals administering them. Neither contact sensitizers nor bleomycin are recommended for pregnant women.

Cimetidine is a medication that may be taken by mouth or as an injection. Most medications are either injected or applied topically.

Cryosurgery If a wart does not respond to treatment with medication, the doctor may suggest surgery. Some patients opt for cryosurgery to remove their warts. For two weeks before the procedure, the patient applies a gel of salicylic acid. At the end of the two weeks, the wart will have turned white and taken on a cottony texture.

The doctor will then apply a small amount of liquid nitrogen, using a cotton swap, a spray, or a cry probe. The extreme cold destroys the root of

HPV VACCINE

A vaccine against the HPV strains most likely to cause cervical cancer is available, and the American Cancer Society recommends that women who are able to get the vaccine do so.

Studies have shown that the vaccine that targets four strains of HPV is 100 percent effective in preventing changes in cells in the cervix for four years. The Food and Drug Administration approved the vaccine for use in females between the ages of 9 and 26. However, it was less effective in women who had been previously exposed to two of the strains. Because the vaccine is less effective in women who have already been exposed to the virus, it is recommended that the virus be given before a woman becomes sexually active.

However, a woman should not get the vaccine if any of the following applies to her:

- Is pregnant, although the vaccine appears to be safe for mother and baby
- Has had a life-threatening allergic reaction to yeast
- Is allergic to the other components of the vaccine
- Has had a reaction to a previous dose of the vaccine

the wart. Common warts are usually treated with an open spray applied for 10 seconds. The procedure may be repeated at four-week intervals.

The advantages of cryosurgery for removal of warts include a short (two-week) preparation time, minimal wound care, and a low risk of infection.

Laser surgery By using an intense, focused beam of light, the doctor can burn the wart, destroying it. But laser surgery is not recommended for every case. This procedure is usually reserved for when a wart has not responded to medication, when warts are particularly widespread, when a wart is large, or when the patient is pregnant and needs the wart or warts removed. Local anesthetic is required for laser surgery.

Conventional surgery Warts may be removed with surgery. Usually surgery involves both burning the wart with an electric current (called electro-surgery), and curettage, cutting the wart off with a scalpel. Because this treatment tends to leave scars, it is considered less desirable than cryosurgery.

How are Plantar Warts Treated?

Plantar warts are found on the soles of the feet. The pressure of standing and walking can cause a layer of thickened skin to form over the wart itself. Unlike other kinds of warts, plantar warts can be painful.

To treat a plantar wart, the doctor scrapes the upper layer with a knife, in a procedure called paring. Because the upper layers of a plantar wart are dead and have no blood vessels, there is little to no pain or bleeding. Paring

may be used to distinguish a plantar wart from a callus; the doctor will look for evidence of blood vessels deep inside the structure, which indicate it is a plantar wart. Paring can also be used to remove skin layers and make the wart more accessible to other treatments, such as medication or cryosurgery.

How are Warts Treated with Home Remedies?

Some people have reported success in removing warts by applying duct tape. They cover the wart with tape and leave it on for six days. Then they remove the tape, soak the wart, and use an emery board on the wart. They repeat the process until the wart is gone. Doctors think that this may work because the tape removes some wart tissue (called debriding) every time it is removed.

Why Do Warts Recur?

No matter how they are treated, warts often recur. Treatments kill the wart itself but not the HPV that causes them. However, given time, the body's immune system can eliminate the viruses that cause warts.

To reduce the risk of warts recurring, individuals need to avoid walking barefoot in locker rooms, swimming pool areas, and showers. They should not touch existing warts, whether their own or someone else's. They should not share personal items, such as razors or towels, with a person who has warts.

▶ See also **Genital Warts • Sexually Transmitted Diseases (STDs)**

Resources

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Organizations

- American Academy of Dermatology.** P.O. Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: www.aad.org.
- Mayo Clinic.** 200 First Street SW, Rochester, MN, 55905. Web sites: <http://www.mayoclinic.com/health/hpv-infection/DS00906>; <http://www.mayoclinic.com/health/common-warts/DS00370>; <http://www.mayoclinic.com/health/genital-warts/DS00087>; <http://www.mayoclinic.com/health/plantar-warts/DS00509>.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

Huntington's Disease

Huntington's disease, formerly called Huntington's chorea (kor-EE-a), is a rare disease that causes part of the brain to deteriorate. A person with the disease has involuntary and strange movements. It is a genetic disorder, meaning that is inherited by the child from the parent's genes*.*

Who Is at Risk for Huntington's Disease?

In the United States, only about five out of 100,000 people develop Huntington's disease. Because it is transmitted from parent to child, only children of a parent who has the abnormal gene are at risk, and they have a 50 percent chance of developing the disease.

What Is Huntington's Disease?

Huntington's affects the basal ganglia (GANG-lee-a, nerve cell bodies in part of the white matter of the brain). This part of the brain acts as an important pathway for the central nervous system*. Huntington's disease causes erratic movements, usually first affecting the face and speech. Memory, reasoning, and speech become affected. Eventually, the abilities to walk, swallow, and take care of oneself are lost. Males and females are equally affected. A person with Huntington's disease usually first has symptoms between the ages of 35 and 50. A person with the disease may live for a period of 10 to 20 years, but the condition is progressive (becomes worse over time).

What Are the Symptoms of Huntington's Disease?

A person with Huntington's disease may first make unusual or strange facial grimaces and become clumsy. Also, the person may become irritable or forgetful. The person may appear to be drunk even without having consumed any alcohol. The awkwardness that comes from the disease

GEORGE HUNTINGTON

The word "chorea" comes from the Greek language, by way of Latin, and means "dance." During the Renaissance, the Swiss physician Paracelsus (1493–1541) wrote about the uncontrollable rhythmic movements characteristic of several different movement disorders.

In 1872, the American physician George Huntington (1850–1916) described an inherited choreatic disorder that began late in life. Because of that research the disorder was named Huntington's Chorea, later known as Huntington's disease.

WOODY GUTHRIE'S STORY

Woodrow Wilson (Woody) Guthrie (1912–1967) was a folk singer and song writer who was well known during the 1930s and 1940s for his songs about migrant workers and poor city people. Among his best known songs are “This Land Is Your Land” and “So Long, It’s Been Good to Know You.” Woody Guthrie died of Huntington’s disease.

When he first exhibited symptoms of the disease in the late 1940s, people thought he was drunk. Only after he was diagnosed as suffering from Huntington’s Chorea (as it was then known) in the 1950s was his behavior understood.

Although there is a predictive test for HD, Woody’s son, folk singer Arlo Guthrie (b. 1947), has opted not to be tested.

* **dopamine** (DOE-puh-meen) is a neurotransmitter in the brain that is involved in the brain structures that control motor activity (movement).

may put the person in danger, for example, by losing his balance while crossing the street.

What Is the Treatment for Huntington’s Disease?

There is no cure for Huntington’s disease, but there is medicine to control the erratic movements caused by the disease. This medicine blocks the production of dopamine* in the brain.

Offspring of someone with Huntington’s disease are advised to seek genetic counseling before deciding whether to have children of their own, as these children also could get the disease. A particular blood test can determine whether a person has the gene for Huntington’s disease.

Is There a Cure for Huntington’s Disease?

There is no cure for Huntington’s disease, but knowing if a person has the gene can influence that person’s decision about having children who might develop this disease later in their lives. The test shows whether the person has the gene that causes the disease. Sometimes people who are at risk may not want to know if they have the gene, and they take the chance of having children before the onset of the disease is noticed. They feel that knowing they have the gene will make it impossible for them to live a normal life.

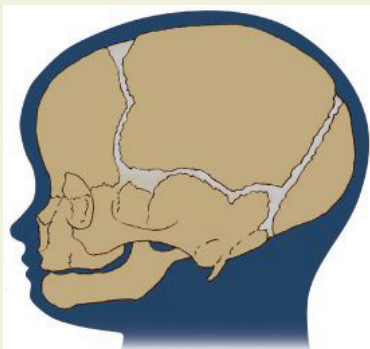
▶ See also **Genetic Diseases**

Resources

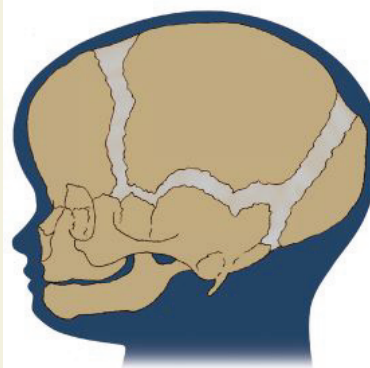
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Healthy infant



Hydrocephalus

▲
When babies are born with hydrocephalus, excess fluid and pressure inside the skull cause the skull bones to pull apart and the head to enlarge. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Organizations

Huntington's Disease Society of America. 505 Eighth Avenue, Suite 902, New York, NY, 10018. Toll free: 800-345-HDSA (4372).
Web site: <http://www.hdsa.org>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Web site: <http://www.ninds.nih.gov/disorders/huntington/huntington.htm>.

Hydrocephalus

Hydrocephalus (hy-dro-SEF-a-lus) is an abnormal build-up of fluid inside the skull. This excess fluid often creates pressure on the brain and may result in mental and physical handicaps.

Why Is the Baby's Head So Big?

When Liz saw her baby brother in the hospital nursery, she was upset by his appearance. His head seemed huge. The doctor explained that John had hydrocephalus, or too much fluid within his skull. Because he was a newborn, the bones in his head had not yet grown together, which allowed his head to expand with the pressure caused by the extra fluid. The doctor warned Liz's family that the excess fluid may have squeezed and damaged John's brain, but it was too soon to tell for sure.

What Is Hydrocephalus?

Hydrocephalus refers to fluid buildup in and around the brain. The term comes from two Greek words: "hydro" meaning "water," and "cephalie" meaning "brain." Hydrocephalus often is called "water on the brain," but the brain and spinal cord are actually bathed in cerebrospinal fluid (CSF). Tissues lining the inside of the brain make CSF, which is a mixture of water, protein, sugar, and minerals, to cushion and protect the brain.

The brain contains four cavities, or spaces, called ventricles (VEN-tri-kuls). CSF normally flows into and around the ventricles, through tiny openings at the base of the brain, over the brain's surface, and around the spinal cord. Normally, the pressure exerted on the brain by CSF remains fairly constant because the body reabsorbs excess CSF into the bloodstream. In people who have hydrocephalus, however, either the flow of CSF is blocked (obstructive hydrocephalus) or the CSF cannot be reabsorbed (communicating hydrocephalus). In both cases, CSF accumulates and the extra pressure squeezes the brain and disrupts blood flow to the

brain. Without the oxygen and sugar that blood carries, the brain cannot function properly. Over time, blood vessels and nerve cells become damaged, which can result in problems with learning, thinking, and moving. The severity of hydrocephalus varies from person to person.

What Causes Hydrocephalus?

Often medical professionals cannot determine the cause of hydrocephalus, but sometimes they can. About one in 1,000 babies is born with the condition, which is known as congenital hydrocephalus. It may occur because the brain did not develop properly or because the fetus was infected with rubella (German measles), herpes, cytomegalovirus, or other viruses, or with microscopic organisms called protozoa. In addition, at least 80 percent of babies who have the congenital disorder spina bifida (a birth defect that leaves an opening in the spinal cord and spinal column) also develop some degree of hydrocephalus.

In infants, children, and adults, brain tumors* can cause hydrocephalus by blocking the flow of CSF. Hydrocephalus also can result from meningitis, an infection of the linings of the brain and spinal cord, and by bleeding in the brain due to a stroke* or a head injury. Infants born very prematurely frequently experience bleeding in the ventricles of the brain, which often leads to hydrocephalus. Hydrocephalus is less common in adults.

How Is Hydrocephalus Treated?

Babies suspected of having hydrocephalus receive careful monitoring. John's head kept getting bigger and ultimately his doctor used a CT scan* and an MRI* to examine his brain.

Some forms of hydrocephalus require no treatment, but most, like John's, require surgery. The surgeon placed a device called a shunt in John's brain to drain the excess CSF. Shunts are thin flexible tubes that pass through the skull and drain some of the excess CSF into the bloodstream or the abdomen where it is reabsorbed by the body. This procedure relieves pressure on the brain, but it does not cure the brain damage that has occurred already.

Most babies born with hydrocephalus live if they receive treatment, but about 60 percent have physical and/or mental handicaps. Liz's baby brother John was lucky. He was one of the children who did not have any mental or physical abilities because of hydrocephalus.

What Is Normal Pressure Hydrocephalus?

Normal pressure hydrocephalus (NPH) is a condition that typically affects older adults. Rather than having a consistently high level of CSF in the skull, individuals with NPH have a normal level of CSF most of the day, but experience occasional, short-lasting spikes in CSF. Eventually, those spikes cause brain damage, and patients may have symptoms such as dementia*, incontinence*, and walking problems. Sometimes, the symptoms lead to a mistaken diagnosis of Alzheimer's (ALTS-hy-merz) disease*. NPH can result from a stroke, meningitis, head trauma, brain tumor, or

* **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

* **incontinence** (in-KON-ti-nens) is loss of control of urination or bowel movement.

* **Alzheimer's (ALTS-hy-merz) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.

Types of cholesterol

Types	Levels (mg/dl)
Total cholesterol:	
Desirable	<200
Borderline	200 to 240
Undesirable	>240
HDL cholesterol:	
Desirable	>45
Borderline	35 to 45
Undesirable	<35
LDL cholesterol:	
Desirable	<130
Borderline	130 to 160
Undesirable	>160
Ratio of total cholesterol to HDL cholesterol:	
Desirable	<3
Borderline	3 to 4
Undesirable	>4

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Illustration by Corey Light. Reproduced by permission of Gale, a part of Cengage Learning.

- * **arteriosclerosis** (ar-teer-e-o-sklah-RO-sis) is a condition in which arteries of the body have become narrowed and hardened from the buildup of calcium, cholesterol, and other substances, causing decreased blood flow through these vessels.
- * **metabolic** (meh-tuh-BALL-ik) pertains to the process in the body (metabolism) that converts food into energy and waste products.
- * **intestines** are the muscular tubes that food passes through during digestion after it exits the stomach.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

other injury, but usually doctors do not know why it arises. A shunt to drain excess CSF works in some patients, and as of 2009 research was under way to find additional treatments.

▶ See also **Brain Tumor • Cytomegalovirus (CMV) Infection • Herpes Simplex Virus Infections • Meningitis • Rubella (German Measles) • Spina Bifida • Stroke • Toxoplasmosis**

Resources

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Organizations

Hydrocephalus Association. 870 Market Street, Suite 705, San Francisco, CA, 94102. Toll free: 888-598-3789. Web site: <http://www.hydroassoc.org>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Toll free: 800-352-9424. Web site: http://www.ninds.nih.gov/disorders/hydrocephalus/detail_hydrocephalus.htm.

Hyperactivity See *Attention Deficit Hyperactivity Disorder (ADHD)*.

Hyperlipidemias

Hyperlipidemias are abnormally high levels of fatty substances called lipids—primarily cholesterol and triglycerides—in the blood. They increase the risk for arteriosclerosis and heart disease.*

What Are Hyperlipidemias?

Hyperlipidemias are lipid metabolic* disorders that are sometimes called hyperlipoproteinemia or dyslipidemia. High levels of cholesterol or triglycerides may be referred to as hypercholesterolemia or hypertriglyceridemia, respectively.

Cholesterol and triglycerides Fats from food are absorbed in the intestines* and sent to the liver* where they are made into cholesterol and triglycerides. These lipids are also absorbed from food. Cholesterol is used to build cells and certain hormones*. Triglycerides are stored in fat cells until the body requires extra calories* for energy.

WHAT MAKES CHOLESTEROL “BAD” OR “GOOD”?

VLDL, LDL, and IDL are called “bad” cholesterol because special cells remove their cholesterol component and deposit it as plaque* on blood vessel walls. Plaque can clog or block arteries. A heart attack* occurs when an artery* supplying blood to the heart is blocked. A stroke* occurs from the blockage of an artery supplying the brain.

HDL is “good” cholesterol because it removes excess cholesterol from blood vessel walls and carries it to the liver where it is broken down and removed from the body. Thus high levels of HDL reduce the risk of atherosclerosis and heart disease.

Cholesterol and triglycerides are transported through the blood as part of molecules called lipoproteins:

- Very-low-density lipoprotein (VLDL) is formed in the liver and transports triglycerides to fat cells.
- Low-density lipoprotein (LDL) transports cholesterol and is formed from VLDL after VLDL delivers its triglycerides.
- Intermediate-density lipoprotein (IDL) transports cholesterol and triglycerides and is also formed from the breakdown of VLDL.
- High-density lipoprotein (HDL) removes LDL cholesterol from tissues and transports it back to the liver.
- Chylomicrons are large lipoproteins that transport triglycerides to muscle and fat cells.

High levels of triglycerides can also cause arteries to harden, thicken, and narrow. High blood triglycerides are associated with obesity* and metabolic syndrome*, both of which increase the risk of heart attack and stroke. Metabolic syndrome refers to the presence of several metabolic risk factors*, such as abdominal* fat, high blood pressure*, high blood sugar, and high cholesterol.

How Common Are Hyperlipidemias?

An estimated 106.7 million Americans have total blood cholesterol levels that are at least borderline high, defined as 200 to 239 milligrams per deciliter (mg/dL) of blood. Another 37.2 million have cholesterol levels above 239 mg/dL, putting them at high risk for coronary heart disease. Cholesterol levels tend to increase with age.

Hyperlipidemias are more common in men than in women, perhaps because women tend to have higher levels of HDL. Although most hyperlipidemias are acquired conditions, inherited familial hypertriglyceridemia occurs in about one out of every 500 Americans.

Triglyceride levels

Normal	Less than 150 mg/dL
Borderline-high	150–199 mg/dL
High	200–499 mg/dL
Very high	500 mg/dL or above

SOURCE: National Heart, Lung and Blood Institute, National Institutes of Health, U.S. Department of Health and Human Services

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*Illustration by GGS Information Services.
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of Cengage Learning.*

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **calories** (KAL-o-reez) are units of energy that are used to measure both the amount of energy in food and the amount of energy the body uses.

* **plaque** (PLAK) is a raised patch or swelling on a body surface. Arterial plaque occurs on the inner surface of an artery and is produced by fatty deposits.

* **heart attack** is a general term that usually refers to a sudden, intense episode of heart injury. It is usually caused by a blockage of a coronary artery, which stops blood from supplying the heart muscle with oxygen.

* **artery** An artery is a vessel that carries blood from the heart to tissues in the body.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

- * **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.
- * **syndrome** is a group or pattern of symptoms or signs that occur together.
- * **risk factors** are any factors that increase the chance of developing a disease.
- * **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.
- * **high blood pressure** also called hypertension, is a condition in which the pressure of the blood in the arteries is above normal.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **hypothyroidism** (hi-po-THY-royd-ih-zum) is an impairment of the functioning of the thyroid gland that causes too little thyroid hormone to be produced by the body. Symptoms of hypothyroidism can include tiredness, paleness, dry skin, and in children, delayed growth and mental and sexual development.
- * **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

What Causes Hyperlipidemias?

The primary cause of hyperlipidemias is a diet that is high in fat and cholesterol. Other factors that contribute to hyperlipidemias include the following:

- Obesity
- Lifestyle factors, including stress, lack of exercise, and regular excessive alcohol use
- Certain other disorders, including diabetes*, hypothyroidism*, Cushing's syndrome, and kidney* and liver disease
- Some medications, including birth control pills, estrogen, corticosteroids*, certain diuretics*, and beta blockers.

How Do People Know They Have Hyperlipidemia?

Because acquired hyperlipidemias may have no symptoms until complications develop, they are generally detected through regular blood screenings. A fasting lipoprotein profile is recommended every five years

WHAT ARE INHERITED HYPERLIPIDEMIAS?

Various hyperlipidemias can be inherited from one or both parents:

- Familial combined hyperlipidemia, causing high blood cholesterol and triglycerides, is the most common inherited blood fat disorder that leads to early heart attacks.
- Familial dysbetalipoproteinemia causes the buildup of large lipoprotein particles containing both cholesterol and triglycerides. It is often due to defects in the gene encoding apolipoprotein E.
- Familial hypercholesterolemia causes high levels of LDL from birth because of a genetic* defect that prevents the removal of LDL from the blood. This factor leads to atherosclerosis and heart attacks at an early age. Rare individuals who inherit the defective gene from each parent have severe treatment-resistant hypercholesterolemia.
- Familial triglyceridemia, in which the levels of triglycerides and VLDL—but not cholesterol—are high, is a common inherited disorder that usually becomes apparent during puberty* or early adulthood. It is often associated with obesity, high blood glucose levels, and high insulin* levels, which may further elevate triglycerides.
- Familial lipoprotein lipase deficiency is a group of very rare genetic disorders in which an enzyme* for breaking down fat is missing and chylomicrons build up in the blood.

beginning at age 20. Inherited hyperlipidemias and consequent heart disease usually develop at an earlier age than acquired hyperlipidemias.

How Are Hyperlipidemias Diagnosed and Treated?

Diagnosis A fasting lipoprotein profile measures total cholesterol, LDL cholesterol, HDL, triglycerides, and sometimes VLDL or VLDL cholesterol, and C-reactive protein that is suggestive of cardiovascular disease.

Treatment Treatment of hyperlipidemias aims to lower lipid levels in the blood to reduce the risk or slow the progression of atherosclerosis and heart disease and possibly reverse damage that has already occurred. A diet that is low in saturated fats and cholesterol and high in fruits and vegetables, along with regular exercise, is the frontline treatment. Losing weight and treating underlying diseases or conditions may also be imperative.

Various medications can lower LDL cholesterol or triglycerides or raise HDL cholesterol. Statins are the most common and most effective drugs for treating high cholesterol. They slow down the rate at which LDL is made and speed up the liver's destruction of LDL.

Other drugs for treating hyperlipidemias include the following:

- Bile acid sequestering resins
- Cholesterol absorption inhibitors
- Fibrates
- Nicotinic acid (niacin; vitamin B3), which—in very high doses under a doctor's supervision—can decrease LDL, raise HDL, and lower triglycerides

Can Hyperlipidemias Be Prevented?

A well-balanced low-fat diet and maintenance of healthy body weight are the best ways to prevent high cholesterol. Saturated (animal) fats, including egg yolks and whole-milk dairy products, increase LDL. Monounsaturated fats—such as olive, canola, or peanut oils—and fiber can lower cholesterol levels. Plant foods have no cholesterol, but some low-fat animal products, such as liver, are high in cholesterol.

To control cholesterol the daily diet should include no more than the following:

- 30 percent total calories from fat
- 8 to 10 percent total calories from saturated fat
- 300 mg cholesterol—the amount in one egg
- 2,400 mg sodium

Excess calories are converted into triglycerides. Sugar and refined foods such as white flour may cause a sudden increase in insulin, which can increase triglycerides. Even small amounts of alcohol can raise triglyceride levels. Trans fats—any food with partially hydrogenated oil listed

* **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.

* **diuretics** (dye-yoor-EH-tiks) are medications that increase the body's output of urine.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

* **insulin** is a kind of hormone, or chemical produced in the body, that is crucial in controlling the level of glucose (sugar) in the blood and in helping the body use glucose to produce energy. When the body cannot produce or use insulin properly, a person must take insulin or other medications.

* **enzyme** (EN-zime) is a protein that helps speed up a chemical reaction in cells or organisms.

in its ingredients—should be eliminated from the diet. Finally, regular exercise—30 minutes most days of the week—raises HDL and lowers LDL and triglycerides.

▶ See also **Metabolic Disease**

Resources

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“Triglycerides and Heart Disease.” *Mayo Clinic Health Letter* 26, no. 8 (August 2008): 6.

Organizations

American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: <http://www.nhlbi.nih.gov/health>.

Hypertension

Hypertension, or high blood pressure, is a condition in which the pressure of blood in the arteries is above normal.

What Is Hypertension?

Hypertension is the medical term for high blood pressure. Arteries are the blood vessels that carry the blood from the heart to organs and tissues throughout the entire body. High blood pressure results either when the output of the blood pumped by the heart increases or when there is an increased resistance to the flow of blood through the arteries or both. In terms of numbers, a resting blood pressure of 140/90 or greater in an adult is considered to be high. Normal blood pressure levels are lower in children and slowly increase with age.

Everyone’s blood pressure goes up in moments of excitement or stress, which is entirely normal. High blood pressure is considered to be a medical condition when it continues over an extended period of time. This condition can then become a serious threat to health; the higher the

pressure and the longer it is allowed to continue without treatment, the greater the risk becomes.

People who have hypertension are more likely to suffer a stroke*, heart attack*, or failure of the kidneys* or heart. For this reason, and because there usually are no symptoms until the damage is done, hypertension has been termed “the silent killer.”

Who Has High Blood Pressure?

Hypertension is not contagious and cannot be caught or passed from one person to another. Its causes are varied and complex: hereditary (genetic*) factors, medical conditions, or medications can play roles. In most cases, no single cause for a person’s hypertension can be found.

However, certain generalizations can be made about its prevalence* in the overall population. It has been estimated that one in three adults in the United States has high blood pressure. This prevalence is believed to be about the same in most industrialized Western countries. The prevalence of high blood pressure is relatively low in developing countries.

It is further estimated that about one-third to one-half of people with high blood pressure are unaware of their condition. Many people first find out when they go for a routine medical check-up.

The prevalence of hypertension is slightly higher in women than in men. Men and women of African descent are both more likely than others to develop the disorder. Hypertension usually begins after ages 20 to 30 and is uncommon in children and teenagers. In addition to age, gender, and race, other factors that have been linked to high blood pressure include obesity, smoking, a diet high in sodium (such as that found in table salt), excessive use of alcohol, and a family history of the disorder.

How Does the Body Control Blood Pressure?

As the heart pumps blood into the arteries, the blood is kept under constant pressure. Many times per day, blood pressure rises briefly when the heart beats faster to supply blood to the parts of the body that need it. For example, people’s legs will need more blood when they are running a race. After the effort has ended, blood pressure returns to its usual level.

Over time, when a person is at rest, the body controls blood pressure in two basic ways. One way is by constricting (narrowing) the arterioles (ar-TEE-re-olz), blood vessels that branch off larger arteries. The other way is by regulating the fluid volume of the blood.

The kidneys have a key role in both of these functions. By secreting the hormone renin, they cause the arterioles to constrict, thereby raising the blood pressure. In addition, the kidneys control the fluid volume of the blood either by retaining sodium or by excreting it into urine. Blood volume and blood pressure increase when sodium is retained in the body.

Did You Know?

- People almost never can tell whether they have high blood pressure by how they feel.
- About one-third to one-half of the people who have high blood pressure do not even know it.
- Hypertension is called “the silent killer” because it can cause a heart attack or stroke without warning symptoms.
- Many people with mild hypertension can be treated without the use of drugs.
- The guidelines for preventing high blood pressure are the same as the guidelines for leading a healthy life.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

* **heart attack** is a general term that usually refers to a sudden, intense episode of heart injury. It is usually caused by a blockage of a coronary artery, which stops blood from supplying the heart muscle with oxygen.

* **kidneys** are the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **prevalence** of a disease or condition means how common it is in a population of people.

What Is a Sphygmomanometer?

A sphygmomanometer is the instrument that is used to measure blood pressure. It consists of an inflatable cuff, or wide band, that is wrapped around the upper arm, a rubber bulb to inflate the cuff, and a gauge that gives the pressure reading.

When measuring blood pressure, the cuff is inflated until it briefly stops the flow of blood in the arm (a painless process). The air pressure is then gradually released while a stethoscope (STETH-o-scope), a listening device, is placed on the artery of the arm just below the cuff. The pressure when the sound of the pulse is heard as the blood first begins to flow again is called the systolic pressure (the higher number). As more pressure is released, the sound of the pulse becomes muffled and disappears. The pressure at that point is called the diastolic pressure (the lower number).

The pressure is read on a gauge, which can be a glass column filled with mercury (the earliest type), a dial, or a digital readout. In some instruments, the blood pressure may be read directly, without the use of a stethoscope. The actual numbers in blood pressure readings represent millimeters of mercury (mm Hg), based upon the original glass column filled with mercury.

The word “sphygmomanometer” comes from the Greek word “sphygmos,” meaning “pulse,” plus “manometer,” a pressure gauge.

What Causes Hypertension?

Hypertension results when the body systems that keep the width of the arterioles and the fluid volume of the blood in a normal relationship become unbalanced. This disruption may occur due to disease or some other influence. Disease, such as disorders of the kidneys, certain tumors, or artery conditions, account for only about 10 percent of hypertension cases. In the great majority of cases, the precise cause remains unknown. In these instances, the disorder is referred to as “primary hypertension” or “essential hypertension.”

Certain factors are known to be influential in producing hypertension. Factors that may contribute to the development of hypertension include a fatty diet and lack of exercise (which can lead to obesity) and too much salt in the diet. Hypertension also occasionally occurs in women who are taking birth control pills. Other factors include diabetes*, smoking, and excessive alcohol consumption.

How Does Hypertension Affect the Body?

Hypertension rarely causes symptoms by itself. When it does, the blood pressure usually is extremely high. Symptoms may then include headache, nosebleeds, dizziness, confusion, and seizures*. A florid (reddish) complexion is not, as is often believed, a sign of hypertension.

Hypertension leads to or speeds up the process of atherosclerosis (ath-er-o-skle-RO-sis), or hardening of the arteries. In this process, cholesterol and other materials carried in the blood can build up in places along the artery walls damaged by years of high pressure. If a blockage should occur in the coronary arteries, which supply blood to the muscles of the heart, a heart attack can occur. If artery blockage occurs in the brain, the result is a stroke. Damage to arterioles can lead to brain hemorrhage (another kind of stroke), kidney failure, or blindness. Over a period of years, hypertension can bring about heart failure by overworking the heart.

If left untreated, the course of hypertension varies in different people. In most, the blood pressure tends to increase gradually as they age.

Hypertension during pregnancy A serious condition called preeclampsia (pree-ee-KLAMP-see-a) develops during the second half of pregnancy in about 7 percent of women. This disorder is characterized by a sudden rise in blood pressure, along with severe headaches, visual disturbances, and retention of fluids in the body. The condition is most common in first pregnancies and in women younger than 25 or older than 35 years. If left untreated, preeclampsia can lead to eclampsia, which is characterized by seizures and extremely high blood pressure that may be fatal to the mother or baby.

How Is Hypertension Is Defined by Numbers?

Blood pressure is expressed as two numbers: the systolic (sis-TOL-ik) pressure and the diastolic (dy-a-STOL-ik) pressure. The first (higher) number is the systolic pressure, which occurs during systole (SIS-to-lee), when the heart

contracts. The second (lower) number is the diastolic pressure, which occurs during diastole (dy-AS-to-lee), when the heart relaxes between beats.

These numbers are read from a special instrument, called a sphygmanometer (sfig-mo-ma-NOM-e-ter). Written down, the two numbers are separated by a slash. Normal pressure taken at rest in adults should be below 120/80, expressed as “120 over 80.” Healthy young adults typically will have a pressure of about 110/75, however, and normal blood pressures are even lower in young children. As previously mentioned, a pressure of 140/90 or higher (either number) in adults means stage 1 hypertension.

How Is Hypertension Diagnosed?

When assessing or diagnosing hypertension, a physician may take more than one reading, especially if the first reading is high. This is so because blood pressure varies over time. Moreover, some people have what is called “white coat hypertension,” which means that their blood pressure tends to go up when they are being examined by a doctor. To get an accurate reading, doctors try to have their patients feel as relaxed as possible. For people who have never had their blood pressure taken, it is important for a doctor to explain that the process is painless.

Diagnosing high blood pressure involves more than just numbers. A doctor has to try to determine the cause. The patient may be asked about eating and exercise habits. It is often important to know if someone else in the family has a history of high blood pressure. The doctor also may want to know about the patient’s salt intake, consumption of alcohol, smoking habits, use of medications such as birth control pills, and use of street drugs. Urine and blood samples may be taken to check kidney function and blood cholesterol levels.

It is commonly observed that blood pressure tends to go up with age. Although true statistically, this fact does not mean that it is acceptable from a health standpoint. Blood pressure that is equal to or more than 140/90 indicates Stage 1 hypertension and is a cause of concern at any age.

How Is Hypertension Treated?

For the small percentage of people whose hypertension is caused by particular disorders of the kidneys or certain tumors or artery conditions, surgery may be the chosen treatment and should provide a cure. For the great majority, however, the choice of treatment is likely to be changes in lifestyle or medication in addition to lifestyle changes.

Good health habits Many people with prehypertension can lower their blood pressure by making certain modifications in their lifestyle and diet, without the use of drugs. These changes may involve losing weight, getting more exercise, or modifying their diets in certain ways.

Excess weight, especially obesity, can be a factor in raising blood pressure. In losing weight, it is usually best to take a gradual approach and to emphasize reduction of fat in the diet. Any weight loss program should also include regular exercise such as walking briskly or jogging (with a

What the Numbers Mean

Blood pressure is measured in units called millimeters of mercury (mm Hg). It is written as two numbers, one over the other. The number on top is the systolic pressure (when the heart contracts). The bottom number is the diastolic pressure (when the heart relaxes between beats). When systolic and diastolic blood pressures fall into different categories, the higher category should be used to classify blood pressure level.

Blood pressure in adults falls into the following categories:

- **Normal:** systolic: <120 *and* diastolic: <80
- **Prehypertension:** systolic: 120–139 *or* diastolic: 80–89
- **Stage 1 hypertension:** systolic: 140–159 *or* diastolic: 90–99
- **Stage 2 hypertension:** systolic: >160 *or* diastolic: >100

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body’s pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

doctor's approval in adult patients). Many experts believe that it is almost impossible to lose weight permanently through diet alone.

Many people with hypertension can help to lower their blood pressure by adopting a low-sodium, or low-salt, diet. Studies have shown that people can get all the salt that they need in the foods they eat without adding any. Good rules to follow are to add less salt when cooking and at the table and to shop for foods that are low in sodium. Labels on cans or packages of processed food will indicate how much sodium is contained in each portion.

Another factor that may contribute to high blood pressure is stress. Although some stress is unavoidable in daily life, frequent unrelieved stress can be harmful. It is worthwhile to find ways, such as relaxation techniques, to lower stress levels. Physical exercise is an effective way for many people to decrease stress and blood pressure.

Common-sense rules about avoiding harmful substances apply to people with normal as well as high blood pressure. It is not advisable to smoke at any age or for adults to have more than one or two alcoholic drinks per day. The nicotine from cigarettes speeds up the heart and constricts blood vessels. Alcohol abuse has been associated with increased risk of developing hypertension, as well as many other health problems. Street drugs such as cocaine can have a direct adverse effect on the heart and increase blood pressure.

Medication When hypertension is present, or when prehypertension does not respond to diet, exercise, and other lifestyle changes, medicines may be prescribed. Several different types of drugs are available, the choice of which depends upon the particular needs of the patient.

Diuretic drugs are among the more commonly used pharmaceutical products. They act to increase the flow of urine and decrease the blood volume. Another group, called beta-blockers, alters the way the nervous system functions in the control of blood pressure. A third group of drugs, called vasodilators (va-zo-DY-layt-orz), act to relax the blood vessels, thereby decreasing the resistance to blood flow. Other types of drugs may be prescribed as well.

Prescription drugs for hypertension may have various side effects, depending upon the drug and the person taking it. All antihypertensive drugs may cause dizziness and fainting, however, if the blood pressure is lowered too much. It is extremely important not to stop taking medication without consulting a doctor.

Doctors treating hypertension may wish to have their patients monitor their blood pressure by taking readings at regular intervals. Devices for home use are available for this purpose.

Can Hypertension Be Prevented?

For teenagers and young adults, who are unlikely to have the condition early in life, hypertension may seem to be only a remote possibility for some time in the distant future. However, establishing a healthy lifestyle by keeping fit and trim through exercise and good eating habits and not

smoking can help prevent health problems such as hypertension from developing later. This is particularly important for people who have a family history of hypertension.

Last, it is important for people to get their blood pressure checked on a regular basis. Although doing so will not actually prevent hypertension, it can get someone who has the condition into treatment earlier, thereby keeping it under control and lessening the risk of developing serious health problems such as heart attack or stroke.

▶ See also **Diabetes • Heart Disease • Stroke**

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American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org>.

American College of Cardiology. 2400 N Street NW, Washington, DC, 20037. Toll free: 800-253-4636. Web site: <http://www.acc.org>.

American Society of Hypertension. 148 Madison Avenue, 5th Floor, New York, NY, 10016. Telephone: 212-696-9099. Web site: <http://www.ash-us.org>.

Mayo Clinic. 200 First Street SW, Rochester, MN 55905. Web site: <http://www.mayoclinic.com/health/high-blood-pressure/DS00100>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: <http://www.nhlbi.nih.gov/hbp/index.html>.

Hyperthyroidism See *Thyroid Disease*.

* **heart attack** is a general term that usually refers to a sudden, intense episode of heart injury. It is usually caused by a blockage of a coronary artery, which stops blood from supplying the heart muscle with oxygen.

Hypochondria

Hypochondria (hy-po-KON-dree-a) is a mental disorder in which people believe they are sick or have a serious disease, but their symptoms are not related to any physical illness and medical examination or tests show no sign of illness.

More than a Temporary Worry

Many people worried about their health from time to time. For example, a symptom such as chest pain can have many causes and may or may not be serious. But if individuals experiencing this symptom have just read a newspaper article about someone who experienced a heart attack*, they might worry that they are about to have one too. This temporary concern is not an example of hypochondria. With true hypochondria the worry is more lasting, and it interferes with one's daily life.

The prevalence of hypochondria among the general public is unknown, but studies have suggested that it accounts for between 4 and 9 percent of visits to doctors. Hypochondria occurs in all age groups and cultures and is about equally prevalent among males and females.

When Medical Reassurance Does Not Help

People with hypochondria may be overly concerned with a variety of symptoms and even with their normal bodily functions. Minor aches and pains, occasional coughing, dizziness, nausea, or small sores can convince people with hypochondria that they are seriously ill. They may also closely monitor normal bodily functions, such as heartbeat, breathing, sweating, and intestinal function, for signs of disease. The health worries of someone with hypochondria may be focused on a particular body organ, such as the heart, or on several parts of the body.

An important characteristic of people with hypochondria is that they are not fully reassured after a medical examination and tests have shown no physical basis for their complaints. Although their fears may be temporarily relieved, the belief that they are ill may still be so strong that they go from one physician to another seeking new tests and treatments.

What Causes Hypochondria?

People may wonder why some people are constantly worried about being sick. The cause or causes of hypochondria are not clearly understood, and experts have varying opinions.

One theory is that people who have hypochondria are excessively sensitive to their bodily sensations and may misinterpret their meaning. In some cases, hypochondria appears to be triggered by the death of a loved one. Researchers have also noted that hypochondria seems to be

more common in people who were seriously ill when they were children or who have spent a lot of time around sick relatives. Such past experiences may contribute to health worries.

Hypochondria may be one symptom of another mental disorder, such as depression* or anxiety*. For example, in some cases of obsessive-compulsive disorder*, a person may have extreme unfounded health worries and feel compelled to keep seeking reassurance from health professionals.

How Is Hypochondria Diagnosed and Treated?

The first step in diagnosing hypochondria is a thorough physical examination to make sure there is no medical disease or condition causing the patient's complaints. When the patient has been reassured that he or she is not ill, yet the intense health worries continue, the diagnosis of hypochondria may be made. The physician will need to take care not to confuse hypochondria with malingering*, or with such closely related mental conditions as conversion disorder* and Munchausen syndrome*.

Hypochondria can be difficult to treat because the beliefs about illness are usually very strong. Although reassurance that the person is in good health is necessary, it is likely to be helpful only for a short time. Psychotherapy can help individuals make gradual changes in the way they think about their bodily sensations and to cope with health anxiety. When hypochondria is a symptom of depression, anxiety, or obsessive-compulsive disorder, treatment focuses on the underlying disorder.

▶ See also **Anxiety and Anxiety Disorders • Conversion Disorder • Malingering • Munchausen Syndrome • Somatoform Disorders**

Resources

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Organizations

University of Maryland Medical Center. 22 S. Greene Street, Baltimore, MD, 21201-1595. Telephone: 410-328-8667. Web site: <http://www.umm.edu/ency/article/001236.htm>.

University of Michigan Health System. 1500 E. Medical Center Drive, Ann Arbor, MI, 48109. Telephone: 734-936-4000. Web site: <http://www.med.umich.edu/1libr/aha/umhypo.htm>.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.

* **obsessive-compulsive disorder** is a condition that causes people to become trapped in a pattern of repeated, unwanted thoughts, called obsessions (ob-SESH-unz), and a pattern of repetitive behaviors, called compulsions (kom-PUL-shunz).

* **malingering** (ma-LING-er-ing) means intentionally pretending to be sick or injured to avoid work or responsibility.

* **conversion disorder** is a mental disorder in which psychological symptoms are converted to physical symptoms, such as blindness, paralysis, or seizures. A person with conversion disorder does not intentionally produce symptoms.

* **Munchausen syndrome** (MOON-chow-zen SIN-drome) is a mental disorder in which a person pretends to have symptoms or causes symptoms of a disease in order to be hospitalized or receive tests, medication, or surgery.



▲ Dried fruit for snacks: apple, apricot, prune, pear. *Adrienne Hart-Davis/Photo Researchers, Inc.*

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **pancreas** (PAN-kree-us) is a gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.

Hypoglycemia

Hypoglycemia (hy-po-gly-SEE-mee-a) is a condition that occurs when the amount of sugar in the blood gets too low.

Melinda's Story

Melinda was at the mall with friends when she started to feel weak and uncoordinated. She developed a pounding headache, began to shake and sweat, and could not see very well. Because Melinda has diabetes*, her doctor had warned her about these symptoms, and she knew they meant that her blood sugar had gotten too low. She carried candy in her backpack at all times for just such an occasion. Melinda told her friends that she should not have skipped lunch because a sensible diet and regular meals help prevent hypoglycemia in people being treated for diabetes. Melinda told them that hypoglycemia can cause coma* if not treated. After eating her candy bar, Melinda felt better within minutes.

What Is Hypoglycemia?

Hypoglycemia is a common medical emergency and means low (“hypo”) blood sugar (“glycemia”). Hypoglycemia is not a disease; it is a symptom of a problem the body has with regulating blood sugar. Its opposite, hyperglycemia (hy-per-gly-SEE-mee-a), means too much sugar in the blood, which is one of the features of diabetes.

Glucose is a sugar that represents an important source of energy for the body. The main dietary sources of glucose are carbohydrates found in foods such as rice, potatoes, bread, tortillas, cereal, milk, fruit, and sweets. After a meal, digestion breaks down food, and glucose molecules are absorbed into the bloodstream and carried to the cells, where they are used to produce energy. Insulin, a hormone* produced by the pancreas*, helps glucose enter cells. When the body takes in more glucose than needed, the extra glucose is stored in the liver and muscles in a form called *glycogen*, or the extra glucose is converted into fat for storage in fat cells. The body can use the stored glucose whenever it needs energy between meals. When the level of glucose in the blood begins to fall, *glucagon*, another hormone produced by the pancreas, signals the liver to break down glycogen and release glucose. This response increases the blood glucose levels to the normal level. When the level of glucose in the blood begins to rise, special cells, called beta cells, signal the pancreas to release insulin so that glucose can enter cells while also reducing glucose production by the liver. This response lowers the amount of glucose in the bloodstream. As the blood glucose level returns to normal, so does the secretion of insulin from the pancreas.

Insulin-Induced Hypoglycemia

The most frequent cause of hypoglycemia is the excessive effect of an incorrect dose of insulin in patients with diabetes who are being treated with insulin. Most people being treated with insulin for diabetes experience

hypoglycemia. Diabetes is characterized by high levels of sugar in the blood due to the body's inability to make enough insulin or to respond to insulin normally. People being treated with insulin for diabetes sometimes take too much insulin or may not eat enough, as happened to Melinda at the mall. In fact, 90 percent of people with insulin-dependent diabetes experience hypoglycemia; it is almost impossible for them to achieve normal blood glucose levels without having at least occasional episodes of hypoglycemia. The frequency of these episodes is also increased under unsteady conditions, such as infection, exercise, and irregular eating. Severe hypoglycemia is sometimes called "insulin shock," which can occur if diabetics take too much insulin, do not eat frequently enough, or do not eat sufficient amounts of sugar. Taking glucose or other sugar-containing (but not artificial sweetener-containing) beverages by mouth, or glucagon by injection, are effective treatments. Long periods of hypoglycaemia can lead to insulin coma, not to be confused with diabetic coma, resulting from hyperglycemia.

Non-Diabetic Hypoglycemia

In people who do not have diabetes, the three major forms are tumor-induced hypoglycaemia, reactive hypoglycaemia, and fasting hypoglycaemia.

Tumor-induced hypoglycemia Hypoglycemia can occasionally be caused by an insulinoma, a tumor* of the insulin-producing cells of the pancreas. Insulinomas secrete insulin and raise insulin levels too high in relation to the blood glucose level. These tumors are very rare and do not normally spread elsewhere in the body. Other non-islet-cell tumors occurring in the chest or abdomen also secrete insulin-like growth factors that may cause hypoglycaemia.

Reactive hypoglycemia Reactive hypoglycemia occurs after eating, especially after a meal containing lots of sugary or starchy foods. The sugar from the meal causes the body to rapidly produce a great deal of insulin to prevent blood sugar from rising too high. But the body makes so much insulin that the blood sugar level drops too low instead.

Fasting hypoglycemia Fasting hypoglycemia occurs several hours after a person's last meal. It can happen as a result of conditions such as anorexia nervosa*, or starvation.

Other possible causes of low blood sugar in people without diabetes are as follows:

- *Mistaken use of diabetes medication.* The accidental intake of another person's oral diabetes medication is a common cause of hypoglycemia.
- *Some medications.* Medications may cause hypoglycemia in children or in people with kidney failure. One medication known to have had this effect is quinine, used in the treatment of leg cramps and malaria.

* **tumor** (TOO-mor) is an abnormal growth of body tissue that has no known cause or physiologic purpose. A tumor may or may not be cancerous.

* **anorexia nervosa** (an-o-REK-se-a ner-VO-sa) is an emotional disorder characterized by dread of gaining weight, leading to self-starvation and dangerous loss of weight and malnutrition.

* **adrenal glands** (a-DREEN-ai glands) are the pair of endocrine organs located near the kidneys.

- *Alcohol.* Excessive alcohol intake in the absence of meals can block glucose production and deplete the body's stores of glycogen.
- *Some severe illnesses.* Liver disease, such as drug-induced hepatitis (liver inflammation), can cause hypoglycemia because the liver is a key glucose-producing organ. Kidney disease also affects glucose levels.
- *Hyperinsulinemia.* Hyperinsulinemia is characterized by excessively high blood insulin levels. It may be caused by a rare disorder of the beta cells of the pancreas that help release insulin.
- *Endocrine deficiencies.* The endocrine system consists of several glands that produce hormones to regulate all processes throughout the body. Some disorders of the adrenal glands* (Addison's disease) and the pituitary gland (hypopituitarism) can result in hypoglycemia because they cause a deficiency of the key hormones regulating glucose production.

How Is Hypoglycemia Diagnosed?

To find out if a person has hypoglycemia, doctors ask about symptoms and whether they go away when the person eats sugar. The doctor will also examine the patient and take a medical history to look for the specific features of disorders known to be associated with hypoglycemia. Blood tests performed when the person is having symptoms of hypoglycemia can confirm low levels of sugar in the blood, if present, and can measure the levels of insulin and other hormones and substances involved in the control of blood sugar levels. The tests can distinguish between the hypoglycemia symptoms due to adrenalin-related hormones and those due to a shortage of glucose being delivered to the brain ("neuroglycopenia").

▶ See also **Anorexia Nervosa • Diabetes • Eating Disorders: Overview • Metabolic Disease**

Resources

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Organizations

American Diabetes Association. 1701 North Beauregard Street, Alexandria, VA, 22311. Toll free: 800-342-2383. Web site: <http://www.diabetes.org>.

Centers for Disease Control and Prevention, Diabetes Public Health Resource. Mail Stop K-10, 4770 Buford Highway, NE, Atlanta, GA, 30341-3717. Toll free: 800-232-4636. Web site: <http://www.cdc.gov/diabetes/projects/index.htm>.

National Institute of Diabetes and Digestive and Kidney Diseases. Building 31, Room 9A06, 31 Center Drive, MSC 2560, Bethesda, MD, 20892-2560. Telephone: 301-496-2560. Web site: <http://www2.niddk.nih.gov>.

Hypothermia *See Cold-Related Injuries.*

Hypothyroidism *See Thyroid Disease.*

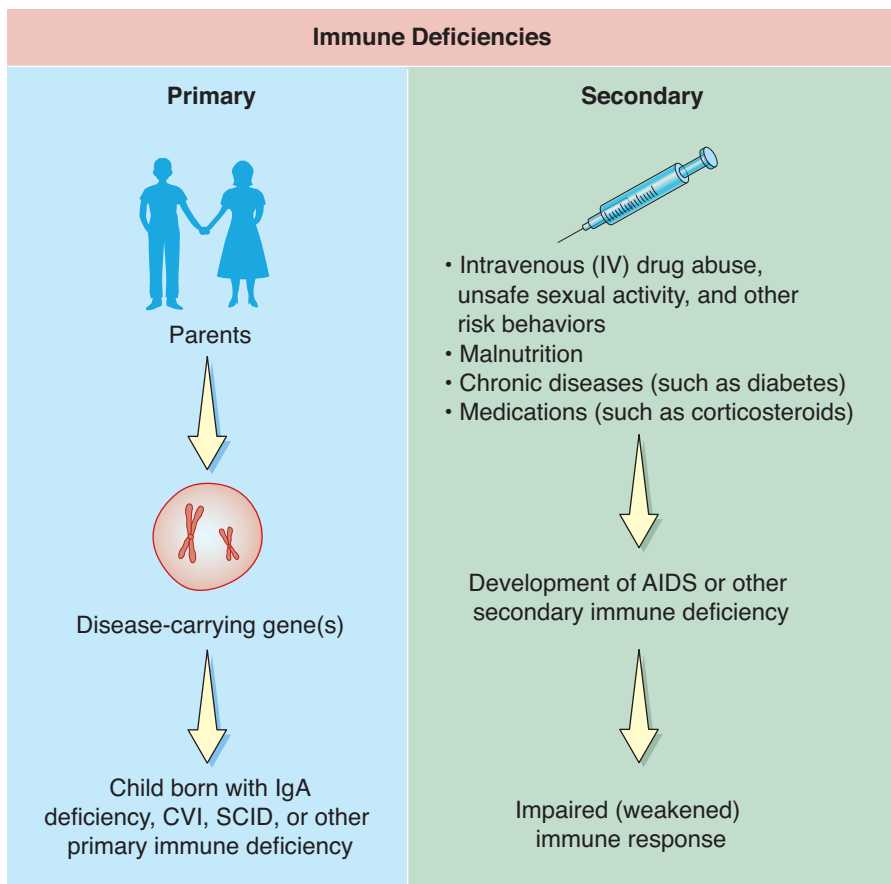
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Immune Deficiencies

Immune deficiencies (ih-MYOON dih-FIH-shen-seez) are conditions that impair the body's immune system so that it is less capable of fighting infection.

What Are Immune Deficiencies?

Immune deficiencies arise when one or more of the parts of the immune system are missing or not working correctly, leaving the body less able to fight disease-causing agents. There are two types of these deficiencies: primary (inherited) immune deficiencies and secondary (acquired) immune deficiencies.



◀ Primary and Secondary Immune Deficiencies. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



Organisms that typically do not cause problems in a person with a healthy immune system may produce an “opportunistic infection” in a person with an immune deficiency. A person particularly at risk for such infections might be placed in isolation in a sterile environment. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

- * **microorganisms** are tiny organisms that can only be seen using a microscope. Types of microorganisms include fungi, bacteria, and viruses.
- * **toxins** are substances that cause harm to the body.
- * **autoimmune diseases** (aw-toh-ih-MYOON) are diseases in which the body’s immune system attacks some of the body’s own normal tissues and cells.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **tonsils** are paired clusters of lymphatic tissue in the throat that help protect the body from bacteria and viruses that enter through a person’s nose or mouth.
- * **appendix** (ah-PEN-diks) is the narrow, finger-shaped organ that branches off the part of the large intestine in the lower right side of the abdomen. Although the organ is not known to have any vital function, the tissue of the appendix is populated by cells of the immune system.

The immune system has many parts that work together to protect the body from foreign invaders, such as microorganisms* and toxins*. When any segment of the immune system is absent or breaks down, it can lead to an immune deficiency. With so many elements of the immune system, there are more than 80 different types of primary immune deficiencies. They range from those that have severe and sometimes fatal effects to mild diseases that cause people few, if any, problems. About half a million people in the United States have some type of primary immune deficiency, with more boys than girls affected by these conditions.

Secondary immune deficiencies are much more common than inherited deficiencies. Unlike patients with primary immune deficiencies, people with secondary immune deficiencies are born with a healthy immune system, but sometime later in life the system becomes weakened or damaged. Both primary and secondary deficiencies typically lead to frequent infections and sometimes to additional medical problems, including certain cancers. These people often experience a variety of skin, respiratory, and bone problems as well, and they are more likely to have autoimmune diseases*.

What Is the Immune System?

The immune system consists of a group of organs, cells, and a specialized system called the lymphatic (lim-FAH-tik) system that helps clear infectious agents from the body. Together, they guard the body against infectious diseases. The lymphatic system is a key part of the immune system: it consists of lymphatic vessels, lymph nodes*, and the thymus (THY-mus) and spleen. Lymph nodes and lymphatic vessels transport lymph, a clear fluid that contains white blood cells called lymphocytes (LIM-fo-sites), throughout the body. The lymphocytes mature in the thymus, a gland located behind the breastbone. The spleen, an organ that is the center of certain immune system activities, is found in the upper-left side of the abdomen. Lymphatic tissue is also found in other locations throughout the body, including the tonsils* and the appendix*.

When a foreign substance or microorganism enters the body, phagocytes (FAH-go-sites) often are the first cells at the site. These large scavenger white blood cells patrol the bloodstream, looking for possible invaders. When they find one, they engulf, digest, and destroy the intruder.

Other components of the immune response react when presented with specific antigens*. The most important players in this fight are two types of lymphocytes that learn to recognize and destroy the foreign invaders.

B cells, the first type, are white blood cells that produce antibodies*, which circulate in the blood and lymph streams. The first time B cells encounter a new foreign substance, they make antibodies in response to the intruder’s antigens. When the antibodies come across that specific antigen again, they attach themselves to it, marking it (and with it, the entire foreign substance or microorganism) for destruction by other

cells. Antibodies also summon phagocytes and body chemicals, such as complement proteins*, to the site of an infection and move them into action against the antigens.

T cells, the second type, are specialized white blood cells that have several roles. They monitor and coordinate the entire immune response, which includes recruiting many different cells to take part in that response. Some T cells, the T helper cells, signal the B cells to start making antibodies. Other T cells, the T killer cells, attack and destroy substances that they recognize as foreign. Once the foreign antigens have been defeated, cleanup crews of scavenger phagocytes called neutrophils (NU-tro-fils), a type of white blood cell that can surround and destroy invading organisms, and macrophages (MAH-kro-fay-jez), another form of engulf-and-destroy cell, arrive to clear up remains of the infection.

What Are Primary Immune Deficiencies?

A genetic* abnormality in any type of cell of the immune system can lead to a primary immune deficiency. Some of these deficiencies produce no symptoms, whereas others cause severe symptoms and may even be fatal. Although primary immune deficiencies are present at birth, some patients do not begin to show signs of the condition until later in childhood or even beyond childhood.

There are several well-known primary immune deficiencies. About 1 person in 600 is born with selective IgA deficiency, a mild disease that most often affects those of European ancestry. People with this condition lack immunoglobulin (ih-myoo-no-GLAH-byoo-lin) A (IgA), a class of antibodies that fight organisms that can infect the mucous membranes that line the mouth, airways, and digestive system*. Many patients with this disorder experience few symptoms, but some may have frequent infections.

The effects of common variable immunodeficiency, also known as hypogammaglobulinemia (hi-po-gah-muh-gloh-byoo-lih-NEE-me-uh), can range from mild to severe. Its symptoms occasionally affect infants but often do not appear until early adulthood. Those symptoms include frequent bacterial infections of the ears, sinuses*, bronchi*, or lungs brought on by low levels of various immunoglobulins, including IgA and IgG.

Caused by defective genes on the X chromosome*, X-linked agammaglobulinemia (a-gah-muh-gloh-byoo-lih-NEE-me-uh) is uncommon and affects only males. Patients have very low levels of mature B cells as well as low levels of immunoglobulins, which can result in pus* collections in the lungs, sinuses, and ears in addition to other infections.

SCID, also known as bubble boy disease, strikes about 1 in one million people. This group of immune disorders is marked by major deficiencies in B cells and T cells, low levels of white blood cells, and decreased levels of IgA, IgG, and IgM antibodies. Such massive defects in the immune

The SCID Mouse

To gain a better understanding of the human immune system, scientists developed a laboratory mouse that lacks an enzyme necessary for its immune system to function properly. Like people with severe combined immunodeficiency disease (SCID), these mice cannot fight infections.

Another very useful mouse model was developed in the 1980s, when scientists transplanted parts of the human immune system into the mouse. This gave an opportunity to researchers to study the workings of the human immune response more easily, as well as the impact of drugs and viruses on the immune system. This mouse has been described as a “living test tube.”

* **antigens** (AN-tih-jens) are substances that are recognized as a threat by the body's immune system, which triggers the formation of specific antibodies against the substance.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **complement proteins** are proteins that circulate in the blood and play a role in the immune system's response to infections. More than 20 complement proteins have been identified.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **digestive system** is the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, rectum, and other organs involved in digestion, including the liver and pancreas.

- * **sinuses** (SY-nuh-ses) are hollow, air-filled cavities in the facial bones.
- * **bronchi** (BRONG-kye) are the larger tube-like airways that carry air in and out of the lungs.
- * **chromosome** (KRO-mo-zom) is a unit or strand of DNA, the chemical substance that contains the genetic code to build and maintain a living being. Humans have 23 pairs of chromosomes, for a total of 46.
- * **pus** is a thick, creamy fluid, usually yellow or ivory in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.
- * **pneumonia** (nu-MO-nyah) is inflammation of the lungs.
- * **sepsis** is a potentially serious spreading of infection, usually bacterial, through the bloodstream and body.
- * **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.
- * **chronic** (KRAH-nik) lasting a long time or recurring frequently.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **cirrhosis** (sir-O-sis) is a condition that affects the liver, involving long-term inflammation and scarring, which can lead to problems with liver function.

system can leave patients open to many serious, even fatal infections, including the following:

- pneumonia*
- sepsis*
- meningitis*

Other primary immune deficiency diseases may involve other components of the immune system, including neutrophils and phagocytes. There may be fewer of these cells produced, as occurs in a condition known as neutropenia (nu-tro-PEE-nee-uh), which is marked by low levels of neutrophils in the blood. Chronic* granulomatous (gran-yoo-LO-muh-tus) disease is an immune disorder in which bacteria-fighting phagocytes are present but do not work properly. Genetic defects also can impair the complement system, a series of 20 or more proteins that come together during the body's immune response to complement (support) the work of antibodies. These conditions and defects in other parts of the complex immune system cause problems with the body's immune response, often making a person more susceptible to a variety of infections.

What Are Secondary Immune Deficiencies?

Secondary immune deficiencies are acquired, rather than inherited, disorders. Many chronic conditions, such as diabetes*, cancer, and cirrhosis* of the liver, make a person more likely to have infections. Patients who have had their spleens removed or whose spleens do not work properly, as occurs in sickle-cell disease*, for example, are especially vulnerable to infection by certain bacteria that the spleen normally fights. In addition, some medications, particularly corticosteroids* and drugs used to treat cancer, may limit the immune system. Malnutrition, especially when there is a lack of protein in the diet, also may weaken the immune response.

The human immunodeficiency virus (HIV*), a virus that attacks the immune system and is the cause of acquired immunodeficiency syndrome (AIDS*), is responsible for a sharp increase in the number of people with secondary immune deficiencies. HIV destroys T cells, which are crucial to the normal functioning of the human immune system. This condition can lead to overwhelming infections. People can contract the virus through contact with blood, semen*, vaginal* secretions, and breast milk.

What Are the Signs and Symptoms of Immune Deficiencies?

Immune deficiencies may be characterized by frequent, recurrent, or prolonged infections. In some cases, there may be an overwhelming or unusual infection. In others, organisms that typically do not cause problems in a person with a healthy immune system may produce an opportunistic infection* in a person with an immune deficiency. These infections are seen in people infected with HIV and often mark the onset of AIDS.

Other immune deficiencies are characterized by chronic opportunistic infections. Depending on the condition, patients may experience

recurrent lung and sinus infections, weakness, tiredness, a lingering cough, diarrhea (dye-uh-REE-uh), skin rashes, and hair loss. Many patients simply look sick. Signs of immune deficiencies also include poor response to treatments, incomplete or slow recovery from illness, fungal or yeast infections that keep coming back, and certain specific infections, such as pneumonia caused by *Pneumocystis carinii* (nu-mo-SIS-tis kah-RIH-nee-eye).

How Are Immune Deficiencies Diagnosed?

Although symptoms of opportunistic infections may suggest an immune deficiency, laboratory tests are needed to diagnose the specific deficiency. These include blood tests to measure levels of white blood cells, red blood cells, and platelets* and to measure the presence of specific types of cells, such as B cells and T cells. Other blood tests can measure the levels or function of antibodies (such as IgA, IgG, and IgM) and complement proteins. Skin tests may be done to check the responses of T cells. Other, more specific tests of the immune system's competency depend on the type of deficiency suspected.

How Are Immune Deficiencies Treated?

The primary goal in treating immune deficiencies is to prevent infections. Although it is a good idea for some people who have immune deficiencies to avoid contact with people who have infections, doing so is not always practical. Many patients take daily medication to prevent certain infections, and patients with antibody deficiencies may receive regular doses of the immunoglobulins they lack. People who have HIV or AIDS take combinations of drugs to keep the virus from making more copies of itself and destroying more T cells. Bone marrow* transplantation, to replace the absent or poorly functioning immune system cells of the affected person, is necessary for some patients with severe immune deficiencies, such as SCID. Prompt recognition and treatment of infections, including opportunistic infections, is essential.

▶ See also **AIDS and HIV Infection • Meningitis • Pneumonia • Sepsis**

Resources

Organizations

Eunice Kennedy Shriver National Institute of Child Health and Human Development. 31 Center Drive, Building 31, Room 2A32, MSC 2425, Bethesda, MD, 20892-2425. Toll free: 800-370-2943. Web site: http://www.nichd.nih.gov/health/topics/Primary_Immunodeficiency.cfm.

Jeffrey Modell Foundation. 747 Third Avenue, New York, NY, 10017. Telephone: 212-819-0200. Web site: <http://www.info4pi.org>.

- * **sickle-cell disease** is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.
- * **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.
- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **semen** (SEE-men) is the sperm-containing whitish fluid produced by the male reproductive tract.
- * **vaginal** (VAH-jih-nul) refers to the canal in a woman that leads from the uterus to the outside of the body.
- * **opportunistic infection** are infections caused by infectious agents that usually do not produce disease in people with healthy immune systems but can cause widespread and severe illness in patients with weak or faulty immune systems.
- * **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.
- * **bone marrow** is the soft tissue inside bones where blood cells are made.

- * **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.
- * **fungi** (FUNG-eye) are microorganisms that can grow in or on the body, causing infections of internal organs or of the skin, hair, and nails.
- * **parasites** (PAIR-uh-sites) are organisms such as protozoa (one-celled animals), worms, or insects that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. Parasites live at the expense of the host and may cause illness.
- * **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. A virus can only reproduce within the cells it infects.
- * **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.
- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

Immune System and Other Body Defenses: Overview

The skin and the immune system help protect the body from infection and disease.

The First Line of Defense: Physical Barriers

The human body is constantly under the threat of attack from foreign invaders that can cause infection and disease. These invaders range from living microbes (MY-krobes), such as bacteria*, fungi*, parasites*, and viruses*, to non-living toxins, chemicals, and drugs. Fortunately, the body has a number of safeguards, located at the surface and internally, that prevent most foreign invaders from entering or causing harm. The physical barriers that keep these invaders at bay are often referred to as the body's first line of defense.

The skin is the largest organ in the body, and it provides both a physical and a chemical barrier against the outside world. The skin forms a protective layer that shields blood vessels, nerves, muscles, bones, and organs. Human skin serves also as a chemical shield; it produces peptide antibiotics* that it secretes in response to the skin's coming into contact with some microorganisms.

However, no organism is sealed completely against its environment. The human body has direct contact with the external environment in multiple places (not just at the skin's surface). The walls of the lungs' airways and the mucus-coated surfaces of the intestines are barriers between the human body and potentially harmful agents from the external environment.

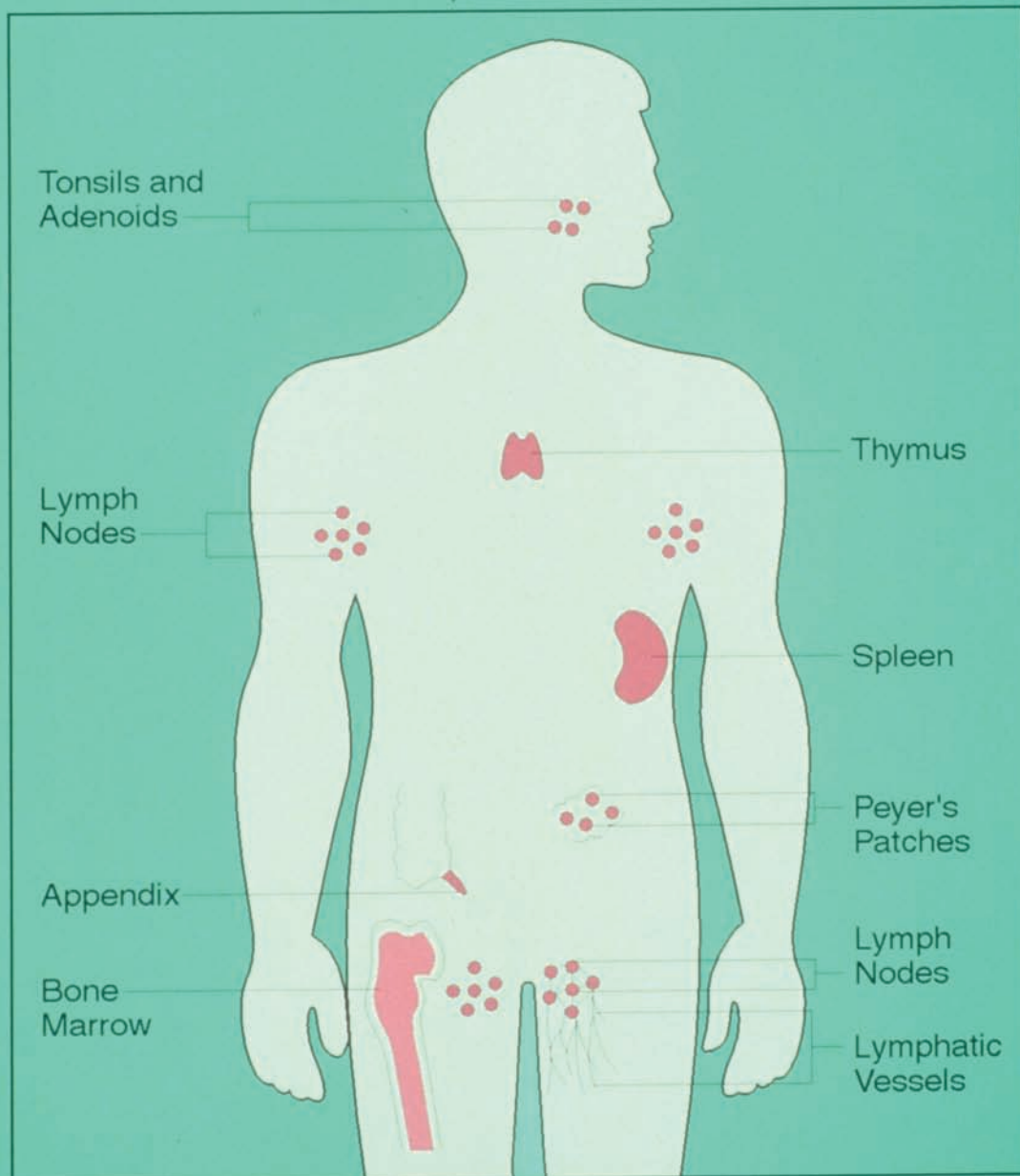
The moist linings of the lungs' airways protectively secrete mucous (MYOO-kus), a sticky substance that traps microbes and other irritants that enter the body through the nose and throat. Tiny hairs, called cilia (SIH-lee-uh), are thread-like projections that line the trachea and the lungs and propel foreign particles and mucus out of the respiratory tract and away from the lungs to a place where they can be swallowed safely. The majority of harmful microbes that make it to the stomach are destroyed by stomach acids. In addition, tears and saliva both contain peptide antibiotics that destroy invaders.

Another important defense mechanism is the brain-blood barrier at the interface between circulating blood and the brain. The blood-brain barrier is a semi-permeable layer of cells that lines individual brain capillaries. It is a specialized "filter" that surrounds the brain and spinal cord and acts as a physical barrier to prevent proteins, toxins, and most microbes from entering brain cells while letting in glucose, the brain's principal nutrient.

The Second Line of Defense: The Immune System

A second line of defense is the intricate and complicated immune system*, whose function is to recognize and destroy foreign substances and microorganisms that enter the body. The properly functioning immune

Organs of the Immune System



The human body has several lines of defense against infection which work to prevent germs from invading the body or to destroy them once they find their way in. *National Institutes of Health. Reproduced by permission.*

- * **antigens** (AN-tih-jens) are substances that are recognized as a threat by the body's immune system, which triggers the formation of specific antibodies against the substance.
- * **histamine** (HIS-tuh-meen) is a substance released by the body during inflammation. It causes blood vessels to expand and makes it easier for fluid and other substances to pass through vessel walls.
- * **bone marrow** is the soft tissue inside bones where blood cells are made.
- * **lymphatic system** (lim-FAH-tik) is a system that contains lymph nodes and a network of channels that carry fluid and cells of the immune system through the body.

system can distinguish between the body's own tissues and foreign substances. It recognizes foreign entities by the presence of antigens*, usually located on the outside surfaces of these substances. (The body's cells have their own antigens, but these antigens are not recognized as foreign.) This ability to distinguish allows cells of the immune system to identify and destroy only those substances that carry harmful antigens. The immune system is also able to “remember” antigens that the body has been exposed to on a prior occasion, so that the body can mount a better and faster immune response the next time any of these antigens appears.

Inflammation Inflammation is one sign that the immune system is reacting to infection. Inflammation occurs when a tissue is injured. To the eye, inflamed skin may appear red and swollen, and the area may feel slightly warm to the touch. Indeed, inflammation is characterized by pain, redness, heat, and swelling. Inflammation also may cause a fever, which may help to kill bacteria or viruses at the site of the infection.

When bacteria, toxins, burns, or other culprits damage tissue, the injured tissues leak chemicals, including histamine* and other substances. This chemical mixture causes blood vessels around the damaged area to saturate injured tissues and make them swell. The increased flow of blood and fluid to the area also brings phagocytes and other infection-fighting cells to take care of any toxins or other antigens in the area. Pus, which is a whitish fluid containing dead body cells and tissue, dead bacteria, dead toxins, and dead and living phagocytes, sometimes forms at the site of inflammation.

Lymphocytes Lymphocytes (LIM-fo-sites), a kind of white blood cell that develops in bone marrow*, circulate throughout the body in the bloodstream and in the lymphatic system*. Lymphocytes are the part of the immune system that has the capacity to recognize and remember disease-causing agents.

Lymphocytes can be divided into two classes: B lymphocytes and T lymphocytes. B lymphocytes (or B cells) produce immunoglobulins (ih-myoo-no-GLAH-byoo-lins), also called antibodies. One particular B lymphocyte recognizes a specific antigen; its activity is triggered when it encounters its “matching” antigen. The activated B lymphocytes go to work, synthesizing and releasing rapidly large numbers of antibodies. The antibodies bind to specific antigens (and may in the act of binding neutralize the offending agent's capacity to do harm). Antibodies also stimulate the activity of phagocytic cells, which work with another type of white blood cell, called phagocytes (FAH-go-sites)—scavenger cells that surround and digest infected cells or microorganisms—and destroy the invaders.

T lymphocytes (or T cells) help to regulate the immune response. Several subsets of T cells have been discovered, each subset having a different function. Some T cells produce chemical messengers that communicate with and attract other kinds of white cells, whose assistance is needed. Some destroy virally infected cells and tumor cells. Some

T cells, like B cells, are antigen-specific and destroy foreign antigens or the substances that carry them.

Targeting antigens with antibodies Almost all activity of B cells and of some T cells targets specific antigens. That is, each time a new kind of foreign agent carrying a particular kind of foreign antigen invades the body, the immune system must produce a new round of B cells and T cells, which attack only that antigen. It is estimated that a healthy immune system can create more than 100 million types of antibodies. As some B cells and T cells mature, they begin to distinguish between the body's own cells and tissues that do not belong in the body. These immune cells become "memory" cells, because they remember a particular antigen, so that the next time it appears, the immune response can mobilize quickly.

In some cases, people acquire permanent immunity* to a disease; for example, people who contract chicken pox usually will not have it again, or, if they do, they have a much milder case.

When a B cell encounters a foreign invader, it starts to produce immunoglobulins or antibodies. An antibody is a very large protein molecule, and it has an antigen-binding site. Like a key designed to fit only a specific lock, an antibody "locks" onto a single type of antigen like an identifying marker. The combination of antigen and antibody (bound to each other) is known as an "antigen-antibody complex" or an "immune complex." There is also something called the "complement system." Immune complexes attract complement proteins, which normally circulate in the bloodstream in an inactive form. The complement proteins are a group of proteins that work to "complement," or amplify, the activities of antibodies.

T cells and cytokines Once the antibody binds to the antigen, a group of T cells known as helper T cells, which have become activated by the presence of the same antigen, secrete signaling molecules, small peptide molecules known as cytokines. These signaling molecules stimulate other white blood cells (or they induce white blood cells to stimulate yet another set of white blood cells) in such a way that the activity of the antibodies is enhanced, or they may draw white blood cells to the site of infection or injury. Some T cells, called killer T cells, are specialized to attack and destroy target cells. At the same time, millions of antibodies circulate in the bloodstream to bind to other "matching" antigens they encounter and so mount a larger attack.

Interferons are a group of cytokines that enhance and amplify immune response and are also used in medical therapies. The singular form, interferon, is used to refer to these therapies. Interferon has been effective in slowing the growth of some cancers. Among them are chemicals that alert phagocytes to the site of the infection. The complement system, a group of proteins that circulate in blood in inactive form, are activated by a large number of triggers, including the presence of antigen-antibody complexes at sites of infection. The proteins migrate to the site of an infection, where they amplify the already existing immune response and help to break up and dissolve microorganisms and foreign particles.

* **immunity** (ih-MYOOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.

- * **rheumatoid arthritis** (ROO-mah-toyd ar-THRY-tis) is a chronic disease characterized by painful swelling, stiffness, and deformity of the joints.
- * **lupus** (LOO-pus) is a chronic, or long-lasting, disease that causes inflammation of connective tissue, the material that holds together the various structures of the body.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

Other Defenses

In addition to physical barriers (such as the skin and the mucous coating of inner membranes) and the immune system, the body has several other defense mechanisms that fight harmful invading agents. Coughing and sneezing are automatic reflexes that can rid the body of irritants. Tears serve a similar purpose.

Immune Response Effectiveness and Disease

Strong and healthy immune systems successfully ward off many diseases, particularly infections, but weakened immune systems are less able to do so. Thus, a weakened immune system gives various diseases an opportunity to develop. Age affects the immune system's effectiveness and can be a cause of immune deficiency. Newborns and the elderly may have weak or impaired immune responses to infectious disease. The immune systems of newborns are not fully developed at birth but typically become stronger during the first year of life. Breastfeeding strengthens the infant's developing immune system.

Autoimmune diseases A functioning immune system may be overactive and may mount an immune response against substances and tissues normally present in the body (i.e., the body attacks its own cells), giving rise to a number of immunological (ih-myoo-no-LAH-jih-kul) disorders, which are called autoimmune (aw-toh-ih-MYOON) diseases. In autoimmune diseases, the body cannot distinguish between itself and foreign particles: it may turn its disease-fighting powers on its own tissues, blood, and organs.

As of the early 2000s, more than 80 chronic autoimmune diseases had been identified. These diseases affect women more than men. According to the American Autoimmune Related Diseases Association, regarding the known chronic autoimmune diseases, about 75 percent of cases occur in women, and women appear to be most vulnerable to these diseases during their childbearing years when the levels of hormones are highest in their bodies.

Heredity seems to play a part as well. An individual may inherit a predisposition toward autoimmune diseases in general but may not have the same disease a close relative has. For example, a grandmother may have rheumatoid arthritis*, and the granddaughter may have lupus*. These diseases are related in many ways, but they are different diseases.

Medical conditions that increase risk of infectious disease

Some common medical conditions can put people at increased risk for infectious disease.

- People with diabetes* are especially prone to infection, in part because high blood sugar levels can interfere with white blood cell function.

- Individuals with chronic lung diseases are often at a high risk for pneumonia and bronchitis.
- Urinary tract infections tend to occur more frequently among people born with an abnormal urinary tract or among those who have experienced a urinary tract obstruction, such as a kidney stone*.
- People with certain types of heart disease, particularly diseases of the heart valves, are at greater risk for endocarditis (en-do-kar-DYE-tis), an inflammation of the inner lining of the heart, after dental procedures or surgery.
- Chronic malnutrition that includes a protein deficiency will result in immune problems, in part because immunoglobulins and other molecules are themselves proteins.

Compromised Immune Systems

Chronic diseases can wear down the immune system and make people more susceptible to infection. An immune system that is weakened in this way is said to be compromised. Following are major examples of compromised immune systems and the infectious diseases they can cause.

- Sickle-cell anemia* causes damage to the spleen*. Because the spleen helps to protect the body against bacterial infections, sickle-cell anemia leaves the body more vulnerable to them.
- Human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see) (HIV) infection badly damages and weakens the immune system, and persons with HIV are susceptible to life-threatening infections that take advantage of their failing immune system. In many cases, prompt diagnosis of such “opportunistic” infections and treatment of the underlying HIV with combinations of antiviral drugs have been shown to slow the immune system’s deterioration.
- Certain drugs and drug therapy regimens can also undermine the work of the immune system. Anti-cancer drugs, which usually target rapidly dividing cells, often kill vital beneficial white blood cells in the bone marrow.
- Patients who receive organ transplants are given high dosages of corticosteroid* drugs, which suppress the immune response, in an attempt to prevent their bodies from rejecting the transplanted tissue, which typically is recognized as “foreign.”
- Some people are born with immune system deficiencies, in whom some component of the immune system is missing or does not function adequately. These persons are said to have primary immunodeficiencies. Most primary immunodeficiencies are genetic disorders. They are often diagnosed in children under the age of one year.

* **kidney stone** is a hard structure that forms in the urinary tract. This structure is composed of crystallized chemicals that have separated from the urine. It can obstruct the flow of urine and cause tissue damage and pain as the body attempts to pass the stone through the urinary tract and out of the body.

* **sickle-cell anemia** also called sickle-cell disease, is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.

* **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.

* **corticosteroid** (KOR-ti-ko-STER-oid) is one of several medications that are prescribed to reduce inflammation and sometimes to suppress the body’s immune response.

- * **sepsis** is a potentially serious spreading of infection, usually bacterial, through the bloodstream and body.
- * **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **allergies** (AL-uh-r-jeez) are immune system-related sensitivities to certain substances, for example, cat dander or the pollen of certain plants, that cause various reactions, such as sneezing, runny nose, wheezing, or swollen, itchy patches on the skin, called hives.
- * **asthma** (AZ-mah) is a condition in which the airways of the lungs repeatedly become narrowed and inflamed, causing breathing difficulty.
- * **placenta** (pluh-SEN-ta) is an organ that provides nutrients and oxygen to a developing baby; it is located within the womb during pregnancy.

- Hypogammaglobulinemias (hi-po-gah-muh-gloh-byoo-lih-NEE-me-uhs) are conditions in which the body has fewer antibodies than normal, which always means an increased risk of infection. Hypogammaglobulinemias frequently result in a greater number of bacterial respiratory illnesses.
- Agammaglobulinemias (a-gah-muh-gloh-byoo-lih-NEE-me-uhs) are conditions characterized by the absence of antibodies in the body and can cause severe, often fatal infections.

Other primary immune disorders include the following:

- Severe combined immune deficiency syndrome, in which an infant is born with a significant lack of both B cells and T cells, often leads to serious immunity problems; it occurs in one in one million births. During the first three months of life, babies with this condition can experience life-threatening infections and diseases, particularly sepsis*, pneumonia, and meningitis*. Common childhood diseases, such as chicken pox, can easily overwhelm these patients' immune systems.
- Chronic granulomatous (gran-yoo-LO-muh-tus) disease occurs in males when the body's phagocytes are ineffective against certain bacteria and fungi. Patients develop recurrent and unusual skin, lymph node*, and other infections. Repeated infections can lead to granulomas (gran-yoo-LO-muhs), masses that develop in the skin, lungs, liver*, lymph nodes, and bones. They can be slow to heal and drain.

Other Influences on Body Defenses

Many environmental factors can affect the health of the immune system. In environments in which cigarette smoking is rife, for example, people are more at risk for lung cancer and respiratory ailments, both of which can lead to various secondary infections, including bronchitis. Second-hand smoke, or passive smoking, increases the incidence of respiratory infections in both infants and children. Children who are exposed to second-hand smoke may be predisposed to pneumonia, allergies*, and asthma*, as well as repeated irritations of the eyes, nose, and mouth.

Nutrition, too, has an impact on the immune system. Diets deficient in a variety of nutrients, such as certain vitamins, minerals, or protein, can cause increased vulnerabilities to infection.

Medical Ways of Boosting the Immune System

In some instances, a patient will be given antibodies produced by another person to boost his or her own immunity, which is known as passive immunity. Infants are born with immature immune systems and receive important antibodies from their mothers prior to birth (across the mother's placenta*) and after birth from breast milk. These maternal antibodies usually disappear in the infant's system within 6 to 12 months, but until

that time they help to protect the infant against a range of infections, including pneumonia*, bronchitis*, influenza*, and ear infection.

Doctors can also give gamma globulin (GAH-muh GLAH-byoo-lin) to patients, antibody preparations that offer temporary immunity to individuals who might need this protection. When individuals receive an immunization or are given a vaccine*, their body's immune system is being primed to recognize the particular bacterium or virus that forms the basis of the vaccine. If, sometime later, these individuals are exposed to the same bacterium or virus, they will probably be able to fight off the infection again and not come down with the infectious disease.

▶ See also **AIDS and HIV Infection • Bronchiolitis and Infectious Bronchitis • Endocarditis, Infectious • Fungal Infections • Immune Deficiencies • Meningitis • Pneumonia • Sepsis • Urinary Tract Infections • Vaccination • Varicella (Chicken Pox) and Herpes Zoster (Shingles)**

Resources

Books and Articles

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Organizations

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CancerHelp, Cancer Research UK. P.O. Box 123 Lincoln's Inn Fields, London, UK. Web site: <http://www.cancerhelp.org.uk/help/default.asp?page=118>.

Discovery Communications. One Discovery Place, Silver Spring, MD, 20910. Telephone: 240-662-2000. Web site: <http://www.howstuff-works.com/immune-system.htm>.

Genetic Alliance. 4301 Connecticut Avenue NW, Suite 404, Washington, DC, 20008. Toll free: 800-336-4363. Web site: <http://www.geneticalliance.org>.

Nobel Web AB. Sturegatan 14, Stockholm, Sweden. Web site: http://nobelprize.org/educational_games/medicine/immunity.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **bronchitis** (brong-KYE-tis) is a disease that involves inflammation of the larger airways in the respiratory tract, which can result from infection or other causes.

* **influenza** (in-floo-EN-zuh), also known as the flu, is a contagious viral infection that attacks the respiratory tract, including the nose, throat, and lungs.

* **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

- * **immunoglobulins** (im-mune-o-GLOB-u-linz) are types of antibodies.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.
- * **susceptibility** (su-sep-ti-BIL-i-tee) means having less resistance to and higher risk for infection or disease.
- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).
- * **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.
- * **bone marrow** is the soft tissue inside bones where blood cells are made.
- * **foreign** means coming from outside a person's body.
- * **antigen** (AN-tih-jen) is a substance that is recognized as a threat by the body's immune system, which triggers the formation of specific antibodies against the substance.
- * **virus** (VY-rus) is a tiny infectious agent that can cause infectious diseases. A virus can only reproduce within the cells it infects.
- * **bile** is a greenish-brown fluid manufactured in the liver that is essential for digesting food. Bile is stored in the gallbladder, which contracts and discharges bile into the intestine to aid digestion of fats after a person eats.
- * **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.
- * **respiratory** (RES-pi-ra-to-ree) refers to the breathing passages and lungs.

Immunoglobulin Deficiency Syndromes

Immunoglobulin deficiency syndromes (IDS) are immunodeficiencies in which some or all antibodies* are deficient or absent, resulting in susceptibility* to frequent, severe, and/or unusual infections.*

What Are Immunoglobulin Deficiency Syndromes?

There are many types of IDS, most of which are inherited or primary immunodeficiencies. Secondary immunodeficiencies are caused by an underlying disease or outside agent, such as HIV* or chemotherapy*.

The immune system B-cells or B-lymphocytes are the antibody-producing cells of the humoral or antibody-mediated immune response. Bone marrow* stem cells develop into precursor B-lymphocytes, which mature into B-cells. Each B-cell produces a specific antibody that recognizes and binds to a specific foreign* antigen*, such as a bacterium or virus*. When a B-cell encounters its antigen, it is stimulated to become a plasma cell and produces large amounts of antibodies that recognize that antigen.

Antibodies are protein molecules called immunoglobulins (Igs). There are five major classes of Igs:

- IgG is the most long-lasting and abundant antibody, present in large amounts in the bloodstream and tissues.
- IgM is the first type of antibody produced by B-cells. Later in the immune response IgM is replaced by a different Ig class with the same antigenic specificity.
- IgA antibodies are secreted in tears, bile*, saliva, and mucus*. They protect the respiratory* and gastrointestinal* tracts from infection.
- IgE antibodies are responsible for allergic reactions.
- IgD antibodies may help regulate B-cell function. They are present in only minute amounts.

Igs consist of four chains of amino acids*: two longer heavy chains and two shorter light chains that together form a "Y"-shaped protein. Each arm of the "Y" forms a binding site for the antibody's specific antigen.

T-cells or T-lymphocytes are part of the cellular or cell-mediated immune response:

- Killer or cytotoxic T-cells directly destroy antigens.
- Helper T-cells assist B-cells in producing antibodies and killer T-cells in attacking antigens.
- Regulatory T-cells suppress the actions of other T-cells.

Most IDS result from a failure in either the maturation of B-cells or the ability of B-cells to switch from one type of Ig production to another.

With some types of IDS, the cellular immune system* retains its functions. However, B-cells are dependent on T-cells for producing antibodies; thus, some Ig deficiencies result from impaired T-cell function.

Primary IDS Primary IDS are caused by genetic* defects that are inherited as either X-linked or autosomal recessive traits. Recessive traits are usually only apparent in the absence of a normal copy of a gene. Because males have only one X chromosome*, inherited from their mothers, genes for recessive disorders that are located on the X chromosome* (X-linked) usually cause disease only in males. Females have two X chromosomes and are unlikely to inherit two X-linked defective genes*, although they can pass a defective gene on to their offspring. Autosomal recessive IDS are caused by defective genes on chromosomes other than the X chromosome. Autosomal recessive IDS affect both males and females, but tend to be less common than X-linked IDS.

There are many different types of primary IDS, involving many different genes. Some cause deficiencies in all types of Ig molecules and some affect only one or a few types:

- X-linked agammaglobulinemia (XLA) causes severe deficiencies in all Igs due to a mutation* in a gene that is required for the normal maturation of precursor B-cells into B-lymphocytes.
- Common variable immune deficiency (CVID) is a relatively common IDS in which the degree and type of Ig deficiency and other lymphocyte abnormalities vary greatly. Most CVIDs result from the failure of B-cells to mature into antibody-producing plasma cells. In some CVIDs T-helper cells fail to promote a full antibody response or there are an excessive number of killer T-cells. Mutations in several different genes have been associated with CVID, although in most cases the genetic cause is unknown.
- Hyper-IgM (HIM) syndrome* with IgG deficiency can be caused by a variety of genetic defects that prevent interactions between T- and B-cells that are required for switching antibody production from IgM to IgG, IgA, or IgE. These result in normal or increased levels of IgM and deficiencies in IgG and IgA. The most common defect is an X-linked recessive trait that affects only males (XHIM). Defects in two autosomal genes that are involved in IgM switching cause HIM without affecting T-cell function.
- Selective IgG subclass deficiencies affect only one or two of the four IgG subclasses. They can result from defects in B-cell maturation that prevent the switching of IgG production from one subclass to another. Because IgG subclasses have somewhat different functions, a deficiency in one subclass increases susceptibility to only certain types of infections. IgG2 deficiency often occurs in combination with IgG4 and IgM deficiencies.
- Selective IgA deficiency is the inability of B-cells to switch from producing IgM to producing IgA, resulting in the complete absence

What Is Bruton's Agammaglobulinemia?

XLA was one of the first known immunodeficiency disorders. It was described in 1952 by Ogden Bruton (1908–2003).

In 1993 the gene that causes XLA was discovered on the X chromosome. It was named BTK for Bruton's tyrosine kinase.

* **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

* **amino acids** (a-MEE-no acids) are the chief building blocks of proteins. In humans, certain amino acids are required to sustain life.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **chromosome** (KRO-mo-zom) is a unit or strand of DNA, the chemical substance that contains the genetic code to build and maintain a living being. Humans have 23 pairs of chromosomes, for a total of 46.

* **X chromosome** (X KRO-mo-som), A chromosome is a structure inside the body's cells containing DNA, the genetic material that helps determine characteristics, such as whether a person has brown hair or blue eyes. The X chromosome carries many different genes. Females have two X chromosomes, while males have only one.

- * **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.
- * **mutation** (myoo-TAY-shun) is a change in an organism's gene or genes.
- * **syndrome** is a group or pattern of symptoms or signs that occur together.
- * **transient** (TRAN-shent) means brief or producing effects for a short period of time.
- * **chronic** (KRAH-nik) lasting a long time or recurring frequently.
- * **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).
- * **nutrients** are the components of food (protein, carbohydrate, fat, vitamins, and minerals) needed for growth and maintenance of the body.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.
- * **allergies** (AL-uhr-jeez) are immune system-related sensitivities to certain substances, for example, cat dander or the pollen of certain plants, that cause various reactions, such as sneezing, runny nose, wheezing, or swollen, itchy patches on the skin, called hives.

of IgA. Most people with selective IgA deficiency have only mild symptoms or none at all; however, some people are extremely susceptible to infection, perhaps because they also lack IgG2 and/or IgG4. Although unknown, the cause of IgA deficiency may be a combination of genetic and environmental factors.

- Selective IgM deficiency is similar to CVID.
- Selective IgE deficiency does not usually cause symptoms.
- Heavy-chain deletions occur when part of a gene encoding an Ig heavy chain is lost. These usually result in the absence of an Ig subclass. In extreme cases they can result in a form of agammaglobulinemia (absence of most or all antibodies).

Transient hypogammaglobulinemia of infancy Infants are born with their mothers' antibodies circulating in their bloodstream. They begin producing their own antibodies by six months of age. Infants with transient* hypogammaglobulinemia have low antibody levels until they reach a year to three years of age. This condition is more common in premature infants and is believed to be due to the delayed development of T-helper cells. It is not inherited.

How Common are Immunoglobulin Deficiency Syndromes?

Primary IDS are much more common than was previously thought. They are the most common type of immunodeficiency disorder, accounting for about 50 percent of all primary immunodeficiencies.

Among selective IgG deficiencies, IgG2 deficiency is the most common in children and IgG3 deficiency is the most common in adults. IgG4 deficiency usually occurs in conjunction with IgG2 deficiency; however, IgG4 is not normally detectable until the age of 10. IgG1 deficiency is very rare.

Selective IgA deficiency is one of the most common IDS, especially among Caucasians, affecting as many as 1 in 500 people. However, many people are unaware of their IgA deficiency.

What Are the Symptoms of Immunoglobulin Deficiency Syndromes?

IDS usually cause recurrent, severe, or chronic* infections—especially respiratory and gastrointestinal infections—from childhood on. The infections can spread to various organs.

Other symptoms of IDS may include the following:

- Chronic diarrhea*
- Malabsorption of nutrients*
- Enlarged lymph nodes* and spleen*
- Allergies*
- Autoimmune diseases* such as arthritis*
- Failure to thrive*

Symptoms of CVID vary from mild to severe. The majority of CVID cases are not diagnosed until early adulthood. In about 20 percent of cases, the first symptom is a very low level of blood platelets* or severe anemia* due to antibodies destroying the body's own blood cells.

Infections due to HIM and selective IgG subclass deficiencies usually begin in the first or second year of life. Failure to produce specific antibodies in response to certain childhood vaccines* is a common symptom of an IgG subclass deficiency.

It is estimated that between 25 and 50 percent of people with selective IgA deficiency develop symptoms over a 20 year period. About one-half of people with known selective IgA deficiency are susceptible to infections and 25 to 33 percent have autoimmune diseases.

How Are Immunoglobulin Deficiency Syndromes Diagnosed and Treated?

Diagnosis IDS are usually diagnosed by measuring the levels of the various Igs in the blood. If family members have IDS and the gene mutation is known, prenatal* diagnosis is possible. Other family members can be also tested to determine whether they carry the defective gene.

Boys with XLA usually have very small or absent tonsils* and lymph nodes, because these tissues are made up of B-lymphocytes, and B-cells are generally absent from the blood. XLA can be confirmed by the absence of BTK protein in white blood cells or platelets or by detecting a BTK mutation in the DNA*. Although there are many different BTK mutations, family members usually share the same one. Any male newborn with a brother or maternal uncle or cousin with XLA should be immediately tested for the percentage of B-cells in his blood, so he can be treated before he becomes ill.

Patients with CVID usually have very low or undetectable levels of antibodies against polio, measles*, diphtheria*, and tetanus* despite immunizations. Sometimes the degree of immunoglobulin deficiency is determined by measuring antibody levels following vaccinations*. The number and function of T-lymphocytes in the blood may also be measured. Tissue cultures* can determine whether B-cells make antibodies and whether T-cells are functioning properly.

XHIM is diagnosed by the absence of a protein called CD40 ligand on the surfaces of activated T-cells and identification of a mutation in the CD40 ligand gene. Autosomal recessive forms of HIM have similar symptoms to XHIM but may occur in females and/or the CD40 ligand is normal. HIM diagnosis can be confirmed by mutation analysis of the genes involved.

Treatment Most primary IDS can be treated effectively. Antibiotics* are used to prevent and treat infections. Severe IDS are treated with immunoglobulin replacement therapy. Other treatments are as follows:

- * **autoimmune diseases** (aw-toh-ih-MYOON) are diseases in which the body's immune system attacks some of the body's own normal tissues and cells.
- * **arthritis** (ar-THRY-tis) refers to any of several disorders characterized by inflammation of the joints.
- * **failure to thrive** is a condition in which an infant fails to gain weight and grow at the expected rate.
- * **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.
- * **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.
- * **vaccines** (vak-SEENS) are preparations of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.
- * **prenatal** (pre-NAY-tal) means existing or occurring before birth, with reference to the fetus.
- * **tonsils** are paired clusters of lymphatic tissue in the throat that help protect the body from bacteria and viruses that enter through a person's nose or mouth.
- * **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.
- * **measles** (ME-zuls) is a viral respiratory infection that is best known for the rash of large, flat, red blotches that appear on the arms, face, neck, and body.

- * **diphtheria** (dif-THEER-eh-uh) is an infection of the lining of the upper respiratory tract (the nose and throat). It is a disease that can cause breathing difficulty and other complications, including death.
- * **tetanus** (TET-nus) is a serious bacterial infection that affects the body's central nervous system.
- * **vaccinations** (vak-sih-NAY-shunz), also called immunizations, are the giving of doses of vaccines, which are preparations of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself.
- * **cultures** (KUL-churz) are tests in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.
- * **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.
- * **transplants** (TRANS-plantz) are organs or tissues from another body used to replace a poorly functioning organ or tissue.
- * **gamma globulin** (GAH-muh GLAH-byoo-lin) is a type of protein in the blood that contains the antibodies produced by the cells of the body's immune system that help defend the body against infection-causing germs, such as bacteria and viruses.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **mumps** is a contagious viral infection that causes inflammation and swelling in the glands of the mouth that produce saliva.

- XHIM is sometimes treated with granulocyte-colony-stimulating factor (G-CSF) and cured by bone-marrow or cord-blood stem cell transplants*.
- Many children under the age of five with selective IgG subclass deficiencies outgrow the disorder.
- Most infants with transient hypogammaglobulinemia have some antibodies and are not prone to infections, although premature infants may require treatment with gamma globulin* and antibiotics.

Managing Immunoglobulin Deficiency Syndromes Maximizing resistance to infection includes the following:

- Balanced nutrition
- Adequate exercise and sleep
- Avoidance of stress

Good hygiene for patients and their families is essential for reducing the risk of infection:

- Routine effective hand washing and use of disposable hand wipes
- Washing of toys
- Immediate first-aid for cuts and scrapes
- Tooth brushing, flossing, and regular dental visits
- Avoidance of people with infections
- Avoidance of drinking water that may be contaminated with *Cryptosporidium*, which can cause severe gastrointestinal problems and chronic liver* disease.

Patients with IDS should not be given any live-virus vaccines such as live polio or measles, mumps*, rubella (MMR).

Resources

Books and Articles

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Buckley, Rebecca H., ed. *A Guide for School Personnel: Primary Immune Deficiency Diseases*. Towson, MD: Immune Deficiency Foundation, 2005.

Organizations

Immune Deficiency Foundation. 40 West Chesapeake Avenue, Suite 308, Towson, MD, 21204. Toll free: 800-296-4433. Web site: <http://www.primaryimmune.org/idf.asp>.

**National Institute of Child Health and Human Development
Information Resource Center.** P.O. Box 3006, Rockville, MD,
20847. Toll free: 800-370-2943. Web site: <http://www.nichd.nih.gov>.

Impacted Teeth

Impacted teeth are teeth that have not broken through the gum at all or that have not fully emerged from the gum.

What Are Impacted Teeth?

An impacted tooth, also called an unemerged tooth, an unerupted tooth, or a dental impaction, is a tooth that does not emerge through the gum in the correct position. There are two types of impacted teeth. A fully impacted tooth is one that exists in the jaw under the gum line but never breaks through the gum. A partially impacted tooth is one that breaks through the gum line (a process called eruption) but does not fully emerge. Although any tooth may become impacted, the most common teeth to have this condition are the third molars, more commonly known as the wisdom teeth. These are the grinding teeth that are farthest back in the jaw. They normally emerge sometime in the late teens or early twenties.

Researchers are not sure why so many people develop impacted wisdom teeth, but there are several theories. One is that early humans had a larger jaw with enough space for the wisdom teeth. Over the centuries, as the humans began to cook food and their diet became softer, less chewing was needed. As the chewing muscles became smaller, so did the jawbones to which these muscles are attached. Another theory is that the diet of early humans wore down the teeth enough that space was created in the jaw by the time the wisdom teeth were ready to erupt.

Teeth can be impacted in several ways. In the most common type of impacted tooth, a mesial impaction, the third molar (wisdom tooth) comes in at an angle so that it is blocked from erupting by the second molar, which is in front of it in the jaw. Impacted teeth can also be positioned in the jaw in a number of other ways ranging from vertical to completely horizontal, so that their eruption through the gum is prevented either by bone or by other teeth. Some impacted teeth are able to partially emerge before they are blocked, whereas others are unable to break through the gum line at all.

What Can Happen When a Tooth Is Impacted?

Sometimes impacted teeth cause no pain or visible problem, whereas other times they can lead to tooth decay, infection, and gum disease. Normally, partially impacted wisdom teeth cause more health problems than fully impacted teeth. When a tooth partially emerges from the gum, it creates a



▲ Impacted wisdom tooth in the lower jaw. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

Does Having Wisdom Teeth Make You Smart?

Wisdom teeth got their name because they emerge from the gum between the ages of 17 and 25, an age at which people are supposed to develop their full reasoning powers and acquire “wisdom.” However, people with emerged wisdom teeth are no smarter than people whose wisdom teeth are impacted or who, for genetic reasons, never get any wisdom teeth at all.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

tiny opening between the gum and the tooth that cannot be cleaned out through brushing or flossing. Bacteria can then enter this space, reproduce, and cause an infection that dentists call pericoronitis, which causes the gum to become tender and swell. The condition can be very painful and also can cause bad breath and a bad taste in the mouth. Pericoronitis is usually treated with antibiotics to kill the bacteria causing the infection, but the disease may return repeatedly if the partially impacted tooth remains in place.

Tooth decay (cavities) can also develop on the second molar and/or the partially impacted wisdom tooth when bacteria get trapped in the space where the teeth are touching. This space is small, hard to clean, and hard for the dentist to reach if a filling is needed to treat the cavity. Finally, people with partially impacted teeth are more likely to develop periodontal (gum) disease, which often occurs gradually and only becomes evident later in life. Periodontal disease damages the gums so that teeth become loose and may fall out or need to be removed.

How Are Impacted Teeth Diagnosed and Treated?

A partially impacted tooth is obvious to the dentist on examination. The dentist must then determine whether the tooth is in the process of emerging normally or if it is stuck in position and impacted. A dental x-ray that shows what is happening below the gum line may help the dentist decide whether the tooth is impacted. An x-ray is the only way to confirm the presence of a fully impacted tooth, since in some people, wisdom teeth never develop in the jaw. Most dentists take x-rays on a regular basis to help detect tiny cavities and other dental abnormalities. These x-rays are safe and expose people to a very low level of radiation, although special precautions must be taken with women who are or might be pregnant.

The treatment for an impacted tooth is extraction, which is performed by either a dentist or an oral surgeon. An oral surgeon is a person who has graduated from dental school and then had a minimum of four years of hospital-based training in dental, jaw, and related surgery. Extractions can be done using local or general anesthesia or intravenous* sedation depending on the complexity of the extraction and the patient's preferences. The patient is usually given antibiotics* to combat infection and medication to manage pain following the extraction.

Although dentists agree that extraction is the appropriate treatment for an impacted tooth that is causing health problems, there are two philosophies on whether impacted wisdom teeth should be routinely removed. One school of thought is that impacted wisdom teeth are likely to cause health problems and that they should be removed before these health problems arise. The dentists supporting this position point out that wisdom teeth are much easier to remove and healing is much faster in adolescents than in older individuals, because younger people have more flexible bones. The other philosophy is that although some wisdom teeth

should be removed, all wisdom teeth do not need to be routinely extracted when no problems have occurred. People who support this position note that not all impacted wisdom teeth cause problems. People with impacted wisdom teeth should discuss their individual situation with their dentist and review the pros and cons of extraction of teeth that are not yet causing health problems before making treatment decisions.

▶ See also **Gum Disease**

Resources

Organizations

American Association of Oral and Maxillofacial Surgeons. 9700 W. Bryn Mawr Avenue, Rosemont, IL 60018-570. Telephone: 847-678-6200. Web site: http://www.aaoms.org/wisdom_teeth.php.

American Dental Association. 211 East Chicago Avenue, Chicago, IL, 60611-2678. Telephone: 312-340-2500. Web site: <http://www.ada.org>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web sites: <http://www.nlm.nih.gov/medlineplus/ency/article/001057.htm>; <http://www.nlm.nih.gov/medlineplus/toothdisorders.html#cat42>.

Impetigo

Impetigo (im-puh-TIE-go) is a very common skin infection among children. It produces blisters and sores, which usually appear on the face and hands, although they may show up any place on the body. The infection is contagious and often spreads from one child to another in childcare facilities or classrooms.

More than a Little Itch: Ariana's Story

Five-year-old Ariana had an itch on her hand and scratched it on and off for a couple of days. During that time, she noticed that the itchy spot was red. Still, she scratched it. By the end of the week, she developed some new red and itchy spots next to her nose. Some of them had noticeable blisters. When her mother noticed the sores by her nose, she thought they looked a bit like acne. When Ariana described the red patch on her hand, her mother decided it was time to take her daughter to the doctor's office. After examining the red patches, the doctor told them that Ariana had impetigo or "school sores." He explained that it was a very common



▲ Impetigo, a bacterial skin infection, occurs as scattered thin-walled skin blisters containing clear yellow or slightly turbid fluid without surrounding redness. *CMSP/Getty Images.*

- * **dermatitis** is a skin condition characterized by a red, itchy rash. It may occur when the skin comes in contact with something to which it is sensitive.
- * **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.
- * **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.
- * **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.
- * **strep throat** is a contagious sore throat caused by a strain of bacteria known as *Streptococcus*.
- * **rheumatic fever** (roo-MAH-tik) is a condition associated with fever, joint pain, and inflammation affecting many parts of the body, including the heart. It occurs following infection with certain types of strep bacteria.
- * **scarlet fever** is an infection that causes a sore throat and a rash.
- * **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

skin infection among children. He gave Ariana's mother some ointment to put on the sores, told her to keep her daughter out of kindergarten for the next two days so her daughter would not infect other children, and recommended that she give Ariana her own towels to use for a couple of days so she would not infect the other members of her family. In addition, he instructed Ariana to leave the sores alone so her skin could heal. Within a week, the redness was gone, and by the next week, Ariana had already nearly forgotten that she had ever had impetigo.

What Is Impetigo?

Impetigo is one of the most common skin infections seen in children. In fact, among children, impetigo is the third most common skin disease. Only dermatitis* warts occur more often. Impetigo produces blisters and sores, usually by the nose and face, and/or on the hands and forearms. It is very contagious* and can readily spread to other parts of the body, too. This infection can also spread from one person to another. Impetigo usually clears up with a simple antibiotics* treatment. If it is not treated, however, the infection can become more serious and lead to other, much more dangerous conditions.

What Causes Impetigo?

Bacteria* cause impetigo. Two common bacteria that lead to impetigo are *Streptococcus pyogenes* and *Staphylococcus aureus*. Both bacteria are too small to be seen by the naked eye. *Streptococcus pyogenes* are round and form chains, so they look a little like strings of pearls. Besides impetigo, this bacteria can cause other illnesses, such as strep throat* (also known as acute pharyngitis), rheumatic fever*, and scarlet fever*. *Staphylococcus aureus*, which is round and sometimes goes by the name golden staph, can also cause other illness besides impetigo. Some of these illnesses, such as pneumonia* and toxic shock syndrome, can be life-threatening.

In impetigo, both *Streptococcus pyogenes* and *Staphylococcus aureus* can infect people when they touch something that has the bacteria on it. For instance, a boy who has impetigo on his hands may dry them on a towel. If a girl then uses the same towel, the bacteria can infect her, and she can develop impetigo herself. These bacteria often infect the skin through a cut or other sore that a person has, but they can also infect unbroken, healthy skin.

Who Gets Impetigo?

Impetigo is especially common among infants and among children up to six years of age. The infection is known as school sores, because it is especially widespread among young, school-aged children who pass it along to their classmates through direct contact. In other words, one child may purposely or inadvertently touch the wound of another child and become infected. Impetigo often spreads from child to child very quickly in child-care centers and classrooms. The more crowded the children are, the more likely impetigo will spread.

Impetigo also occurs among people of any age who play close-contact sports such as wrestling or football. If one player has impetigo and brushes his or her infected site against another player, the infection can spread from person to person. In addition, it is particularly common among children who are undergoing dialysis (dy-AL-i-siss). Dialysis is a treatment procedure for people whose kidneys are not working properly. In this procedure, a dialysis machine acts as an artificial kidney for the patient.

What Are the Symptoms of Impetigo?

Impetigo comes in two main types: impetigo contagiosa and bullous impetigo. A third type of skin infection, known as deep impetigo or ecthyma, also occurs. Each type has its own set of symptoms.

Impetigo contagiosa Most people who have impetigo have the form called impetigo contagiosa (cun-tay-gee-O-suh), which is also sometimes known as nonbullous impetigo. A person with this condition first has a red sore at the site of the infection. Common places for the infection are next to the nose or mouth. The sore oozes liquid, sometimes pus, which hardens into a yellow- or brown-colored crust. As the sore heals, the crust disappears, and the underlying red mark heals up without leaving behind a scar. Most children have several such sores near one another. These sores may itch, and children may scratch them. If the child then touches another area of the body without washing first, the bacteria can spread and produce sores elsewhere on the body.

Sometimes, a child will also have swollen lymph nodes* near the sores.

Bullous impetigo An infection of the *Staphylococcus aureus* bacterium is the cause of bullous (BULL-us) impetigo. This type mainly affects babies and children up to two years of age, although older children and adults are sometimes affected. Children with bullous impetigo get red sores with large, liquid-filled blisters that may look painful, but are not. They are, however, itchy. These blisters often appear on arms and legs and on the trunk of the body. Eventually, these blisters burst and, as happens in impetigo contagiosa, a yellowish to brownish crust forms and later disappears. The underlying red mark in bullous impetigo may heal more slowly than sores from other forms of impetigo. Bullous impetigo appears to be less contagious than impetigo contagiosa.

Sometimes, teachers, childcare workers, or other people may think that the sores look like cigarette burns or scald injuries and mistakenly think that the child is the victim of child abuse, but a doctor can set the record straight.

Deep impetigo In both impetigo contagiosa and bullous impetigo, the sores remain mainly on the skin's surface. In ecthyma (ek-THI-muh), the sores run more deeply into the skin and extend into the second layer,

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

which is called the dermis (DER-miss). Ecthyma sores are painful and may be filled with liquid or pus. They often occur on the legs and on the feet. In addition, the sores may turn into deep ulcers, which means that some of the skin cells have died. Like other forms of impetigo, ecthyma sores ooze and crust over. Ecthyma sores, however, do not heal as well as sores caused by bullous impetigo or impetigo contagiosa, and scars are common. Some children with ecthyma may also have swollen lymph glands near the site of the infection.

How Is Impetigo Diagnosed?

A doctor typically needs only look at the sore to diagnose it as impetigo. Occasionally, the doctor may order a test to confirm the diagnosis, but usually this is not necessary.

How Is Impetigo Treated?

Impetigo will often heal by itself within several weeks and leave no scars behind. Doctors, however, often treat it to help with the itching or with the soreness and to prevent the bacteria from spreading from one person to the next. Common treatments are antibiotic ointments such as mupirocin (myoo-PEER-o-sin, Bactroban) and retapamulin (Altabax). Typically, doctors recommend carefully washing the site and gently removing the crust and then applying the ointment. Sometimes, the doctor may prescribe an antibiotic, such as a penicillin, cephalosporin, or macrolide, which is taken by mouth.

In some people, impetigo may recur. These patients usually become so familiar with the sores that they are able to notice them and treat them very early. They should, however, report the return of the condition to the doctor. The physician may be able to find out where the impetigo-causing bacteria are living—for instance, in the person's nose or elsewhere on the body—and may be able to apply antibiotics to that location to wipe out the bacteria once and for all.

If left untreated, impetigo can become a dangerous infection, one that may lead to more serious problems in the lungs, kidneys, joints, and/or bones.

Can Impetigo Be Prevented?

Medical professionals recommend the following to help children and others avoid getting impetigo or from spreading it to other people:

- In general, all individuals should wash their hands often. In addition, they should wash any wounds—even small cuts and scrapes—with soap and water. Doing so helps reduce the possibility of becoming infected with *Streptococcus pyogenes* or *Staphylococcus aureus*.
- People with impetigo should always use a clean washcloth and towel every time they wash their hands, face, or other parts of the body, and then put the towel and washcloth in the laundry to be cleaned.

- People with impetigo should never share their wash cloths or towels with others, because doing so can spread the bacteria to another person. In addition, children should not share clothing or bedding with others, and adults should not share their razors.
- People with impetigo should always carefully wash their hands, especially after touching the infected site, to lessen the chance of spreading the bacteria to other sites on their bodies or to other people.

▶ See also **Bacterial Infections • Skin Conditions**

Resources

Organizations

American Osteopathic College of Dermatology. 1501 East Illinois Street, P.O. Box 7525, Kirksville, MO, 63501. Toll free: 800-449-2623. Web site: http://www.aocd.org/skin/dermatologic_diseases/impetigo.html.

New Zealand Dermatological Society. c/o Tristram Clinic, 6 Knox Street, Hamilton, New Zealand. Web site: <http://dermnetnz.org/bacterial/impetigo.html>.

Incontinence

Incontinence is a person's inability to control when he or she passes urine or feces*.*

What Is Incontinence?

Older men and women, as well as some children, find they cannot wait when they have to go to the bathroom. Usually, incontinence (in-KON-ti-nens) involves urinating at the wrong time, or it can mean having a bowel movement before reaching a bathroom. Although incontinence occurs mostly in older men and women and younger children, it can occur in people of all ages.

Sometimes incontinence occurs as a small amount of urine is released when a person strains, such as with coughing or laughing too hard. In other instances, it occurs only when the bladder is too full.

What Causes Incontinence?

There are many causes for incontinence. Urinary tract infections, cancer, diabetes, stroke, Parkinson's disease*, and Alzheimer's (ALTS-hy-merz) disease* are some of the illnesses that can cause incontinence. Several problems in the brain or spinal cord can lead to urine and

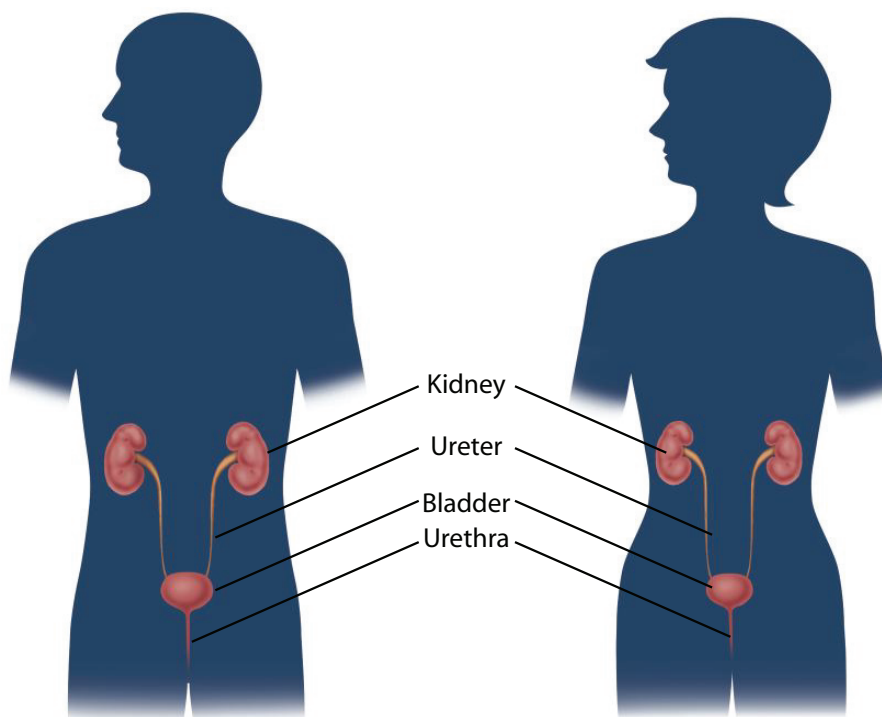
* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

* **Parkinson's disease** is a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.

* **Alzheimer's (ALTS-hy-merz) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.

Anatomy of the kidneys and urinary tract. *Illustration by Frank Forney.*
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bowel incontinence. Surprisingly, severe constipation can cause bowel incontinence. Withholding stool (feces) can cause a hardened plug of stool to block the rectum. This plug irritates the lining of the rectum and causes watery stool to leak out from around the hardened plug.

Urinary incontinence affects older women more than it affects men. One reason is that changes in a woman's hormone levels later in life can weaken muscles that control urination. Women who have had children may also experience more incidence of incontinence because the muscles that are stretched during pregnancy and childbirth may become weakened.

Some over-the-counter cold medicines as well as some prescription drugs for conditions such as high-blood pressure can cause incontinence.

How Is Incontinence Treated?

Treatments for urinary incontinence involve avoiding liquids and caffeinated drinks such as coffee near bedtime and going to the bathroom at regular intervals. Also, a woman can do certain exercises to strengthen muscles and help her control her urine. Some adults wear pads to absorb small amounts of urine that leak. Medications and surgery are helpful for some people.

The treatment for bowel incontinence depends on the cause. If the cause is chronic constipation, treatment involves adding fiber to the diet and correcting the constipation. Other causes may require surgery.

▶ See also **Bedwetting (Enuresis)**

Resources

Books and Articles

Ellsworth, Pamela, and David A. Gordon. *Questions & Answers about Overactive Bladder and Urinary Incontinence*. Sudbury, MA: Jones and Bartlett, 2006.

Mayo Clinic on Managing Incontinence. Rochester, MN: Mayo Clinic, 2005.

Organization

National Kidney and Urologic Diseases Information Clearinghouse.
3 Information Way, Bethesda, MD, 20892-3580. Toll free:
800-891-5390. Web site: <http://kidney.niddk.nih.gov/kudiseases/pubs/uiwomen/index.htm>.

Infection

Infection is a process in which bacteria, viruses*, fungi*, or other microorganisms* enter the body, adhere to or enter cells, and multiply. To do this, they must get around or overcome the body's natural defenses at each step. Infections have the potential to cause illness, but in many cases the infected person does not get sick.*

How Does Infection Occur?

Microorganisms that can cause illness are everywhere in the environment: in air, water, soil, and food, as well as in the bodies of animals and other people. Infection occurs when some of the invading microorganisms get past a series of natural defenses. Those defenses include the following:

- **Skin:** The skin physically blocks germs but may let them in if it is cut or scraped.
- **Coughing deeply:** Coughing expels germs from the lungs and breathing passages but may be less effective in weak, sick, or injured people.
- **Bacteria:** Called “resident flora,” normal bacterial flora are present in some parts of the body. They compete with harmful germs and crowd them out. They can, however, be weakened or killed by medications, allowing harmful germs to thrive and cause illness.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. Viruses can only reproduce within the cells they infect.

* **fungi** (FUNG-eye) are microorganisms that can grow in or on the body, causing infections of internal organs or of the skin, hair, and nails.

* **microorganisms** are tiny organisms that can only be seen using a microscope.

- * **malaria** (mah-LAIR-e-uh) is a disease spread to humans by the bite of an infected mosquito.
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **tuberculosis** (too-ber-kyoo-LO-sis) is a bacterial infection that primarily attacks the lungs but can spread to other parts of the body.
- * **plague** (PLAYG) is a serious bacterial infection that is spread to humans by infected rodents and their fleas.

- **Inflammatory response:** Inflammation is the body's response to a harmful presence. It is primarily a response of the body's immune system. Certain kinds of white blood cells surround and destroy or otherwise attack microorganisms, often causing fever, redness, and swelling.
- **Antibodies:** These protein molecules are produced by a specialized cell of the immune system. Antibodies target specific microorganisms. This response is also called "humoral immunity." Usually these antibodies are produced in response to a person's having been infected by or exposed to the microorganism.

The immune system's responses may fail if the microorganisms are too numerous or if they are too virulent. "Virulent," from the Latin for "poisonous," describes microorganisms that are particularly good at countering the body's defenses. For instance, some microorganisms can prevent formation of those antibodies that might have targeted them. Another important factor is the level of competence of the immune system. If it is damaged—weakened, for instance, by age or illness—infection is more likely. Babies tend to get more infections because their immune systems have not yet learned to recognize and attack some microorganisms.

Where Does Infection Occur?

Localized infections A localized infection remains in one part of the body. An example is a cut on the hand that leads to a bacterial infection but does not cause problems elsewhere in the body. Localized infections can be very serious if they are internal, for example, appendicitis (localized to the appendix) and endocarditis (localized to the interior wall of the heart).

Systemic infections Most serious infections, however, occur when the microorganisms travel throughout the body, usually by way of the bloodstream, and the sites of infection in the body are multiple. These are called systemic infections, and they include flu, malaria*, AIDS*, tuberculosis*, plague*, and most of the infectious diseases whose names are familiar.

How Do Infections Lead to Illness?

The major causes of infection are viruses, bacteria, fungi, and parasites, including protozoa (one-celled organisms), worms, and insects such as mites (which cause scabies) and lice.

Bacteria can release toxins (poisons). Viruses can take over cells and prevent them from doing their normal work. Bacteria and fungi—and larger infective agents such as worms or other parasites—can multiply so rapidly that they physically interfere with the functioning of the lungs, heart, or other organs. The immune response itself—which can bring on fever, pain, swelling, and fatigue (as by-products of the effort to overcome the offending agent)—often is the major cause of the sick feelings an infected person gets.

Do Infections Always Cause Illness?

Infections often do not cause illness. Of people infected with the bacterium that causes tuberculosis, for instance, only about one in 10 will ever get sick. Some viruses and parasites, too, can remain in the body a lifetime without causing illness. In such cases, called latent infection, people usually get sick only if their immune system weakens.

How Do Infections Spread?

The microorganisms that cause infections are present in water, soil, food, and air; they may be transmitted through contact with these substances; through contact with an infected person's blood, skin, mucus, and/or respiratory secretions expelled during coughing or sneezing; through sexual contact; or through insect bites. Many microorganisms are spread by two or more of these routes; no one microorganism spreads in all these ways. In addition, many disease-causing microorganisms can be transmitted, in pregnant women, from mother to fetus, called a congenital infection in the newborn infant.

What Are the Symptoms of Infection?

The symptoms vary greatly depending on the part of the body and type of microorganism involved. The first sign of bacterial infection is often inflammation: fever, pain, swelling, redness, and partial loss of function. By contrast, viral infections less commonly cause inflammation but may cause a variety of other symptoms, ranging from a runny nose or sore throat to a rash or swollen lymph nodes*.

What Is the Treatment for Infection?

The specific treatment depends on the microorganism that is involved: Doctors prescribe antibiotics for bacterial infections, antiviral drugs for some viral infections (for most, however, no treatment exists), antifungal* medications for fungus infections, and anthelmintic drugs for worms. The doctor's decision to use (or not use) medications may also depend on the exact location of the infection, as well as the age and the general medical condition of the patient. In some cases of localized infection, as when an abscess or collection of pus* forms, the patient may need surgery to drain the infected area.

How Are Infections Prevented?

Disinfecting wounds When a wound occurs, prompt and thorough cleansing of the fresh wound by placing it under running water is one of the most effective ways to prevent infection. Additional methods of preventing infection include using antibacterial ointment or spray and covering the wound. Serious wounds should receive immediate medical attention.

Immunization Systemic infectious diseases can be controlled and even eradicated through immunization. Immunizations are available for such

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **antifungal drugs** (an-ty-FUNG-al drugs) are medications that kill fungi.

* **pus** is a thick, creamy fluid, usually yellow or ivory in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

diseases as chickenpox, diphtheria, hepatitis A and hepatitis B, influenza, measles, mumps, pertussis (whooping cough), pneumococcal pneumonia, polio, rabies, rubella (German measles), tetanus, typhoid fever, and yellow fever.

Hygiene, sanitation, and public health Individuals can prevent many other systemic infections by washing hands before handling food; by cooking meats thoroughly; by using safer sex techniques; and by controlling or avoiding ticks and mosquitoes. In addition, a clean public water supply and a system for the sanitary disposal of human wastes can help to prevent infections. While clean water supplies and sewage systems are typical in developed countries, many developing countries have neither. To prevent or reduce the incidence of sexually transmitted infection: be responsible, practice safe sex, and know your partner.

▶ See also **Bacterial Infections • Fungal Infections • Parasitic Diseases: Overview • Viral Infections • Worms: Overview**

Resources

Books and Articles

Ballard, Carol. *Fighting Infectious Diseases*. Milwaukee, WI: World Almanac Library, 2007.

Rotbart, Harley A. *Germ Proof Your Kids: The Complete Guide to Protecting (Without Overprotecting) Your Family from Infections*. Washington, DC: ASM Press, 2008.

Organizations

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-6612. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/PubsOrderForm/default.asp>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: http://www.who.int/topics/infectious_diseases/en.

Infectious Arthritis See *Arthritis, Infectious*.

Infectious Bronchitis See *Bronchiolitis and Infectious Bronchitis*.

Infectious Endocarditis See *Endocarditis, Infectious*.

Infectious Mononucleosis See *Mononucleosis, Infectious*.

Infertility

Infertility (in-fer-TIL-i-tee) means that a couple has difficulty conceiving a child after approximately a year of trying. The man, woman, or both may have problems with their reproductive system that cause them to be infertile.

Fertilization and Implantation

Infertility, the inability to accomplish or maintain a pregnancy, is a widely known medical problem. While beginning a pregnancy is a problem for many couples, maintaining a pregnancy once it begins can also pose an obstacle to successful childbirth.

In order to get pregnant, an egg is released from one of the woman's two ovaries* and travels down the fallopian tube* toward the uterus*. If sperm* are present during this time, the egg may be fertilized while in the fallopian tube.

The fertilized egg continues down the fallopian tube into the uterus, where it implants into the lining of the uterus. The placenta* develops, rich with blood and nutrients, and nourishes the embryo*. The embryo is attached to the placenta via the umbilical cord*.

Infertility results from the interruption of any one of these steps.

What Is Infertility?

Infertility is the failure to become pregnant after about a year of trying many times without using contraception*. Infertility problems increase as a person gets older, and they are more widespread as many women wait to have babies until they are in their 30s and 40s. In the early 2000s, fertility problems affected at least 6.1 million couples in the United States.

Doctors can find no medical cause for up to 20 percent of infertility cases. In 15 to 20 percent of infertility cases, both the man and the woman have fertility problems. The rest of the time, infertility is caused by problems with either the male or the female reproductive system. Some doctors believe that smoking, drinking a lot of alcohol, poor eating habits, stress, excess weight, and generally poor health can make the physical problems causing infertility even worse.

* **ovaries** (O-vuh-reez) are the sexual glands from which ova, or eggs, are released in women.

* **fallopian tubes** (fa-LO-pee-an tubes) are the two slender tubes that connect the ovaries and the uterus in females. They carry the ova, or eggs, from the ovaries to the uterus.

* **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.

* **sperm** are the tiny, tadpole-like cells males produce in their testicles. Sperm can unite with a female's egg to result eventually in conception.

* **placenta** (pluh-SEN-ta) is an organ that provides nutrients and oxygen to a developing baby; it is located within the womb during pregnancy.

* **embryo** (EM-bree-o), in humans, is the developing organism from the end of the second week after fertilization to the end of the eighth week.

* **umbilical cord** (um-BIH-lih-kul) is the flexible cord that connects a baby to the placenta, the organ that unites the unborn child to the mother's uterus, the organ in which the baby develops.

* **contraception** (kon-tra-SEP-shun) is the deliberate prevention of conception or impregnation.

- * **varicose vein** (VAR-i-kose VAYN) is an abnormally swollen or dilated vein.
- * **scrotum** (SKRO-tum) is the pouch on a male body that contains the testicles.
- * **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.
- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.
- * **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **tumors** (TOO-morz) usually refer to abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.
- * **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

Infertility in men Roughly 35 to 40 percent of infertile couples are unable to conceive because of a problem with the male reproductive system. Infertility can result when a man does not produce enough sperm, or when the sperm have too short a life span, do not move properly, or cannot penetrate the egg to fertilize it. These problems can be caused by many factors, including abnormalities of reproductive organs, a varicose vein* in the scrotum*, inflammation* in the male genitals, and sexually transmitted diseases, such as chlamydial (kla-MID-eal) infections, gonorrhea (gon-o-REE-a), and syphilis (SIF-i-lis). Some men have trouble ejaculating (discharging sperm), which also can cause infertility. In rare cases, the immune system* of the man or woman may produce antibodies* that kill sperm.

Infertility in women Another 35 to 40 percent of couples are infertile due to a problem with the female reproductive tract. Problems can occur in any part of the system:

- **Ovaries:** The ovaries (O-va-reez) are a pair of organs where egg cells develop and mature. About 25 percent of female infertility is caused by the failure of a mature egg to leave the ovary (a process called ovulation).
- **Hormones:** Problems with hormone* production can prevent pregnancy.
- **Fallopian tubes:** A woman has two fallopian (fa-LO-pe-an) tubes (one associated with each ovary), which carry eggs from the ovaries to the uterus (YOO-ter-us). Infertility can occur when one or both of the fallopian tubes are blocked, scarred, or collapsed.
- **Pelvic inflammatory disease (PID):** Infertility also is common in women with PID, which is an infection of the female reproductive organs (especially the fallopian tubes).
- **Uterus:** The uterus is the muscular organ in which a fertilized egg develops into a fetus (FEE-tus; developing baby). If the uterus contains scar tissue or a piece of tissue dividing it in half, the fertilized egg might not be able to implant and grow.
- **Endometriosis:** Women also can have infertility problems due to conditions such as endometriosis (en-do-me-tree-O-sis), which occurs when pieces of the lining of the uterus grow outside the uterus.
- **Fibroids:** Fibroids (FY-broidz) are noncancerous tumors* that also can cause infertility.
- **Cervix:** The cervix (SER-viks) is the opening between the uterus and the vagina. Infertility can occur if the cervix does not produce enough mucus* to allow sperm to pass into the uterus.
- **Vaginal infections:** The vagina (va-JY-na) is the tubular canal that runs from the cervix to the outside of the body. Certain vaginal infections that spread to the uterus and fallopian tubes can cause infertility.

How Is Infertility Diagnosed?

The first step in treating infertility is finding out the cause. Both the man and the woman require a complete physical examination to determine if a physical disorder is causing infertility.

The first test for male infertility is an analysis of the sperm for shape, movement, and number. The first test for a woman is to find out if she is ovulating. Home ovulation* kits are available for this purpose, as are body temperature charts (the body temperature fluctuates during the menstrual cycle*). Tests of a woman's blood and urine also help doctors to determine if a woman is having normal menstrual cycles. An x-ray of the uterus and fallopian tubes can reveal any blockage that might prevent the egg from being fertilized. In some cases, the doctor may look inside the body with a laparoscope*. The laparoscope has a light and a camera on the end, which conveys images to a monitor screen. This device allows the doctor to see the organs inside the body. This flexible tube is inserted into the abdomen* through a small incision.

How Is Infertility Treated?

Difficulty conceiving a baby may not be a permanent condition, and many couples with fertility problems eventually have a child without medical intervention. However, some couples need medical help to become pregnant, and the treatment depends on the cause of infertility. If a hormone deficiency causes infertility, treatment may involve taking hormones prescribed by a doctor. If there is damage or an abnormality in the female organs, it sometimes can be repaired surgically. For other couples, treatment can range from taking fertility drugs to using assisted reproductive technology (ART). Many treatments for infertility exist; a few of them are described below.

Artificial insemination Artificial insemination (in-sem-i-NAY-shun) is the introduction of a man's sperm into the opening of a woman's uterus with a tube called a catheter (CATH-e-ter). Before insemination, antibodies and unhealthy sperm are removed from the semen (SEE-men), the fluid containing sperm. The sperm used in artificial insemination ideally comes from the woman's male partner. However, in cases in which the man is infertile or carries a genetic disorder, sperm from a donor may be used.

Fertility drugs Fertility drugs can be used to treat problems with ovulation. A number of different medications have been developed that help stimulate the maturation and release of ova (eggs).

In vitro fertilization (IVF) "In vitro" literally means "in glass" (as in a test tube) and, therefore, refers to a procedure performed outside the body. In vitro fertilization (IVF) occurs when eggs are removed from the woman and mixed with sperm in the laboratory. Fertilized eggs, or embryos, then are placed in the woman's uterus. This procedure bypasses the fallopian tubes.

Multiple Births

One of the major problems facing couples undergoing fertility treatment is multiple births. Fertility drugs may result in multiple births, because they can stimulate release of multiple eggs. For example, as many as 10 percent of women who become pregnant with the help of the drug Clomid (KLO-mid), or clomiphene citrate (KLO-mi-feen SY-trayt), have twins, and 1 in 400 women have triplets.

Assisted reproductive technologies such as in vitro fertilization usually place two to five eggs inside the woman's reproductive tract, because not all are expected to survive—but sometimes they all do. On January 26, 2009, Nadya Suleman gave birth to eight babies after undergoing fertility treatment. The births received much media attention and started discussions on the issues surrounding in vitro fertilization.

The more embryos that develop at one time in the uterus, the more likely they are to be born prematurely, to be small, and to have serious health problems such as cerebral palsy (se-REE-bral PAWL-zee) and brain damage. Because of such health problems and because of ethical and financial issues associated with multiple births, fertility treatment can be controversial.

* **ovulation** (ov-yoo-LAY-shun) is the release of a mature egg from the ovary.

* **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of breeding age.

* **laparoscope** (LAP-a-ro-skope) is a fiber-optic instrument inserted into an incision in the abdominal wall to perform a visual examination.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis

Before IVF, women usually take fertility drugs in order to produce multiple eggs. Eggs are taken from a woman's ovaries using a needle inserted through the vagina. The male partner provides a sperm sample, which is mixed with the eggs in a dish in the laboratory. After several days, if the eggs have been fertilized and have developed into embryos, two to five embryos (usually) are placed into the uterus (not all are expected to develop into fetuses). About two weeks later, the woman takes a pregnancy test to see if the procedure was successful.

Coping with Infertility: Jim and Sarah's Story

Jim and Sarah Albertson are among the 10 to 20 percent of the reproductive-aged population in the United States who have difficulty having a baby. Even although pregnancy is possible in more than half of couples pursuing fertility treatment, it does not seem possible for them.

Jim and Sarah began trying to have a baby on their honeymoon, when they were both 34. Five years later, they still have no children. Sarah has had surgery to remove fibroids, and she has taken hormones and fertility pills. Jim has done everything possible to increase his sperm count. They have tried artificial insemination. It seems their whole lives revolve around trying to get pregnant, but nothing is working.

As Jim and Sarah watch one friend after another have a baby, their own home begins to feel empty. They try not to blame each other, but it is hard not to. Even though their health plan does not cover in vitro fertilization, they decided to spend their own money to try to get pregnant that way. Three tries and \$30,000 later, they still have no baby. With the help of marital counseling and the support of other couples with the same problem, Jim and Sarah are learning to accept that they may not have biological children.

 *See also* **Pregnancy**

Resources

Books and Articles

Clark, Rebecca A., Gloria Richard-Davis, Jill Hayes, et al. *Planning Parenthood: Strategies for Success in Fertility Assistance, Adoption, and Surrogacy*. Baltimore, MD: Johns Hopkins University Press, 2009.

Davis, Melanie, Caroline Overton, and Lisa Webber. *Infertility: The Facts*. New York: Oxford University Press, 2008.

Ford, Melissa. *Navigating the Land of IF: Understanding Infertility and Exploring Your Options*. Emeryville, CA: Seal Press, 2009.

Perkins, Sharon, and Jackie Meyers-Thompson. *Infertility for Dummies*. Hoboken, NJ: Wiley, 2007.

Organizations

American Society for Reproductive Medicine. 1209 Montgomery Highway, Birmingham, AL, 35216-2809. Telephone: 205-978-5000. Web site: <http://www.asrm.org>.

International Council on Infertility Information Dissemination. P.O. Box 6836, Arlington, VA, 22206. Telephone: 703-379-9178. Web site: <http://www.inciid.org>.

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web site: <http://www.womenshealth.gov/faq/infertility.cfm>.

RESOLVE, The National Infertility Association. 1310 Broadway, Somerville, MA, 02144. Telephone: 617-623-0744. Web site: <http://www.resolve.org>.

* **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **perianal disease** affects the regions around the anus.

Inflammatory Bowel Disease

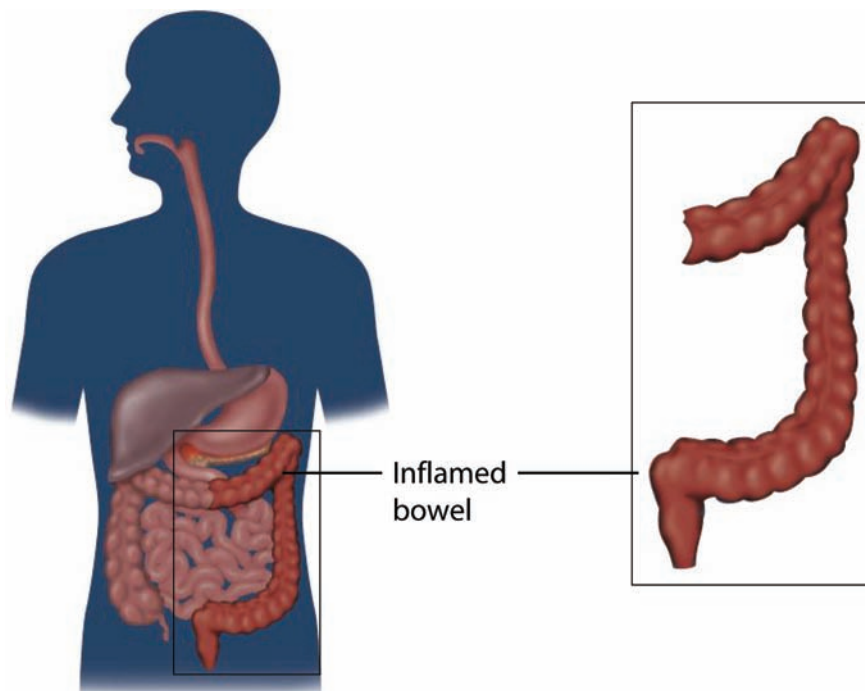
Inflammatory bowel disease (IBD) refers to a group of disorders that cause the intestines to become inflamed. IBD generally refers to chronic (long-lasting) inflammatory bowel diseases of unknown cause. IBD is typically diagnosed as either ulcerative colitis or Crohn's disease, depending on depth of inflammation of the intestinal wall and the affected regions: ulcerative colitis affects the most superficial layer of the colon, called the mucosa, and the inflammation always involves the rectum, whereas Crohn's disease affects all layers of intestinal tissue (transmural involvement) and may occur anywhere along the intestinal tract from lips to anus but most commonly occurs in the lower part of the small intestine (ileum).*

What Is Inflammatory Bowel Disease?

Inflammatory bowel disease (IBD) encompasses several disorders resulting in chronic inflammation* of the gastrointestinal tract. The different types of IBD have many symptoms in common, including abdominal pain, frequent diarrhea (sometimes with blood and mucus), constipation, weight loss, and fatigue. IBD is often associated with other inflammatory conditions, for example, fever, inflammation of the joints (arthritis), skin or eye lesions, and perianal disease*. There are many chronic inflammatory intestinal diseases, including those caused by bacteria (diverticulitis, chronic appendicitis, *H. Pylori* gastritis), parasites (amoebic colitis, *Giardia* duodenitis), physical and chemical agents (radiation enteritis, bile and peptic gastritis, and esophagitis), but the term IBD generally refers to chronic inflammatory bowel diseases of unknown cause.

What is known is that IBD is not passed from person to person. However, up to 25 percent of people with IBD have a relative with the

When inflammation occurs in the large intestine (colon) or in the lower part of the small intestine (ileum), it causes pain and swelling and may lead to diarrhea, weight loss, fatigue, and fever. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **mucosa** (mu-KOH-sa) is the moist tissue that lines some organs and body cavities. It makes mucus, a thick, slippery fluid.

disease, suggesting that genetic factors play a role in its development. Some researchers believe that IBD occurs because a virus or bacterium triggers an inappropriate response from the immune system* in people who have a genetic tendency for the disease. This abnormal response would then cause the digestive tract to become inflamed. But despite decades of study and searching for an infectious agent, as of 2009 none had been identified.

What Are the Different Types of IBD?

The two major types of IBD are ulcerative colitis and Crohn's disease. The disorders have many points in common: the cause of both IBDs remains unknown; they both have unpredictable outcomes; they have common symptoms, which are not necessarily intestinal; laboratory tests are inconclusive; and responses of patients vary to treatment.

Ulcerative colitis Ulcerative colitis involves inflammation of the surface mucosal layer of the colon. The deeper or muscular and serosal layers of tissue are rarely affected. Inflammation always begins in the rectum. If the disease remains limited to this portion of the colon, then it is called ulcerative proctitis. But the disease often extends toward the small intestine for an unpredictable distance and then abruptly stops. Besides the affected segment, no other diseased regions occur that are separated by healthy tissue ("skip areas"), as are present in Crohn's disease. The inflammation typically involves only the mucosa*, with formation of ulcers. These sores often result in bloody diarrhea, and substantial blood

loss can occur. Ulcerative colitis affects only the rectum in approximately 25 percent of cases. It often spreads in continuous fashion to the more proximal large intestine. The small intestine is never involved, except when the ileum is temporarily inflamed. As the disease becomes chronic, the colon wall loses its undulations and starts looking like a “lead pipe”, as seen on imaging tests. In severe cases, it can extend to the submucosa*, but this is very rare.

Most people who develop ulcerative colitis are between the ages of 15 and 40, the most typical symptom being bloody diarrhea, accompanied by abdominal pain, cramping, and fever. The severity of the disease varies from person to person. Some people seldom have an attack of symptoms. Others have almost continuous attacks that interfere with their daily activities. One of the most serious complications of ulcerative colitis is “toxic megacolon,” which can lead to intestinal perforation, sepsis*, and death.

Experts agree that having ulcerative colitis increases the risk of intestinal cancer. Five percent of people with ulcerative colitis develop colon cancer. The longer a person has ulcerative colitis and the larger the affected region, the greater the risk of developing cancer: If only the lower colon and rectum are involved, the risk of cancer is the same as for the general population. But if the entire colon is affected, the risk of cancer becomes 32 times the normal rate. In some cases, cells lining the colon become pre-cancerous, a condition referred to as “dysplasia,” which greatly increases the risk of cancer.

Crohn’s disease Crohn’s disease (sometimes referred to as ileitis or enteritis) is an inflammation that extends deep into the tissues of the intestinal wall, unlike ulcerative colitis, which is only in the mucosa. Crohn’s disease involves all layers of the bowel (transmural inflammation) and frequently involves the small intestine. Here it typically results in areas of marked thickening of the intestinal wall with multiple areas of narrowing resulting in obstruction of the passage of the intestinal contents. These areas may alternate with stretches of normal intestine. These normal areas are called skip areas. Crohn’s disease affects the ileum and cecum* in 40 percent of patients, only the small intestine in 30 percent, and only the colon in 25 percent. Much less commonly, Crohn’s disease can also affect the more central parts of the gastrointestinal tract, including the mouth, tongue, esophagus, stomach, and duodenum*. Perianal complications (fistulas*, fissures*, abscesses*) are common and coincide with the disease’s characteristic transmural inflammation pattern.

There are many conflicting theories about what causes Crohn’s disease. Men and women seem to be afflicted in equal numbers, and about 20 percent of people with the disease have a relative who also has it. Many people with Crohn’s disease have weakened immune systems, but it is not known whether this is a cause or a result of the disease.

The symptoms of Crohn’s disease vary from person to person. Typical symptoms include ongoing abdominal pain, loss of appetite, diarrhea,

* **submucosa** (sub-mu-KOH-sa) is the layer of tissue under the mucosa.

* **sepsis** is a potentially serious spreading of infection, usually bacterial, through the bloodstream and body.

* **cecum** (SEE-kum) the pouch-like start of the large intestine that connects it to the small intestine.

* **duodenum** (dew-eh-DEE-num) is the first part of the small intestine that connects to the stomach.

* **fistulas** (FIS-tu-las) are abnormal connections between two organs or leading from an internal organ to the surface of the body.

* **fissures** are tears in tissue.

* **abscesses** (AB-seh-sez) are localized or walled off accumulations of pus caused by infection that can occur anywhere within the body.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

* **biopsies** (Bi-op-seez) are tests in which small samples of skin or other body tissue are removed and examined for signs of disease.

weight loss, and fatigue. Perianal disease is experienced by 50 percent of patients. Children with Crohn's disease may develop slowly and not reach their full growth potential because their bodies do not get enough nourishment for normal growth. Adults may also have problems with getting adequate nutrition.

The most common complication of Crohn's disease is blockage of the intestine, because the intestinal walls tend to swell and thicken with scar tissue that eventually impairs the movement of intestinal contents. In some people, inflammation, perforation, and scarring extend into surrounding tissues, creating fistulas and a high risk of additional infection.

How Is IBD Diagnosed?

A medical history, physical examination, and diagnostic tests are required to diagnose IBD. Blood samples may be taken to search for evidence of anemia* and infection. Examination of stool samples for the presence of blood is also helpful in reaching a diagnosis.

Often the colon is examined through a procedure called a colonoscopy. An endoscope (a lighted flexible tube with a camera attached to a television monitor) is inserted through the anus. This procedure allows the doctor to see the inside lining of colon and rectum. Sometimes during

ENDOSCOPY

The word “endoscopy” means “peering within.” Endoscopes allow a physician to see inside the human body.

An endoscope is a long flexible tube with a light and camera inside its tip. It captures an image and sends a magnified form of it back to a video screen. This system makes it possible for the physician to examine the inside of the body in the area of interest.

Endoscopes also contain openings through which the doctor can maneuver tiny surgical tools, such as scissors, forceps, suction devices, and water sprays. Thus, this tool enables the doctor to perform surgery or to take tissue samples without cutting through the wall of the abdomen or chest.

After its approval by the Food and Drug Administration in 2001, wireless capsule endoscopy, also known as the “video pill,” began to be used because it is a less invasive procedure than the conventional endoscope. As the name implies, it is a little camera in the form of a pill that can be swallowed. As it travels through the digestive tract, it produces images that are of the same high quality as those produced by endoscopes. But the areas of interest can not be cleaned of intestinal contents or be repositioned with the inflation of air, nor can biopsies* be taken or bleeding lesions be stopped. For these and other reasons, this technology is less frequently employed. When an abnormality is found with the pill, a conventional endoscopic procedure is almost always required.

the colonoscopy a tissue sample (called a biopsy) is taken from the intestinal lining for further examination under a microscope.

Another diagnostic procedure commonly used is a barium study. A person drinks a mixture of barium that is flavored with another liquid, and then the person is x-rayed. Because barium shows up on x-rays, the doctor can detect abnormalities as the mixture flows through the person's intestines. CT scans* may be useful in evaluating the progress of the disease once it has been diagnosed.

However, invasive procedures such as endoscopies and barium x-rays can be contraindicated during the acute phase of IBD, as they carry the risk of perforating the intestinal wall, which is weakened by inflammation.

How Is IBD Treated?

Because ulcerative colitis and Crohn's disease often have different complications, they also have distinct medical and surgical treatments aimed at relieving specific symptoms.

Medication and Diet Medication and diet are the two primary approaches to controlling IBD. They do not cure the disease but are effective in reducing symptoms in the majority of people. In severe cases of IBD, surgery may be necessary. Anti-inflammatory drugs often are used to help control the inflammation. In some cases, immunosuppressant drugs may be helpful in controlling symptoms that do not respond to anti-inflammatory drugs. Antibiotics are also used to treat Crohn's disease. Several experimental drug therapies were under investigation as of 2009.

Many of the drugs used to treat IBD are powerful and may have undesirable side effects. The physician must balance the undesirable side effects against the positive benefits, sometimes trying several different drug combinations before a successful balance is reached.

In addition to drug therapy, a special diet may be prescribed. Because IBD interferes with nutrition, people with the disease often must increase the amount of calories, vitamins, and minerals they consume. Some individuals find that they must avoid specific foods that aggravate their symptoms. Other people find that a bland, low-fiber diet offers some relief. Because there is no cure for IBD and because the diseases are unpredictable in their course, people with any form of the disease should receive regular medical examinations that include a review of their treatment and diet.

Surgery In severe cases of IBD, a person may need surgery to remove damaged sections of the intestines. About 20 percent of people with ulcerative colitis require surgery at some point in their lives. Severe cases may require removal of the entire colon and rectum. After this procedure, normal bowel movements are no longer possible, so the small intestine is given a surgically created opening through the lower abdomen. (The names of types of surgery that create an opening end with “-ostomy.”) This opening is covered with a bag that collects waste and must be emptied several

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **colostomy** (ko-LOS-to-mee) is a surgical procedure in which a part of the large intestine is removed, and the end of the intestine is attached to an opening made in the abdomen. The stool is passed through this opening into a special bag.

times a day. Different ostomies may be performed. When the colon and rectum are removed, the surgeon performs an ileostomy to attach the bottom of ileum to the stoma (opening). When the only the rectum is removed, the surgeon performs a colostomy* to attach the colon to the stoma. An alternative to using an outside collecting bag is to perform a “continent ileostomy.” In this procedure, the surgeon creates an internal reservoir pouch using a part of the small intestine. A valve is constructed and a stoma is placed through the abdominal wall. A tube can then be inserted through the stoma and valve to drain the pouch.

About 70 percent of people with Crohn’s disease eventually need to have damaged areas of the intestine removed. Removing the damaged parts does not cure the disease, because the inflammation may return in other places in the intestine, usually near the surgical site. Many people with Crohn’s disease need additional surgeries. Multiple surgical resection can lead to short bowel syndrome. Surgery may be necessary to remove or open narrowed areas causing obstruction. Surgery may be required for the removal and healing of fistulae.

Extensive Crohn’s disease may require intravenous feeding to assure normal growth and development in children.

Living with IBD

People with IBD often go for substantial periods when they feel well and have few symptoms. During these times they are able to hold jobs, raise families, and participate in normal daily activities. Throughout the United States, there are support groups for people with IBD that help them learn to cope with their illness and maintain a normal, happy life.

Nevertheless, IBD is very frequently a difficult problem, producing both physical and emotional stresses. Comprehensive care should always offer patients with these problems knowledgeable and sensitive professional services. Addressing these issues is time-consuming yet essential.

▶ **See also Colitis • Colorectal Cancer • Constipation • Crohn’s Disease • Diarrhea • Diverticulitis/Diverticulosis • Irritable Bowel Syndrome**

Resources

Books and Articles

Sklar, Jill. *The First Year: Crohn’s Disease and Ulcerative Colitis: An Essential Guide for the Newly Diagnosed*. New York: Marlowe, 2007.

Targan, Stephen R., Fergus Shanahan, Loren C. Karp, eds. *Inflammatory Bowel Disease: From Bench to Bedside*. New York: Springer Science and Business Media, 2003.

Zonderman, Jon, Ronald S. Vender. *Understanding Crohn Disease and Ulcerative Colitis*. Jackson: University Press of Mississippi, 2006.

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://familydoctor.org/online/famdocen/home/common/digestive/disorders/252.html>.

American Gastroenterological Association. 4930 Del Ray Avenue, Bethesda, MD, 20814. Telephone: 301-654-2055. Web site: <http://www.gastro.org>.

Crohn's and Colitis Foundation of America. 386 Park Avenue South, 17th Floor, New York, NY, 10016. Toll free: 800-932-2423. Web site: <http://www.cdfa.org>.

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov>.

Pediatric Crohn's and Colitis Association. P.O. Box 188, Newton, MA, 02468. Telephone: 617-489-584. Web site: <http://pcca.hypermart.net>.

United Ostomy Association. 19772 MacArthur Boulevard, Irvine, CA, 92612-2405. Toll free: 800-826-0826. Web site: <http://www.uoa.org>.

Influenza

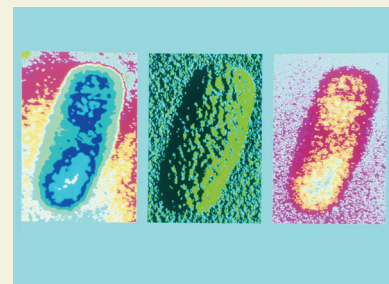
Influenza (in-floo-EN-zuh), also called the flu, is a contagious viral infection that attacks the respiratory tract, including the nose, throat, and lungs.

Joseph's Story

Joseph was coughing, sneezing, and starting to feel very tired, but he went to school anyway. During lunch, several of his friends asked him if he was sick. As he started to answer, he sneezed. It happened so quickly that he could not cover his nose. None of his friends saw or felt the microscopic droplets that carry influenza virus that came out of Joseph's nose and that they unknowingly inhaled into their own lungs.

The next morning, Joseph woke up and felt as if he could not get out of bed. He had a high fever—about 102 degrees Fahrenheit—but felt shivery. His head, muscles, and whole body ached, and his nose was congested. He had the flu.

For the next few days, Joseph's friends felt fine. They did not know that the flu virus they had inhaled was spreading through their bodies,



▲ Three digitized views of Type A influenza virus. J. L. Carson, Custom Medical Stock Photo, Inc. Reproduced by permission.

* **epidemics** (eh-pih-DEH-miks) are outbreaks of diseases, especially infectious diseases, in which the number of cases suddenly becomes far greater than usual. Usually, epidemics that involve worldwide outbreaks are called pandemics.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

latching onto healthy cells and infecting them. Then one morning, several of Joseph's friends woke up with a fever, sneezing, and coughing. Within a few hours, they felt as if they had no energy. They, too, had the flu.

What Is Influenza?

The respiratory infection influenza, commonly known as the flu, causes symptoms that include fever, muscle aches, sore throat, and a cough. In its early stages, influenza sometimes is confused with the common cold because both affect similar parts of the body, but the flu is more severe, lasts longer, and can cause dangerous, even fatal, complications.

Influenza virus is classified as type A, B, or C. Types A and B cause large flu outbreaks or epidemics* each year, whereas type C flu virus causes only mild symptoms. Type A influenza virus is the most threatening to humans because it is likely to mutate (change) into new strains frequently.

When the human immune system* encounters a foreign protein such as a flu virus, it produces antibodies* that inactivate that particular virus. This process is likely to take a week or two, so that the first time individuals are infected with a particular virus, they get sick. However, if these individuals are later exposed to the same virus, their body recognizes it and is able to quickly produce the specific antibody needed to

EPIDEMIC

There have been epidemics of influenza throughout history, but none compares with the one that circled the planet in 1918 and 1919. (An epidemic that is worldwide is called a “pandemic.”) More than 20 million people died, including almost 500,000 Americans.

The flu began to spread in the spring of 1918, at first in military camps in the United States and France. Soldiers living in very close quarters and the massive movement of troops around the globe contributed to the wide-spread infection. Soldiers from many countries were exposed to one another and to civilians across Europe and the Far East. Later, when the flu spread to Spain, it received a lot of newspaper publicity, which is why this epidemic is sometimes called the Spanish flu.

In 2005 Jeffrey Taubenberger, a researcher at the Armed Forces Institute of Pathology outside Washington, D.C., extracted virus proteins from preserved lung tissue of people who had died in the 1918–1919 flu epidemic. He showed that the epidemic had been caused by a bird flu virus that had mutated so that it was able to infect humans. The human immune system was unprepared to cope with such a radically different type of flu virus, so many more people died in the outbreak than in a normal flu outbreak. More often influenza viruses mutate only slightly, just enough to make people sick but not enough to kill them.

kill the virus immediately. In this second exposure, the individuals do not get sick. This process forms the basis of immunity* to disease.

Influenza viruses have two key proteins on their surface, haemagglutinin (HA) and neuraminidase (NA). These proteins influence the ability of the virus to infect healthy cells. The viral genes that produce these surface proteins mutate rather rapidly, and so the proteins themselves change rapidly. The antibodies made against one type of HA or NA protein do not work well against the mutated (changed) proteins. Thus, a person who has already had flu can get the flu again if he or she is next exposed to a different (mutated) strain.

How Common Is Influenza?

Millions of people contract the flu each year. Influenza is extremely contagious, mostly because people (especially school children) often spread it before they even know that they are sick. Also, those with the infection usually remain contagious for about a week after first showing symptoms. When an infected person sneezes, coughs, or talks too closely to others, the flu virus is transmitted through tiny drops of fluid that are launched into the air and can be inhaled by someone else. The virus can also be left on surfaces that a person with the flu has touched, such as door-knobs, desks, and keyboards, so people who forget to wash their hands after touching these objects can easily become infected from rubbing their eyes or touching their mouth. The virus is very hardy and can live as long as two days on hard surfaces.

Influenza affects people of all ages, but it is a special problem for the very young, the elderly, and people with weakened immune systems, including people with AIDS*, people with certain cancers or who are receiving chemotherapy* to treat cancer, people who have had organ

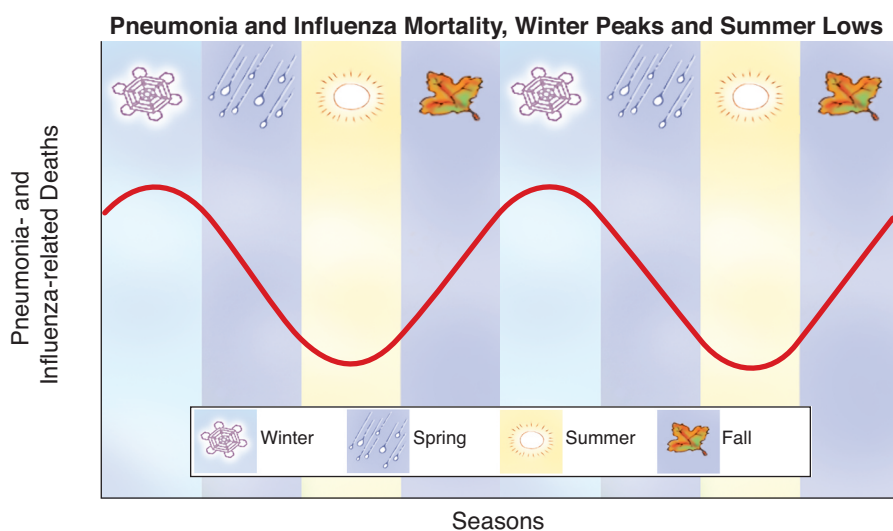
Flu in the Animal World

Many different subtypes of type A influenza virus cause infection in humans. Other type A subtypes cause influenza in chickens, ducks, pigs, horses, ferrets, whales, seals, and dogs. Normally animal flu does not spread to humans, but there have been a few cases in Asia when avian (bird) flu passed from birds to people who handled them.

* **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **chemotherapy** (KEE-mo-THER-ah-pee) is the treatment of cancer with powerful drugs that kill cancer cells.



Source: Centers for Disease Control and Prevention (CDC)

Cases of influenza virus infection typically peak in the fall and winter and decrease in the warmer months.

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

What Is the Stomach Flu?

When people complain about the stomach flu, what they actually are describing is gastroenteritis (gas-tro-en-ter-EYE-tis). The stomach cramps, nausea, and vomiting that accompany a bout of gastroenteritis usually only last a day or two and are different from the group of symptoms seen with influenza virus infection.

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

* **opportunistic infections** are infections caused by infectious agents that usually do not produce disease in people with healthy immune systems but can cause widespread and severe illness in patients with weak or faulty immune systems.

* **bronchitis** (brong-KYE-tis) is a disease that involves inflammation of the larger airways in the respiratory tract, which can result from infection or other causes.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **asthma** (AZ-mah) is a condition in which the airways of the lungs repeatedly become narrowed and inflamed, causing breathing difficulty.

transplants, and anyone else who is taking any medication that suppresses the immune system.

When people inhale the flu virus, it enters the airways. The HA proteins help it to attach to healthy cells. The virus then enters the cell and uses the cell's protein-making and nucleic acid-making capacity to make more of the virus. The host cell eventually bursts open, releasing new virus particles that repeat the cycle. Although the body's immune system fights back, it takes time for it to destroy the virus, and during that time, the person develops flu symptoms.

How Do People Know They Have the Flu?

Flu symptoms are usually worse than those seen with a cold. Symptoms include:

- Sneezing, runny nose, and congestion (stuffed-up nose)
- High fever
- Headache
- Chills
- Dry-sounding cough
- Muscle aches
- Abdominal* pain and poor appetite
- Tiredness

Most people have symptoms of the flu for 7 to 14 days. The high fever and body aches usually disappear within a few days, but those symptoms may be quickly replaced by a sore throat, runny nose, and lingering cough. In some cases, fever may even return for a brief period. Feelings of tiredness and exhaustion can last several days or weeks in some people with the flu. Trying to return to a normal routine too quickly can cause symptoms, especially exhaustion, to reoccur.

Many flu symptoms are not caused by the influenza virus, but by the body's struggle to control and destroy the virus. White blood cells produce a protein called interleukin (in-ter-LOO-kin) that leads to aches, fever, and fatigue until the virus is eliminated.

People who get the flu sometimes develop complications. The flu virus weakens the body's defenses against infection. This effect increases the likelihood of developing an opportunistic infections* in the lungs. About two weeks after getting the flu, some people develop bronchitis* or pneumonia*. Bacterial pneumonia can be a serious complication of the flu. It usually occurs when bacteria invade lung tissue that is already inflamed by the flu virus. This complication can be life-threatening in infants and in elderly people. Influenza can also worsen the symptoms of other common heart and lung diseases, such as congestive heart failure, chronic* bronchitis, and asthma*. Hundreds of thousands of Americans are hospitalized every year due to the virus, and about 20,000 die from the flu or its complications.

Because the flu can go from bad to worse very quickly, doctors recommend that people with the flu seek medical care immediately if they experience any of the following:

- A fever that lasts longer than 5 days
- Any breathing difficulty, including wheezing (WEE-zing), a whistling sound that occurs while breathing or coughing
- A continuous cough that makes it difficult to breathe
- A cough that brings up blood or thick green or dark yellow mucus

How Is Influenza Diagnosed and Treated?

Doctors usually diagnose the flu based on the symptoms and information about whether flu is currently common in the patient's area. Laboratory tests to diagnose influenza do exist, but they are not often used because

IS IT A COLD OR THE FLU?

Doctors say that more than 200 different viruses can cause symptoms of the common cold. In fact, many people say that they have the flu when they really have a common cold. How can people tell the difference? Here is some information comparing the common symptoms of a cold with those of influenza.

- **Symptoms** come on slowly with a cold, but suddenly with the flu.
- **Fever** is rare with a cold, but high (lasting 3–4 days) with the flu.
- **Headache** is sometimes present with a cold, but often present with the flu.
- **Aches and pains** are slight with a cold, but typical and often severe with the flu.
- **Fatigue and weakness** is mild with a cold, but typical and may last several weeks with the flu.
- **Extreme exhaustion** is never seen with a cold, but comes early and prominently with the flu.
- **Sneezing** is usual with a cold, but only seen sometimes with the flu.
- **Running nose** is usual with a cold, but only seen sometimes with the flu.
- **Scratchy or sore throat** is common with a cold, but only seen sometimes with the flu.
- **Chest discomfort** is mild to moderate with a cold, but is common and can become severe with the flu.
- **Coughing** is seen both in colds (a hacking cough) and the flu.

H1N1—The New Flu, a Lesson in Epidemiology

In April 2009 an infectious respiratory disease caused by a subtype of the influenza A virus was identified. Initially called a swine flu because it contained swine flu genes, it was quickly renamed H1N1 influenza A.

The H1N1 influenza virus had not been previously identified and the virus and associated flu were subjects of intense research. Information about the virus and its associated flu accumulated rapidly.

What concerned health experts about the H1N1 virus was that it was of unknown lethality and that it had the ability to pass directly from person to person. Because the H1N1 flu was a new strain, humans had no immunity to it. As a result, the resources of the World Health Organization (WHO), the Centers for Disease Control (CDC), state public health departments, and various international organizations charged with protecting public health were mobilized to attempt to prevent and/or mitigate a possible worldwide influenza pandemic. In some areas schools and businesses were shut down and events that would attract crowds such as soccer matches were canceled. Despite preventive actions, new cases of H1N1 were diagnosed worldwide; however, the vast majority of H1N1 flu cases appeared to have the same severity of symptoms, risks of complications, and transmissibility as a normal seasonal flu.

By mid-May 2009, 33 countries had officially reported 6,500 cases of H1N1 influenza with 65 deaths. At the same time, health officials worldwide were watching the Southern Hemisphere where flu season was about to begin to see how the H1N1 virus circulated there. The outcome would determine how aggressively public health officials would approach the H1N1 flu in the fall flu season in the Northern Hemisphere.

- * **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.
- * **Reye's syndrome** (RYES SIN-drome) is a rare condition that involves inflammation of the liver and brain, and sometimes appears after illnesses such as chicken pox or influenza. It has also been associated with taking aspirin during certain viral infections.
- * **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

of their cost, unreliability, and the time it takes to get a result. To perform a flu test, the doctor uses a small cotton swab to collect some of the fluid from the nasal passages. This fluid sample can then be tested in a laboratory to see if the flu virus is present.

The flu was treated in the early 2000s the same way it was one hundred years before. Patients were advised to rest in bed and drink plenty of liquids to prevent dehydration* and stay warm. Over-the-counter medications can help the fever, aches, and cough, but aspirin should be avoided during the flu or other viral infections because of its relationship to Reye's syndrome*.

Occasionally, doctors prescribe antiviral flu medications, such as amantadine (uh-MAN-ta-deen) or rimantadine (rih-MAN-tuh-deen), for people with the flu. These medications do not offer a cure but can reduce the length and severity of the illness. In order to work, they must be taken within 48 hours of the start of flu symptoms. These drugs are normally given only if the person has a weakened immune system and is likely to become very sick from the flu. Antibiotics, such as penicillin, are not effective against viruses, but they are used to treat complications such as opportunistic bacterial infections.

Can the Flu Be Prevented?

Infection by some strains of influenza can be prevented with a flu vaccination* in the fall. The vaccine contains inactive versions of the three flu viruses—two of type A and one of type B—that researchers suspect will be most likely to cause influenza during the coming winter and early spring. The vaccine contains particles from killed influenza viruses. These killed viruses stimulate the immune system to make antibodies, but they do not cause flu symptoms.

Because the influenza virus is constantly mutating, the flu shot does not guarantee that a person will not get the flu. It does, however, reduce the chance of becoming sick by 80 to 90 percent. Almost everyone should get a flu shot, especially the elderly, people with certain heart and lung diseases, and people who work in places such as hospitals, schools, and daycare centers. Because the virus changes over time, each year the vaccine is designed to target slightly different strains of virus, which means that the shot must be repeated every year.

Because the highly contagious flu virus is easily passed from person to person through the air and through its being left on surfaces, the virus can be almost anywhere. Experts recommend that hands be washed thoroughly with warm, soapy water for at least 15 to 30 seconds after one has used a public restroom and before eating or touching the face.

Avoiding contact with people who have the flu can also lower the risk of catching it. By avoiding close contact in large crowds, especially at schools or in malls, and by not touching used tissues or and not sharing drinks, a person can reduce the chance of becoming sick.

▶ See also **Avian Influenza • Bronchiolitis and Infectious Bronchitis • Common Cold • Laryngitis • Pneumonia**

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Organizations

- Centers for Disease Control and Prevention.** 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435.
- Department of Health and Human Services.** 200 Independence Avenue SW, Washington, DC, 20201. Web site: <http://www.pandemicflu.gov/index.html>.
- National Institute on Aging.** 31 Center Drive, MSC 2292, Building 31, Room 5C27, Bethesda, MD, 20892. Telephone: 301-496-1752. Web site: <http://www.nia.nih.gov/HealthInformation/Publications/flu.htm>.
- World Health Organization.** Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/topics/influenza/en>.

Ingrown Toenail

An ingrown toenail is a toenail that cuts into the skin of the toe.

What Is An Ingrown Toenail?

An ingrown toenail is a common condition in which the corners or sides of the toenail cut into the skin of the toe. This condition usually occurs in the big toe and can affect people of all ages. An ingrown toenail is a serious condition for people with impaired blood circulation or diabetes.



▲
Ingrown toenails that have become infected may be treated with antibiotics. People with diabetes or circulatory system problems should receive regular foot care from a doctor or podiatrist.

Dr. P. Marazzi/Photo Researchers, Inc.

What Happens When People Have Ingrown Toenails?

Ingrown toenails tend to run in families, although they also may be caused by the following:

- wearing shoes that are too tight or that do not fit properly
- trimming toenails improperly or too closely
- repeated trauma to the toenail from everyday activities such as work and sports.

Pain and swelling are the first signs of an ingrown toenail. The area around the ingrown toenail can also become infected. A doctor diagnoses an ingrown toenail through a physical examination.

Treatment Treatment depends upon the type and amount of pain present. Ingrown toenails that are not infected may be treated by putting a cotton pad coated with a medicine called collodion (ko-LO-de-on) under the nail's edge. This medicine relieves the pain and allows the nail to grow properly. Ingrown toenails that are infected may be treated with antibiotics or warm soaks. Sometimes, part of the toenail must be removed. An ingrown toenail is a serious condition for people with impaired blood circulation or diabetes. People with these conditions should have their feet cared for by general doctors or by podiatrists, doctors who specialize in the care of the feet.

Prevention Ingrown toenails can be prevented by wearing shoes that fit properly and by trimming toenails properly. Nails should be cut straight across with a nail clipper, not rounded off at the corners, and the nails should be filed smooth.

▶ See also **Infection**

Resources

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Organizations

American Academy of Orthopaedic Surgeons. 6300 North River Road, Rosemont, IL, 60018-4262. Telephone: 847-823-7186. Web site: <http://orthoinfo.aaos.org/topic.cfm?topic=a00154>.

American Podiatric Medical Association. 9312 Old Georgetown Road, Bethesda, MD, 20814-1698. Web site: <http://www.apma.org>.

Insect Bites/Stings See *Animal Bites and Stings*.

Insomnia

Insomnia (in-SOM-nee-a) is a disorder in which people have trouble sleeping or getting enough rest.

The Necessity of Sleep

Humans, like all other living organisms, have cycles of activity and rest, which perhaps evolved partly as a response to the cycles of night and day. Many of the body's hormones* and processes are related closely to such daily cycles. Sleep provides the opportunity to rest, to restore certain essential neurotransmitters*, and even to avoid certain predators. Sleep, in short, is necessary to health and even to life.

Yet millions of people have insomnia. They may have difficulty falling asleep or staying asleep through the night, or they may wake up too early or sleep so restlessly that the body and mind are not refreshed. Insomnia is not defined by how long it takes to fall asleep or by how many hours a person sleeps, because these characteristics vary greatly from person to person. Babies may sleep 16 to 20 hours per day, and school-age children need between 8 and 10 hours every night. Some adults need seven to eight hours of sleep per night, whereas others function perfectly well with just three to four hours. Instead, people are diagnosed with insomnia when sleep problems begin to interfere with daily living, when they can no longer function normally during the day because they are tired or cranky, have no energy, and are unable to concentrate.

Everyone has trouble sleeping sometimes. Young people who are excited about a holiday or stressed about an exam might have trouble falling asleep. Adults who are worried about a sick relative or stressed at work might wake up in the middle of the night and not be able to fall back asleep. These are examples of transient (short-term) insomnia, which are sleep problems that last for one night or even for a few weeks and then disappear. In other cases, episodes of short-term insomnia come and go, which is called intermittent insomnia. But half of all people with insomnia have chronic* insomnia, which is a sleep problem that occurs on most nights for a month or longer.

Insomnia affects people of all ages, but it is most common in older people, especially women. When people travel, start a new job, or move to a new home or school, all of which are changes in routine, they can have trouble sleeping. Physical conditions such as pregnancy, arthritis, the need to urinate frequently, and leg cramps also seem to cause sleep problems. But the most common cause of insomnia is psychological*; anger, anxiety, depression*, and stress keep many people from sleeping well.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **neurotransmitters** (nuro-o-trans-MIH-terz) are chemical substances that transmit nerve impulses, or messages, throughout the brain and nervous system and are involved in the control of thought, movement, and other body functions.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **psychological** (SI-ko-LOJ-i-kal) refers to mental processes, including thoughts, feelings, and emotions.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **tolerance** (TALL-uh-run-see) a condition in which a person needs more of a drug to feel the original effects of the drug.

* **glaucoma** is a group of disorders that cause pressure to build in the eye, which may result in vision loss.

How Is Insomnia Treated?

If insomnia is transient, it should go away when the stress that triggered it eases, such as when that worrisome exam is over. For underlying psychological or physical issues, seeing a doctor can help improve sleep. Dealing with insomnia, however, is often a matter of lifestyle changes. Choices that may contribute to insomnia include the following:

- Reading, eating, or watching television in bed. Use a bed only for sleeping.
- Taking afternoon naps
- Smoking
- Drinking alcohol
- Drinking coffee, tea, cocoa, colas, or other drinks that contain caffeine late in the day

Choices that may contribute to a better night's sleep include the following:

- Keeping to a sleep schedule, which means going to sleep and getting up at the same time every day
- Exercising during the day (but not after dinner)
- Taking a warm bath before bedtime
- Drinking warm milk at bedtime

Over-the-Counter and Prescription Sleep Aids

Many over-the-counter (OTC) drugs are used for insomnia, most of which contain antihistamine, diphenhydramine, or doxylamine. Various problems attend using these drugs on a regular basis: drug tolerance*; dependency (meaning a person comes to rely habitually on the drug to assure sleeping well); and various side effects, such as drowsiness the next day. These drugs can also cause problems for users who have certain existing conditions, for example, allergies, asthma, emphysema, chronic bronchitis, and glaucoma*. Most of these drugs should not be used during pregnancy. In addition to OTC drugs, certain herbs are believed to assist sleep, such as valerian. While some people may have allergic responses to herbs, other side effects are not associated with them. But even with herbal remedies, use should be as needed rather than habitual.

Prescription sleep medications are highly effective in treating insomnia, but they have disadvantages, chief among which may be physical and psychological dependency. These controlled substances can be abused and if abused can be dangerous, even life-threatening. Prescription sleep medications may contain benzodiazepine (Restoril), eszopiclone (Lunesta), or zolpidem (Ambien). The second and third of these have reduced dependency risk.

For both OTC and prescription sleep aids, users should follow directions carefully, use only as needed rather than habitually, avoid alcohol consumption within several hours of taking the sleep aid, and inform any physician

caring for the user of the drug's use. Sleep aids can be effective in special situations, such as in travel across time zones and following certain medical procedures. But they must be used with caution and care and only as needed.

▶ *See also* **Anxiety and Anxiety Disorders • Depressive Disorders • Jet Lag • Sleep Apnea • Sleep Disorders**

Resources

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Organizations

American Insomnia Association. One Westbrook Corporate Center, Suite 920, Westchester, IL, 60154. Telephone: 708-492-0930. Web site: <http://www.americaninsomniaassociation.org>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: http://www.nhlbi.nih.gov/health/dci/Diseases/inso/inso_what.html.

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web site: <http://www.4woman.gov/faq/Insomnia.htm>.

Intellectual Disability

Formerly referred to as “mental retardation,” intellectual disability is a condition that may be present from birth or childhood that is marked by significantly lower intellectual functioning than the average for individuals of the same age and by delays in developing social skills, communication skills, and the ability to care for oneself and live independently. Its effects range from mild to profound.

What Is Intellectual Disability?

Intellectual disability is characterized by considerable delays in cognitive, social, practical, and abstract learning skills. People with intellectual disabilities may have problems with adaptive skills such as communication, personal care, social skills, community interaction, health and safety, leisure activities, school, and work.

Did You Know?

■ Intellectual disability is present in 1 to 3 percent of the U.S. population

■ Intellectual disability is not the same as mental illness. It is possible for people with intellectual disabilities to suffer from depression, anxiety, or other mental illnesses, just as people with average intelligence do.

■ Intellectual disability affects people from all ethnic, social, and economic backgrounds.

* **intelligence quotient test** also known as an IQ test, refers to a test designed to estimate a person's intellectual potential.

* **motor skills** are muscular movements or actions.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

Intellectual disabilities are often classified based on practical and cognitive tests, as well as intelligence quotient tests*.

Mild disability People in this category account for 75 to 90 percent of all cases of intellectual disabilities. Children may go undiagnosed until they are well into their school years. They have an IQ range of 52 to 69. They are often slower to walk, talk, and feed themselves than most other children, but they can learn practical skills, including reading and math, up to the sixth grade level. Mildly disabled adults usually build social and job skills and can live independently.

Moderate disability People in this category account for 10 to 25 percent of all cases of intellectual disabilities. Children in this group have an IQ range of 36 to 51 and show noticeable delays in developing speech and motor skills*. Although they are unlikely to acquire academic skills such as reading or math, they can learn basic communication skills, some health and safety habits, and other essential skills. As adults, they usually cannot live independently, but they can master some simple tasks and travel alone in familiar places.

Severe disability People in this category account for 10 to 25 percent of all cases of intellectual disabilities. Severely disabled children have an IQ range of 20 to 35 and are often diagnosed at birth or soon after. These children have difficulty with motor development and communication. With training, they may learn some self-help skills, such as how to feed and bathe themselves. They usually learn to walk and gain a basic understanding of speech as they age. As adults, they may be able to follow daily routines and perform simple tasks, but they need to be directed and live in a protected environment.

Profound disability People in this category account for 10 to 25 percent of all cases of intellectual disabilities. Children with profound disabilities have an IQ of less than 20 and are usually diagnosed at birth. These children often have additional medical problems and require nursing care. Children who are profoundly disabled need to be continuously supervised. They show delays in all aspects of development. With training, however, they may learn to use their legs, hands, and jaws. Adults who are profoundly disabled usually learn some speech, and they may learn to walk, but they cannot care for themselves and need complete support in daily living.

What Causes Intellectual Disability?

Intellectual disabilities sometimes have a genetic cause, resulting from one or more chromosomal abnormalities. At other times, though, intellectual disability may be the result of problems during pregnancy or childbirth that affect the development of the fetal brain and central nervous system*. Babies may be born with intellectual disabilities if their mothers do not receive proper nutrition and medical care during pregnancy, if their mothers have

INDIVIDUALS WITH DISABILITIES EDUCATION ACT (IDEA)

In 1975, the U.S. Congress passed Public Law 94-142, the Education for All Handicapped Children Act, which was renamed the Individuals with Disabilities Education Act (IDEA) in 1990.

Updated in 2004, IDEA aims to provide children with disabilities a “free appropriate public education.” It states that children with disabilities should be educated alongside their nondisabled peers to prepare them for extended education, work, and independent living. Teachers, principals, parents, civil rights advocates, and even courts of law have debated whether students with disabilities should be educated in the same classrooms as their nondisabled peers. Some argue that this practice places too great a burden on teachers.

Under IDEA, every disabled child has the right to an annual, written individualized education plan (IEP). Teachers, therapists, and parents work together to develop the best plan for educating the child, which may mean full inclusion in regular classes, partial inclusion supplemented by special education classes, or separate classes full-time.

infections during pregnancy, or if their mothers used alcohol or drugs, or were exposed to environmental toxins* during pregnancy. Many different causes of intellectual disability have been identified, but a specific cause can only be pinpointed in about 25 percent of cases.

Chromosomal abnormalities Chromosomes are threadlike structures in cells that carry genetic information. Most cells in the human body have 23 pairs of chromosomes. Chromosome pair 23 determines whether a person is female (two X chromosomes) or male (one X chromosome and one Y chromosome). Chromosomes 1 through 22 determine all of the other traits and characteristics. Intellectual disabilities may occur when a baby has an extra chromosome, an abnormal or partially missing chromosome, or a mislocated chromosome. Often, embryos that have been assigned the wrong number of chromosomes do not survive, and the pregnancy results in miscarriage*. Nearly 75 percent of early miscarriages occur due to these chromosomal abnormalities. The chromosomal abnormalities most often linked to intellectual disability are Down syndrome, Fragile X syndrome, Prader-Willi syndrome, and Williams syndrome.

DOWN SYNDROME Down syndrome results from an abnormality on chromosome 21. These abnormalities can occur in several ways:

- Trisomy 21 occurs when there are three copies of chromosome 21 throughout the body.
- Mosaic Trisomy occurs when there are three copies of chromosome 21 in some cells.

Definitions Change

As few as 100 years ago, people with intellectual disabilities were identified as “eternal children,” “mentally deficient,” “mental defectives,” “imbeciles,” and the “feeble-minded.” Even doctors used those terms, publishing medical texts with titles such as *Mental Defectives: Their History, Treatment and Training* (1904), *Mentally Deficient Children: Their Treatment and Training* (1900), and “On the Permanent Care of the Feeble Minded,” published in the *Lancet* medical journal (1903).

Fortunately, language has changed along with social attitudes toward people with intellectual disabilities. In the early 2000s it is widely understood that people with intellectual disabilities can live meaningful, fulfilling lives, in a healthy environment with the support they need.

* **toxins** are substances that cause harm to the body.

* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

* **ADHD** or Attention Deficit Hyperactivity Disorder, is a condition that makes it hard for a person to pay attention, sit still, or think before acting.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

- Translocation Trisomy 21 occurs when some of chromosome 14 is replaced by extra chromosome 21.
- Partial Trisomy occurs when genetic material only attaches to part of chromosome 21 instead of the whole chromosome.

The physical differences that may result from chromosome 21 errors include a flat facial profile, an upward slant to the eyes, a short neck, a single deep crease on the palm, hearing loss, an enlarged tongue, vision problems, thyroid disorders, and heart disease. Chromosome 21 errors have been linked to a mother's age. The incidence of Down syndrome in the children of mothers older than age 45 is 1 in 30, whereas for children of mothers younger than age 30 the incidence is less than 1 in 1,000.

FRAGILE X SYNDROME Fragile X syndrome results from an abnormality on the X chromosome. It is the most common cause of inherited intellectual disability, including autism. The symptoms of Fragile X syndrome tend to be much more severe in boys than girls. Only about one-third of girls with the syndrome have severe mental impairment. About 20 percent of boys with Fragile X are considered autistic. Fragile X can also cause a large head, protruding ears, flat feet, a prominent jaw, hyperextensible (able to extend to a greater than normal degree) joints, ADHD*, anxiety, and seizures*.

PRADER-WILLI SYNDROME Prader-Willi syndrome is caused by missing material on chromosome 15, which occurs when either the father's genetic material does not contribute a chromosome 15 or the mother's genetic material contributes an extra one. Children with this condition have short stature and eat compulsively, so they become extremely obese. As these children age, they have difficulty learning and problem-solving. They are particularly challenged by step-by-step tasks and sequential processing. Prader-Willi children have mild to moderate intellectual disabilities; however, these limitations are overshadowed by their weak social skills and their inability to adapt well to learning circumstances. Early intervention programs for Prader-Willi students were being developed and improved in the early 2000s so these children could realize their maximum potential.

WILLIAMS SYNDROME Williams syndrome is caused by a slight abnormality on chromosome 7. Children who are born with this syndrome have deep eyes and thin, high ears. As they grow older, they are vulnerable to heart problems and other health complications. Most are hypersensitive to sounds. They tend to have sociable and friendly personalities. They approach strangers without concern. However, they are fearful in certain ordinary situations. They are limited in tasks requiring visual detail or spatial judgment. Their relative strength is in language skills although most are not at age level in this area. They tend to be especially good at accurate, precise auditory perception, which makes them likely to have a particular appreciation of music. Not all children with Williams syndrome are musicians, but those who are tend to quite proficient.

Metabolic disorders Sometimes called “inborn errors of metabolism,” these conditions result from abnormalities in the genes* that govern how the body produces and handles amino acids*, proteins, enzymes, hormones, and nutrients. One metabolic disorder that can cause intellectual disability is phenylketonuria (FEN-il-KEE-toe-NOOR-ee-a) (PKU), which is linked to a lack of the enzyme needed to process the amino acid phenylalanine (FEN-ill-AL-a-noon). Another disorder that causes intellectual disability is hypothyroidism (HY-poe-THY-royd-iz-um), which is linked to an underdeveloped, underactive, or damaged thyroid gland*. The thyroid gland is needed to produce hormones essential for normal growth and brain development. Many other metabolic disorders can be detected at birth by a blood test and treated through special diets, medications, and hormone therapy.

Neurological development disorders Problems that interfere with fetal development of the brain, spinal cord, and central nervous system may result in intellectual disabilities, making proper prenatal medical care and good nutrition essential for pregnant women. Factors that are linked to brain development disorders include the mother’s intake of folic acid (a B vitamin) and her exposure to teratogens (toxins), such as environmental waste, alcohol, tobacco, street drugs, and some prescription medications. Some common brain development disorders are anencephaly*, hydrocephalus*, and spina bifida*. Spina bifida can be operated on during pregnancy or after birth, although surgery does not restore normal function to the spinal cord. When folic acid is taken regularly before conception, the incidence of spina bifida can be reduced by up to 70 percent. Many people with either spina bifida or autism have brain development disorders but are not intellectually disabled.

Fetal alcohol syndrome When a pregnant woman drinks alcohol or takes drugs (legal or illegal), these substances are transmitted directly to the fetus. Intellectual disability that is linked to a mother’s drinking is known as fetal alcohol syndrome (FAS). Children with FAS may have skeletal problems and distinctive facial characteristics, including widely spaced eyes, a shortened or flattened nose, and abnormalities in the shape and placement of the ears. In addition, children with FAS may have growth problems, central nervous system disorders, learning disabilities, vision or hearing problems, and behavioral problems.

Infections Serious infections can harm a baby’s developing brain before birth or early in life. Viral infections linked to intellectual disability include cytomegalovirus (SIE-toe-MEG-a-lo-VY-rus) and the rubella virus, which causes German measles. encephalitis* and meningitis* (MEN-in-JY-tis), two infections that result in inflammation of the brain, can also cause intellectual disability.

Other causes Other possible causes of intellectual disability include premature or difficult birth, severe head injury, malnutrition, mercury poisoning, and lead poisoning.

- * **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person’s body structure and physical characteristics. Inherited from a person’s parents, genes are contained in the chromosomes found in the body’s cells.
- * **amino acids** (a-MEE-no acids) are the chief building blocks of proteins. In humans, certain amino acids are required to sustain life.
- * **thyroid gland** (THY-roid GLAND) is located in the lower part of the front of the neck. The thyroid produces hormones that regulate the body’s metabolism (me-TAB-o-LIZ-um), the processes the body uses to produce energy, to grow, and to maintain body tissues.
- * **anencephaly** (AN-en-SEF-uh-lee) is a condition present at birth in which most of the brain is missing.
- * **hydrocephalus** (HY-droe-SEF-uh-lus) is a condition, sometimes present at birth, in which there is an abnormal buildup of fluid within the skull, leading to enlargement of the skull and pressure on the brain.
- * **spina bifida** (SPY-nuh BIF-ih-duh) is a condition present at birth in which the spinal column is imperfectly closed, leaving part of the spinal cord exposed and often leading to neurological and other problems.
- * **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.
- * **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

Diagnosing Intellectual Disability

Chromosomal abnormalities and metabolic disorders are often diagnosed by doctors during prenatal testing or at birth. In other cases, however, a parent, caregiver, or teacher may be the first to notice that a baby or young child is not demonstrating new skills at the same pace as his or her peers. For example, the child may not crawl, walk, or talk by the expected age. Because parents may not notice milder intellectual disabilities, doctors routinely give parents questionnaires to fill out during the child's check-ups. These questionnaires help the doctor to assess the child's developmental skills. If a child is not executing tasks at the same rate as his or her peers, he or she may be referred for more formal testing to determine if any disability is present.

Children who are referred for formal testing meet with a team of professionals that may include physicians, psychologists, social workers, and educators. The team conducts interviews and administers physical and psychological examinations to try to gauge the child's intellectual abilities and adaptive skills. These examinations also rule out other possible causes of the child's delays, such as hearing or vision problems, neuromuscular disorders, emotional or behavioral problems, learning or speech disorders, abuse, or a troubled home life.

Pediatricians use blood tests, brain scans, genetic testing, and other medical tests to detect underlying physical disorders. Psychologists use developmental tests to determine whether babies and children are

SPECIAL OLYMPICS AND BEST BUDDIES

The Kennedy family has been in the spotlight since John Fitzgerald Kennedy became president in 1960. To honor their sister Rosemary Kennedy, who was born in 1918 with severe disability, some members of the Kennedy family have chosen to use their name to improve the quality of life for other people with disabilities.

Eunice Kennedy Shriver founded the Special Olympics in 1968, when she organized the First International Special Olympics Games in Chicago, Illinois. After that, the Special Olympics expanded into an international program of year-round sports training and athletic competition for more than 2.5 million athletes in 180 countries. The program was designed to help participants develop physical fitness and motor skills, self-esteem, and a sense of community.

In 1989, Eunice Shriver's son Anthony started his own program to help people with intellectual disabilities. Best Buddies is a mentoring program that pairs disabled people with nondisabled individuals in the community. As of 2008, more than 1,300 campuses throughout the world had a Best Buddies program.

People can learn more about these organizations by visiting their websites at www.specialolympics.org and www.bestbuddies.org.

developing at a slower pace than their peers, and they use standardized intelligence quotient test to compare the abilities of school-aged children to those of average children in the same age group. Psychologists may also observe the child at play, in school, and interacting with family members before making a diagnosis of intellectual disability. Because developmental delays are not always linked to intellectual disability and because they may improve with physical treatment or changes in the child's environment, psychologists often schedule repeated evaluations to measure delays and assess improvements over time in intelligence and adaptive behaviors.

Can Intellectual Disability Be Prevented?

As of 2009, there was no known way of preventing an intellectual disability. A genetic counselor can help a couple calculate the risk of their having a baby with an inherited disability. Genetic counselors can provide information regarding the options available if the couple is at high risk. One option is in vitro fertilization, which is a medical procedure for conceiving outside of the uterus. In the process of in vitro fertilization, a doctor can test many fertilized eggs from the couple and only chose one that is free from genetic complications. If the woman is over 35 years of age, she may be cautioned about the maternal age-related risk of having a Down syndrome baby. Prenatal tests can detect the presence of Down syndrome and other genetic defects.

Living with Intellectual Disability

Families Parents who learn that an infant or child has an intellectual disability are often shocked, and they may be overwhelmed by such feelings as sadness, guilt, helplessness, and anger until they adjust to the news. Family counselors and support groups are resources that can help parents learn how to meet the special needs of intellectually disabled children and balance those needs with other family responsibilities, including helping siblings to adjust to the situation. To help children with intellectual disabilities, many families work with a team of specialists that includes psychologists, speech-language pathologists, physical and occupational therapists, social workers, and special educators.

Children Children with intellectual disabilities face many physical and emotional challenges. They may know that they are different from their peers in ways that they may not understand and feel frustrated, depressed, and anxious. They may develop behavioral problems to express feelings that they cannot verbalize. Children with intellectual disabilities can benefit from treatment and support in learning academic skills and adaptive behaviors needed for everyday living. They may also get a boost in self-esteem by realizing that they, like other children, are unique and valuable individuals.

Adults Adults with severe or profound intellectual disabilities requiring constant supervision often enter nursing homes or other residential

facilities that offer skilled 24-hour care. However, the majority of adults with mild to moderate intellectual disabilities can achieve varying degrees of independence. Because they may want or need some support and guidance, many continue to live with family members or in group homes or apartment clusters designed especially for people with special needs. Many are able to succeed in jobs and participate in community events. Some even participate in the Special Olympics. These activities help them develop a greater sense of self-worth. Others are able to get married and start their own families.

▶ **See also Attention Deficit Hyperactivity Disorder (ADHD) • Birth Defects and Brain Development • Disability • Down Syndrome • Fetal Alcohol Spectrum Disorders (FASD) • Genetic Diseases • Learning Disabilities • Phenylketonuria (PKU) • Testing and Evaluation**

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Organizations

American Association on Intellectual and Developmental Disabilities. 444 North Capitol Street Northwest, Suite 846, Washington, DC, 20001-1512. Toll free: 800-424-3688. Web site: <http://www.aaid.org>.

Arc of the United States. 1010 Wayne Avenue, Suite 650, Silver Spring, MD, 20910. Telephone: 301-565-3842. Web site: <http://www.thearc.org>.

Dolan DNA Learning Center. 334 Main Street, Cold Spring Harbor, NY, 11724. Web site: <http://www.ygyh.org>.

National Dissemination Center for Children with Disabilities. P.O. Box 1492, Washington, DC, 20013. Toll free: 800-695-0285. Web site: <http://www.nichcy.org>.

National Down Syndrome Society. 666 Broadway, 8th floor, New York, NY, 10012. Toll free: 800-221-4602. Web site: <http://www.ndss.org>.

National Fragile X Foundation. P.O. Box 37, 1615 Bonanza Street, Suite 202, Walnut Creek, CA, 94597. Toll free: 800-688-8765. Web site: <http://www.fragilex.org>.

Prader-Willi Syndrome Association. 8588 Potter Park Drive, Suite 500, Sarasota, FL, 34238. Toll free: 800-926-4797. Web site: <http://www.pwsausa.org>.

Williams Syndrome Association. P.O. Box 297, Clawson, MI, 48017. Toll free: 800-806-1871. Web site: <http://www.williams-syndrome.org>.

Internet Addiction Disorder

Internet addiction disorder refers to a compulsion to be online that interferes with obligations of school or work and is indulged in preference to engaging directly with friends and participating in social activities. Because no substance abuse is involved, this addiction is behavioral rather than chemical.

Bill's Story

Bill looked at his watch. He had just finished playing an online game for almost an hour and a half. He was due at his high school play practice in about 50 minutes; that meant he had about 30 minutes before he had to leave. He checked his e-mail; nothing much there. He thought he would take a quick look at his friends' Facebook pages. He was looking through one of them when one of his cyber friends sent him an instant message. "Wassup?" she asked.

"How are you?" he shot back not remembering that she thinks he is in an earlier time zone. "What are you doing online at this hour?" she asked.

He had to think of a good excuse. Why would a Hollywood talent scout be online so early in the afternoon? "I made a big score today, and I am meeting some important people for dinner so I came home early and now I am just chillin' here."

He continued this fantasy conversation until she had to leave. He then looked at his watch. He was a half hour late for practice. This was the third time this week. The director would surely drop him now.

Bill felt frustrated. He was not doing well in school because he never made time for studying. He stayed up late, writing e-mail, sending instant messages, playing online games, making Facebook entries or reading other people's Facebook pages. He did not make time for his school friends any more. His online friends seemed more important; they

- * **tolerance** (TALL-uh-runce) a condition in which a person needs more of a drug to feel the original effects of the drug.
- * **withdrawal** a group of symptoms that occurs when a drug that causes physical or psychological dependence is regularly used for a long time and then suddenly discontinued or decreased in dosage.

bolstered his self esteem. Only, most of them were people he would never meet, and most of them thought he was someone else, like a Hollywood talent scout.

Bill wondered if he had a mental problem.

Using the Internet makes up a large part of many people's lives. Some are online as part of their job; others are online because the cyber world provides escape from the real world.

What Is Internet Addiction?

Internet addiction is a compulsion to be online that controls some people's lives. Kimberly Young of the Center for Internet Addiction Recovery defined Internet addiction as a deterioration of impulse control much like pathological gambling. Adapting eight pathological gambling criteria to Internet use, Young designed a way to diagnose Internet addiction. She found that people meeting her criteria spent 10 times the amount of hours on the Internet as a comparison group did. Those with Internet addiction suffered severe degradation in their studies, relationships, finances, and careers due to the excessive time they spent online.

The concept of Internet addiction disorder was controversial in the early 2000s. Some researchers accepted and used it, whereas others thought it was misleading. In Korea and China, however, the problem of young people ignoring their social and academic responsibilities to be online was so pervasive that Internet addiction was accepted as a disorder in and of itself. The Korean and Chinese statistics, gathered in public Internet cafés, indicated patterns of excessive use, tolerance*, withdrawal*, and negative repercussions, such as poor achievement and social isolation. In the United States as of 2009, there was no nationwide effort to collect statistics regarding this behavior. Internet addiction was not included in the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (*DSM-IV*) of the American Psychiatric Association (APA). Many argued that what is called Internet addiction is a symptom of other disorders played out through Internet use. However, Jerrold J. Block, in the *American Journal of Psychiatry* (2008), recommended that the APA recognize Internet disorder even though 86 percent of the cases he saw involved some other disorder. He argued there is a good chance that two disorders interact. The American Medical Association (AMA) wrote a report recommending that the APA consider including Internet addiction as a mental disorder in *DSM-V*, expected to be published in 2012.

How Common Is Internet Addiction?

The actual number of people affected by excessive use of the Internet was not known as of 2009. However, estimates were between 5 and 10 percent of those who regularly use the Internet. If the percentage remains the same, with the increasing number of people using the Internet, the number of pathological problems was expected to rise.

What Are the Signs of Internet Addiction?

Any behavior that is considered to be an addiction should show symptoms of tolerance and withdrawal. “Tolerance” means that the user needs more of the addictive experience over time in order to experience the original thrill. “Withdrawal” means that stopping the addictive behavior brings on severe negative physical responses. Young recognized that tolerance and withdrawal need to be part of the composition of this disorder if it is an addiction. The question in her recommended survey for identifying tolerance is: “Do you feel the need to use the Internet with increasing amounts of time in order to achieve satisfaction?” The question in her recommended survey for identifying withdrawal is: “Do you feel restless, moody, depressed, or irritable when attempting to cut down or stop Internet use?” These are two out of eight symptoms identified as comprising Internet addiction, yet the recommended standard is five out of the eight. Therefore, these two essential symptoms of an addiction could be absent, according to Young, in a diagnosis of Internet addiction. The other symptoms recommended by Young in a diagnosis of Internet addiction are:

- Preoccupation with Internet activity
- Previous failed personal attempts at curtailing Internet use
- Losing track of time while on the Internet
- Putting at risk important responsibility, serious relationship, or advancement opportunity
- Lying about the time spent with Internet activity
- Using the Internet activity as a means of escaping problems or feelings of depression

The AMA report endorsing a formal diagnostic disorder for Internet/video game addiction relied on Young’s description of the condition. The AMA did not give any detailed symptoms but summarized the symptoms observed by Young.

In his article, Block presented only four symptoms for Internet addiction: “excessive use,” tolerance, withdrawal, and maladaptive behavior. According to Block, tolerance is the constant need to upgrade computer equipment. Withdrawal is the display of negative moods when the Internet is not available. Block notes the seriousness of Internet addiction in China where it has been defined as spending at least six hours per day on the Internet and having some other maladaptive symptom.

The problems noted in China and Korea were accentuated by several high profile cases. One young man died at an Internet café because he stayed at the computer for such a long time without attending to his basic needs. Another young man murdered his parents after going broke buying virtual material for his online game. These cases highlight the existence of a mental disorder associated with Internet use. The cultural similarities between Korea and China and their cultural dissimilarities with western countries may make these cases culturally specific. However,

similar situations might be happening in the United States without being noticed by the public because of the independence of American youth and because of U.S. privacy laws.

Because the term “Internet addiction” was controversial and had not as of 2009 been recognized by the APA, it might be useful to think of the condition as a disorder that is more universally accepted, such as “problematic computer use” or “pathological computer use.” These terms refer to a pattern of excessive computer use that interferes with daily life.

The term “problematic computer use” implies that there are possibly other problems leading to the excessive use of the computer or Internet. These underlying conditions could be depression or an antisocial personality. Both underlying conditions would be better helped with treatment designed to solve that specific condition. Other problems could be a lack of basic social skills. This lack could be addressed through counseling and social training.

Although he used the term “Internet addiction,” Block prefers the term “pathological computer use”, particularly because of the inappropriate implications of the term “addiction.” The main symptom of pathological computer use is the affected person’s inability to distinguish between the virtual world and reality. People affected may also not be able to function well in reality because of situations in the virtual world.

Many mental health professionals distinguish between different types of problematic activities related to Internet use: pornography, explicit sexual conversations online, online gambling, inappropriate involvement in social networking, and compulsive Internet shopping. There may be an underlying psychological issue in all of these. For example, sexual behavior online may be more symptomatic of a sexual disorder than of compulsive Internet use.

How Is Internet Addiction Diagnosed and Treated?

In any given case of problematic or pathological computer use, a qualified mental health professional needs to make an evaluation. If certified by a clinic specializing in Internet addiction, the mental health professional will most likely use checklists designed by the clinic similar to those designed by Young. These self-styled clinics should also be careful to rule out other possible conditions. Treatment would follow the standard procedures for the most clearly manifested disorder. Complications may involve the coexistence and interaction of two or more conditions.

Diagnosis Any diagnosis needs to be made by a qualified mental health professional. The professional has to rule out any recognized mental disorder before considering the possibility of Internet addiction. There are some people with a mental disorder for whom excessive Internet use is secondary to their existing disorder. These people think that acting out their disorder on the Internet is safe and more socially acceptable. For such people,

treating the mental disorder has a greater priority than treating the excessive Internet use.

The self-styled Center for Internet Addiction Recovery appeared to be in agreement with this point: “Internet addicts suffer from emotional problems such as depression and anxiety-related disorders and often use the fantasy world of the Internet to psychologically escape unpleasant feelings or stressful situations.” Thus, it seemed most Internet addicts fit other widely accepted diagnostic labels and should be treated according to these underlying conditions.

Before a professional can make a diagnosis, the reason for the excessive time on the Internet has to be determined. If the reason is not related to a recognized disorder, there are other considerations to be addressed: time management problems, limited social life, or no priorities in personal responsibility. All of these are serious concerns but may not reach the level of a mental disorder.

Treatment In China and Korea where the problem was identified, the recommended therapy is a boot camp for affected young people. The boot camp emphasizes daily responsibility, time management, and social skills development. Graduates are encouraged to pursue more productive and creative pastimes than spending time on the Internet.

Because the description of Internet addiction is modeled on other obsessive behaviors, the therapy follows the model of effective programs for obsessive behavior. A 12-step program was recommended by a number of sources. The 12-step therapeutic program is based on the model developed by the successful organization Alcoholics Anonymous. The method begins with individuals publicly admitting that they have a problem. An important component is constant interaction with a support group. Furthermore, participants have to acknowledge the pain they have caused others through the obsession and work to make amends.

The first step in treatment is to help the person develop appropriate time management skills; some techniques are designed to curb time on the Internet. While full abstinence of Internet is not practical, avoiding “trigger” applications is encouraged. Therapy, then, is focused on helping the person identify and avoid those websites or programs. Finally, group therapy is designed to provide support. Also, family therapy is encouraged for those who have hurt their families through Internet addiction.

Complications The main complication in identifying and treating Internet addiction is the appeal of the new technology and its fascination for young and old. The young always adapt to new technology faster than the older generation. This fact may explain why so many young people are “hooked.” But Young found many older women spending excessive time on the Internet. These women were old enough to remember when typing was considered a feminine skill. It seemed important to them that they were using a familiar skill in a way that gave them new power. A good typist can make more entries and replies on blogs and bulletin boards.

* **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

* **small intestine** is the part of the intestines—the system of muscular tubes that food passes through during digestion—that directly receives the food when it passes through the stomach.

* **colon** (KO-lin), also called the large intestine, is a muscular tube through which food passes as it is digested, just before it moves into the rectum and out of the body through the anus.

The Internet is an avenue to virtual worlds. There is much that can be explored in these cyber worlds, and they are ever expanding. These two features may give many “explorers,” young and old, a sense of doing something important or creative.

There is also a possible generational component to the young adults who are addicted to online games that they have played for years. These young adults observed the early versions of these games and have watched the games and their roles in playing them evolve. In short, there are individual reasons why people are hooked on Internet activity.

Can Internet Addiction Be Prevented?

Once schools and families learn about the dangers of excessive online use, education can include guidelines for productive use of the Internet for education and research. There are many online sources and commercial products to help parents control their children’s use of the Internet, in order to protect them from predators.

Resources

Books and Articles

Careaga, Andrew. *Hooked on the Net: How to Say Good Night When the Party Never Ends*. Grand Rapids, MI: Kregel, 2002.

Wright, Judith. *The Soft Addiction Solution*. New York: Jeremy Tarcher/Penguin, 2006.

Young, Kimberly S. *Caught in the Net: How to Recognize the Signs of Internet Addiction—and a Winning Strategy for Recovery*. New York: Wiley, 1998.

Intestinal Infections

Intestinal infections are caused by such pathogens (PATH-o-jens, microscopic organisms that cause disease) as bacteria, viruses, and fungi. These infections can affect various portions of the gastrointestinal tract, including the small intestine* and the colon*. Such infections, which often cause diarrhea (dye-uh-REE-uh), are frequently accompanied by gastroenteritis (gas-tro-en-ter-EYE-tis), an inflammation of the stomach and intestines.*

Microorganisms and the Digestive System: What Is Normal?

The inside of the human body is teeming with a wide variety of bacteria, fungi, and other microorganisms, which is perfectly normal, and these microorganisms do no harm in most instances. In fact, some of these

microorganisms are beneficial. The digestive system is one part of the body with an especially high number of normally occurring microorganisms. Estimates suggest that a single person's digestive system is home to some 100 trillion individual microorganisms from 300 to 500 different species. These normally occurring, and either beneficial or typically not harmful microorganisms are collectively known as intestinal microbiota, or sometimes as intestinal flora or gut flora. (The latter two terms are not technically accurate, however, because “flora,” refers to plants and other vegetative matter, and the digestive microorganisms are not plants.) Certain normally occurring, beneficial microbiota have an important part in digestion, and without them, the human body would be unable to break down some foods. Studies also suggest that some types of intestinal microbiota may help defend the body against infection or have other roles in maintaining health.

Although many microorganisms are beneficial or exist in the human body without incident, in some cases microorganisms in the digestive system cause intestinal infections, a number of which can be severe and even fatal.

How Do Intestinal Infections Occur?

Intestinal infections can be spread in many ways. Some people become infected by eating contaminated shellfish, raw or undercooked meat, or unpasteurized* dairy products, or from drinking or swimming in contaminated water. Others get sick by touching something that is contaminated with an infectious organism and then unwittingly transferring that organism to their mouths. This might happen if individuals neglect to wash their hands after touching a surface (such as a kitchen counter or a door handle) or handles anything that might be contaminated with feces (FEE-seez, or bowel movements), such as dirty laundry, or a soiled diaper. Outbreaks of intestinal infections sometimes occur when many people eat or drink the same contaminated food or water.

What Bacteria Are Involved?

One of the most common ways that people get intestinal infections is by eating food or drinking water that has been contaminated with disease-causing microorganisms. Some of the most common of these infections result from bacteria, including those known as *Campylobacter*, *Clostridium*, *Escherichia coli* (or *E. coli*), *Helicobacter pylori*, *Listeria monocytogenes*, *Salmonella*, *Shigella*, and *Staphylococcus*.

Campylobacter infection Diarrhea is usually caused by an infection with *Campylobacter* (kam-pee-lo-BAK-ter) bacteria, and typically with one particular species known as *Campylobacter jejuni* (je-JOO-nee). The Centers for Disease Control and Prevention (CDC) estimates that about 8 out of every 1,000 people in the United States experience *Campylobacter*-caused diarrhea every year. Symptoms, which begin two to five days after infection, include diarrhea that is sometimes bloody,

* **unpasteurized** (pas-CHUR-ized) refers to foods that have not undergone the process of pasteurization (pas-chu-rih-ZAY-shun), in which food is heated to a certain temperature over a period of time to kill organisms and help make the food safer to consume.

* **strains** are various subtypes of organisms, such as viruses or bacteria.

abdominal cramping and pain, and fever. Most people recover on their own within a couple of days to a week.

Campylobacter lives in animals, especially birds. Humans become infected after eating chicken or other poultry that has not been completely cooked or after eating food that has been contaminated by the blood or other juices of uncooked or undercooked poultry. This may happen, for instance, if a person slices a raw chicken on a cutting board and then, without first thoroughly washing the cutting board, uses it again to slice carrots for a raw-vegetable platter. Outbreaks of this type of diarrhea also have occurred after people have drunk contaminated water or unpasteurized milk. In developing countries where clean water is sometimes lacking, *Campylobacter* infections are particularly common, and sometimes result in death. In addition, travelers to foreign lands often unknowingly drink contaminated tap water.

***Clostridium difficile* and *Clostridium perfringens* infection**

Clostridium difficile (klos-TRIH-dee-um DIH-fih-seel) bacteria often live in the intestinal tracts of infants and young children without causing disease. In adults, however, especially the elderly, infection with *C. difficile* can produce fever, watery diarrhea, abdominal pain, and loss of appetite. Risk factors for infection include a hospital stay, gastrointestinal surgery, and having another serious illness. Healthcare workers often spread the bacteria when they touch infected feces or contaminated surfaces then touch patients or give them medicine without first washing their hands. Frequently, infection with *C. difficile* occurs in people who are taking long courses of antibiotics that fight disease-causing bacteria. These antibiotics limit the growth of the harmless, normal bacteria found in the digestive system, which presents a good environment for *C. difficile* to multiply, and when they do, to cause an infection.

The *Clostridium perfringens* bacterium causes perfringens poisoning, which is one of the most common types of food poisoning in the United States. Some *C. perfringens* bacteria may remain in food even after it has been cooked, then multiply when the food is cooled slowly and left at room temperature. People who eat contaminated food may develop intense abdominal cramps, diarrhea, and flatulence (excessive gas), usually within 8 to 22 hours. Most people recover from perfringens poisoning within a day or two, although symptoms can last longer in older people. Quickly refrigerating uneaten cooked food and reheating leftovers to a high enough temperature—at least 165 degrees—can help prevent perfringens poisoning.

***Escherichia coli* infection** *Escherichia coli* (ESH-ur-ick-ee-uh KO-lie) comes in different types, called strains*, and most of these are completely harmless. In fact, it is one of the species of bacteria that normally occurs in the large intestine of the human digestive system, and it plays a part in making vitamin K, which helps blood clot, and in fighting off various infections.

However, a few strains of *E. coli* are harmful. One of these, known as *E. coli* 0157:H7, occurs in the digestive system of numerous animals, including cattle. *E. coli* 0157:H7 produces a toxin that can cause human disease. People come into contact with the bacteria when they eat undercooked beef, such as hamburger, or when they eat other foods contaminated with the bacteria. Such contamination may occur when a farmer uses cow manure as fertilizer on fruit or vegetable crops and a consumer then fails to wash tainted produce before eating it or when a person drinks unpasteurized milk that was contaminated during the milking process. In addition, a person can become infected in other ways, such as by swimming in contaminated water or by being in close contact with an already-infected individual. Occasionally, outbreaks of *E. coli* infections occur when a food-manufacturing plant has a problem with contamination and ships its products over a wide area. Many people may become sick, and some may even die before officials can track down the source of the contamination and issue recalls for the tainted items.

E. coli infections are quite common. The CDC estimates that 73,000 cases of *E. coli* infection occur in the United States each year, and about 60 result in deaths. The symptoms of *E. coli* infection include abdominal cramps and bloody diarrhea, which last about five days. Most people do not need treatment, although those with weak immune systems (such as patients undergoing chemotherapy* or people with HIV* or AIDS*), children, and the elderly require hospitalization if they develop a serious infection.

***Helicobacter pylori* infection** *Helicobacter pylori* is a very common bacterium in the human digestive system, but it is not considered part of the “normal” intestinal microbiota, because it is harmful. Most people have this bacterium living in the stomach and the first part of the small intestine (the duodenum). There, it causes inflammation. Usually, the inflammation is mild and results in no symptoms, so affected individuals are not even aware that it is present. Nonetheless, this bacterium does present a health problem. Research has shown that people with *H. pylori* infection are more likely to have stomach cancer and ulcers, which are open sores on the inner lining of the stomach and/or duodenum. Ulcers are a widespread health condition and affect about 10 percent of the U.S. population. Of those people with ulcers, as many as 80 percent also have *H. pylori* infections.

***Listeria monocytogenes* infection** Listeriosis (lis-teer-e-O-sis) is caused by the *Listeria monocytogenes* bacterium, which is found in the soil, in stream water, in food, and in sewage. People contract listeriosis from eating vegetables grown in contaminated soil or raw or undercooked meat, from drinking contaminated water, or from consuming unpasteurized milk or milk products. Listeriosis is rare, affecting only about 20 of every million people.

Symptoms of illness include fever, headache, nausea, and diarrhea. The bacteria also can spread into the bloodstream or nervous system,

- * **chemotherapy** (KEE-mo-THER-ə-pee) is the treatment of cancer with powerful drugs that kill cancer cells.
- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

- * **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.
- * **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.
- * **stillbirth** is the birth of a dead fetus.
- * **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.
- * **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.
- * **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.
- * **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

leading to meningitis*. Pregnant women are at greater risk for the disease, and about 20 times as many pregnant women as other healthy adults develop listeriosis. The disease can cause miscarriage*, stillbirth*, or serious illness in the newborn. Infants, older people, and people with weak immune systems are also at risk.

Salmonella infection Several different strains of *Salmonella* (sal-muh-NEH-luh) bacteria can cause illness. The *Salmonella typhi* (TIE-fee) bacterium causes the most serious illness, typhoid (TIE-foyd) fever, which is frequent in developing countries. The National Center for Infectious Diseases reports an estimated 12.5 million cases of typhoid fever worldwide each year. In the United States, about 400 cases occur each year, most in people who have traveled to undeveloped countries. Typhoid fever spreads when people eat or drink food or water contaminated with the bacteria. People who are infected may have a high fever, headache, extreme tiredness or weakness, stomach pain, loss of appetite, and sometimes a flat, red rash. A vaccination* for travelers can help prevent typhoid fever, and antibiotics can help patients who become sick.

The *Salmonella* bacteria also cause salmonellosis (sal-muh-neh-LO-sis), which is more common than typhoid fever. The Centers for Disease Control and Prevention (CDC) reports 40,000 cases in the United States each year and estimates that 20 times that number may go undiagnosed. As many as 1,000 people in the United States die from the disease each year. Eating eggs or meat from contaminated animals can cause salmonellosis. Symptoms start 12 to 72 hours after infection and include nausea (NAW-zee-uh), vomiting, diarrhea, fever, and stomach cramps. The disease usually runs its course in four to seven days. Only infants, young children, the elderly, and people with weakened immune systems typically require treatment. (Antibiotic treatment can actually prolong the time that it takes for *Salmonella* bacteria to leave the body.)

Shigella Shigellosis (shih-geh-LO-sis), caused by *Shigella* (shih-GEH-luh) bacteria, inflames the lining of the small intestine. About 18,000 reported cases are documented in the United States each year, but the actual number may be 20 times higher because many people do not seek treatment. Shigellosis is transmitted through contact with feces. Toddlers who are still in potty training are especially at risk, because their hands are prone to becoming contaminated and they may forget to wash their hands or not wash them well. In this age group, the disease can produce complications, including seizures*. In addition, infections can spread through contact with contaminated water, by eating contaminated food, or through some forms of sexual activity.

Symptoms of shigellosis include diarrhea (often with blood or mucus*), fever, vomiting, nausea, and abdominal* cramping. Most people recover without treatment, usually within a week, although doctors may prescribe antibiotics to keep the disease from spreading.

Staphylococcus Toxins produced by certain strains of *Staphylococcus aureus* (staf-ih-lo-KAH-kus AR-ee-us) bacteria can cause food poisoning. When people who are infected with the bacteria handle food such as meat, poultry, egg products, or dishes containing mayonnaise or cream, they may spread the bacteria to the food. The toxins build up when the food sits for a long time at room temperature. When a person becomes infected, symptoms come on quickly, within 2 to 8 hours and last less than 12 hours. They include severe nausea and vomiting, and sometimes abdominal cramping, diarrhea, and headache.

What Viruses Can Cause Intestinal Infections?

A variety of viruses can cause intestinal infections. Some of the most common are enteroviruses, hepatitis A, noraviruses, and rotaviruses.

Enteroviruses Enteroviruses (en-tuh-ro-VY-ruh-sez) are a group of viruses that attack the intestinal tract and cause a wide range of illnesses, including intestinal infections. People who are infected may experience mild diarrhea, vomiting, fever, and abdominal pain. Most get better on their own without treatment from a doctor.

Hepatitis A The hepatitis (heh-puh-TIE-tis) A virus occurs in water contaminated by sewage, in shellfish taken from tainted water, and in fruits and vegetables grown in contaminated soil. The virus can spread when people eat or drink tainted food or water or can pass from person to person during sexual intercourse. Infected people who handle or prepare food can transmit the virus if they do not thoroughly wash their hands after going to the bathroom and then go on to prepare food for others.

Some people with hepatitis A infection show no signs of illness, but others may experience fever, extreme tiredness, loss of appetite, nausea, and vomiting. The patient's liver enlarges and the skin may appear yellowish, a condition known as jaundice*. The disease can lead to permanent liver damage, although this is rare. Symptoms appear two to four weeks after infection and may last several weeks to months. A vaccine is available to protect people at high risk of hepatitis A infection. These include people who travel to developing countries or who engage in illegal drug use or sexual relations with others who already have hepatitis A.

Noravirus infections Infections with noraviruses cause most of the non-bacterial outbreaks of gastroenteritis worldwide. The viruses spread through food or water that is contaminated with feces or through contact with an infected person. Noravirus outbreaks are particularly common on cruise ships, in nursing homes or hospitals, in boarding schools or college dormitories, in prisons, or in other places where people are in long-term and close contact with one another. Symptoms of the infection may include nausea and/or vomiting, diarrhea, abdominal pain, fever and/or headache, tiredness, weakness, and general muscle pain. Most people

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

* **protozoa** (pro-tuh-ZOH-uh) are single-celled microorganisms (tiny organisms), some of which are capable of causing disease in humans.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

recover within a few days, but infants, elderly people, and people with weakened immune systems may require hospitalization. Noravirus infections are occasionally fatal.

Rotaviruses Rotaviruses (RO-tuh-vy-ruh-sez) can infect people of all ages, but infants and young children are infected most often. Outbreaks occur most frequently from November to April in the United States, with about 1 million children affected each year. Of those, between 55,000 and 70,000 require hospitalization. Deaths from the illness are rare in the United States. Worldwide, however, more than 600,000 children die each year from rotavirus infection, according to the World Health Organization.

Rotaviruses spread when people come into contact with infected human feces. The disease is most common in daycare centers, hospital pediatric wards, and homes with young children. Symptoms appear about two days after infection. They include fever, vomiting, and abdominal pain, which last for two to three days, and diarrhea, which can linger for up to eight days. Most people do not require treatment.

Medical professionals used a rotavirus vaccine in the United States in the late 1990s, but stopped administering it after it caused bowel problems in some infants. As of 2009, research was under way to develop a replacement vaccine.

Other Causes of Intestinal Infection

Parasites cause many intestinal infections. Some common parasitic infections that lead to intestinal symptoms, such as cramping and diarrhea, include *Entamoeba histolytica* (en-tuh-ME-ba his-toh-LIH-tih-kuh), which causes amebiasis (ah-mih-BYE-uh-sis); *Giardia intestinalis* protozoa*, which causes giardiasis (jee-ar-DYE-uh-sis); and *Cyclospora cayetanensis* (sy-klo-SPORE-uh kye-uh-tuh-NIN-sis).

Certain fungi can also cause intestinal infections. One group in particular is the *Candida* fungi, which can multiply and lead to an inflammation of the esophagus, a condition called esophagitis. People who are most prone to fungal esophagitis include those who have taken antibiotics over a long time, are undergoing radiation therapy or chemotherapy, have diabetes*, have AIDS, are alcoholics, are suffering from malnutrition, or are elderly. Symptoms include nausea and/or vomiting, difficulty or an uncomfortable feeling when swallowing, mouth sores, and heartburn. Antifungal drugs usually treat the infection.

How Are Intestinal Infections and Food Poisoning Diagnosed?

Many cases of intestinal infection are so mild that they go unnoticed. Others get better without the patient ever seeing a doctor. The symptoms of gastroenteritis—nausea, vomiting, abdominal pain, diarrhea, and loss of appetite—are common to many intestinal infections and some other

diseases as well. When a patient seeks treatment, a doctor often begins with a physical exam and a series of questions about symptoms and food intake. For mild cases, the doctor may not order any laboratory tests and may be satisfied that the patient will recover even though the actual cause of the infection remains unknown. In more severe cases of illness, however, the doctor may need to know the identity of the infecting organism and will collect samples of a bowel movement to examine under the microscope and send to be cultured*, which will help pinpoint the organism involved.

How Are Intestinal Infections Treated?

Most intestinal infections do not require treatment, and patients get better on their own. People with diarrhea and other signs of intestinal infections should talk to their doctors if the symptoms do not clear up in a few days or become severe.

In most cases, patients can remain at home and maintain a relatively normal schedule. To prevent transmission of the infection between young children, parents should consider keeping an infected child at home and out of daycare until the illness resolves. All patients should drink plenty of fluids to avoid dehydration*. Doctors also advise that they avoid anti-diarrhea medicine because it may keep the infectious agent in the body longer. More severe cases of intestinal infections sometimes require hospitalization so patients can receive intravenous fluids*, antibiotics, or other treatment. In most cases, people should feel better within days to a week, although several more weeks may pass before their gastrointestinal tracts recover completely.

Can Intestinal Infections Cause Other Complications?

In otherwise healthy people, intestinal infections rarely cause complications. Mild dehydration is the most common consequence. Infants and the elderly are most at risk for severe dehydration. For people with weak immune systems, the infectious agent may spread throughout the body, causing widespread disease and even death. In infants and young children, cases of long-lasting illness occasionally lead to malnutrition or a failure to grow properly because the infections interfere with their nourishment.

More specific complications from intestinal infections vary. Several, including *Campylobacter*, *Shingella*, *E. coli*, and *Salmonella*, can cause colitis, which is an inflammation of the colon. Another form of colitis, called pseudomembranous (soo-do-mem-bran-us) colitis, can result from *Clostridium difficile*. The condition typically arises after a patient has been taking antibiotics to treat a different infection. The antibiotic may also lower the number of normal, nonharmful bacteria in the digestive system, and present an opportunity for *C. difficile* to multiply. This overgrowth presents a problem because *C. difficile* produces a toxin, which leads to the pseudomembranous colitis. Symptoms include diarrhea and often a fever.

* **cultured** (KUL-churd) means subjected to a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **intravenous fluids** (in-tra-VEE-nus) are fluids injected directly into a vein.

- * **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.
- * **arthritis** (ar-THRY-tis) refers to any of several disorders characterized by inflammation of the joints.
- * **abscesses** (AB-seh-sez) are localized or walled off accumulations of pus caused by infection that can occur anywhere within the body.
- * **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.
- * **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

Beyond colitis, *Campylobacter*, *Salmonella*, and *Shingella* infections can lead to Reiter (RYE-ter) syndrome, which is characterized by joint pain, eye inflammation, and difficulty and pain with urination. *Campylobacter* may spread into the bloodstream and trigger other problems, including a dangerous whole-body inflammation called sepsis or a condition called Guillain-Barré (GEE-yan bah-RAY) syndrome, which is a nerve inflammation that causes muscle weakness or paralysis*. *Salmonella* infection can result in arthritis*, meningitis, brain abscesses*, and bone infections. In about 3 to 5 percent of cases, *Escherichia coli* infections can lead to hemolytic uremic syndrome, a disease that can progress to kidney* failure, considerable bleeding, and severe anemia*.

Can Intestinal Infections Be Prevented?

The best way to prevent intestinal infection is to practicing good hygiene, which includes the frequent and thorough washing of the hands, especially after changing diapers, after going to the bathroom, and before handling food or eating.

Travelers who plan to visit developing countries must also make sure they have any recommended vaccinations (such as the one for typhoid fever) before they leave. Once there, travelers should drink only bottled water and avoid eating raw fruits and vegetables, food from street vendors, and unpasteurized dairy products. To be safe, travelers should only eat food that is served steaming hot, because high heat kills many disease-causing organisms.

Individuals with weakened immune systems, such as people with AIDS, must take special care to avoid infections, because their bodies are simply unable to wage a strong defense against the intruding bacterium or other pathogen. For this reason, infections can spread very rapidly and lead to serious health problems, including death. A person with a weakened immune systems should follow medical advice carefully to avoid an infection and to treat one should it occur.

▶ See also **Inflammatory Bowel Disease • Intestinal Parasites • Staphylococcal Infections • Travel-related Infections**

Resources

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/parasites/toxocara/default.htm>.

Food and Drug Administration, Center for Food Safety and Applied Nutrition. 5100 Paint Branch Parkway, College Park, MD, 20740. Toll free: 888-SAFEFOOD. Web site: <http://www.cfsan.fda.gov/~mow/intro.html>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/infections.html>.

Intestinal Obstruction

Intestinal obstruction refers to the partial or complete blockage of the intestinal portion of the gastrointestinal tract.

What Is Intestinal Obstruction?

The intestines make up part of the gastrointestinal* tract, also known as the digestive tract. The gastrointestinal tract is the path by which food travels from the mouth, through the esophagus, into the stomach, then the small and large intestines. The remaining waste is finally expelled through the anus. The gastrointestinal tract is consistently moving in a manner that propels its contents in one direction through the tract. This movement, known as peristalsis, is caused by the rhythmic contraction of sets of smooth muscle that lines the gastrointestinal tract. The rhythmic contractions happen in waves and are involuntary. Peristalsis is specifically initiated by a set of circular smooth muscle contracting behind the food material (called the bolus) to prevent it from moving back toward the mouth, followed by a contraction of longitudinally oriented smooth muscle to push the contents forward.

Intestinal obstruction refers to the partial or complete blockage of the intestinal portion of the gastrointestinal tract. Intestinal obstruction may be mechanical, meaning that there is some type of physical blockage that prevents the contents of the intestines from passing down the tract. Examples of mechanical obstructions include foreign bodies in the intestines and the intestines physically twisting upon themselves thereby causing blockage. Intestinal obstruction is not considered mechanical if it is caused by a lack of the muscular contractions of peristalsis. A condition known as ileus, nonmechanical obstruction, has the same effect of the bolus not moving through the gastrointestinal tract.

What Causes Mechanical Obstruction?

Mechanical obstruction of the intestines may be caused by tumors in the intestine or surrounding structures that have grown enough to cause obstruction of the gastrointestinal tract. Obstructions may be caused by scar tissue that formed as a result of previous abdominal surgeries. Hernias in which the intestinal tissue sticks through a defect in the abdominal wall musculature or through other tight spaces such as the diaphragmatic hiatus may also cause obstruction. Sometimes pouches

* **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

* **cystic fibrosis** (SIS-tik fy-BRO-sis) is a disease that causes the body to produce thick mucus that clogs passages in many of the body's organs, including the lungs.

of intestinal tissue called diverticula form on the intestine. If these diverticula become inflamed, they may cause intestinal obstruction. Inflamed diverticula results in a condition known as diverticulitis. For the large intestines, 60 percent of mechanical obstructions are caused by tumors, 20 percent are caused by diverticular disease, and 5 percent are caused by volvulus (a twisting of the intestine upon itself). For the small intestines, the majority of mechanical obstructions are caused by scar tissue or hernia.

Volvulus and Intussusception Volvulus is a condition that involves the intestine twisting on itself so that the movement of intestinal contents is obstructed. Volvulus is most likely to occur in infants less than one year of age, the elderly, and psychiatric patients. If the twisting cuts off the blood supply to that section of the intestines, the tissue can die and gangrene set in. In this case, it is referred to as a strangulating obstruction. Intussusception involves the intestines telescoping into itself and has the same effect as volvulus. Intussusception most often occurs in male infants of three to nine months of age or in adults with intestinal tumors.

Inflammatory bowel disease Crohn's disease is a type of inflammatory bowel disease. One aspect of Crohn's disease is that it causes narrowing of the intestine from repeated cycles of inflammation and fibrosis, the formation of scar tissue as part of the healing process after the damage done by the inflammation. Intestinal obstruction is a potential complication of Crohn's disease. Approximately 30 to 50 percent of Crohn's disease patients experience intestinal obstruction.

Causes of Nonmechanical Obstruction

Meconium ileus Meconium is material that collects in the fetal intestine. It consists primarily of cells sloughed from the intestinal lining. It makes up the bulk of the material in the first passage of feces that occurs after birth of a baby. Meconium ileus is a disorder of newborns in which they are unable to excrete feces after birth. It is often a sign that the infant may have cystic fibrosis*, but it may also occur in infants with very low birth weight.

Postoperative ileus Abdominal surgery usually is accompanied by postoperative intestinal ileus, a condition in which the intestines are temporarily unable to maintain peristalsis. While no mechanical obstruction is present, ileus has the same effect of disturbing the normal passage of intestinal contents down the gastrointestinal tract. This lack of motility (movement) results in an accumulation of gas and fluid in the intestines.

What Are the Symptoms of Intestinal Obstruction?

Mechanical Obstruction Mechanical intestinal obstruction has many associated signs and symptoms. Abdominal pain or cramps may occur in intermittent waves. Cramps are caused by the inability of the intestines to push the bolus along the tract. Nausea and vomiting are also

common. Bowel sounds that can be heard with a stethoscope, and are frequently audible without any aid, are high pitched and gurgling, later falling silent. No gas or feces are passed and the abdomen becomes distended and sore to the touch. dehydration* may be severe and cause imbalances in the electrolytes of the body that may result in kidney failure.

Nonmechanical Obstruction Nonmechanical intestinal obstruction may cause vague, mild abdominal pain and some abdominal bloating. Cramping of the abdomen is usually not a symptom. Nausea and vomiting with resulting dehydration may or may not be present. Gas and feces usually are not passable. The abdomen may be somewhat distended and tender. Unlike mechanical obstruction, in which early hyperactive bowel sounds are present, nonmechanical obstruction causes no bowel sounds early on.

How Is Intestinal Obstruction Diagnosed?

If intestinal obstruction is suspected, imaging studies are done on the abdomen to detect any mechanical obstructions that may be present. Different types of imaging tools may be used, such as abdominal x-ray, CT scans*, or ultrasound*. Depending on the suspected location of the obstruction, contrast-assisted x-ray studies of the upper or lower gastrointestinal (GI) tract may be done. In an upper GI series water-soluble contrast is swallowed and then x-rays are taken to observe the passage of the material through the upper gastrointestinal tract. A barium enema may be used, in which case a white contrast material made of barium sulfate is inserted in the rectum and passed into the colon. The contrast material shows up on film to display the shape of the intestines and any mechanical blockage. Blood work may also show an imbalance in electrolytes, ionized particles present in the body that are necessary for body function. When an obstruction is noted, it is continually watched in case a strangulated intestine occurs at or adjacent to the point of obstruction. If this complication occurs, usually abdominal pain and tenderness increase and a fever may develop along with increased white blood cell production. This developing condition calls for urgent surgical intervention. Because strangulation of the intestines can rapidly progress to death, timing of diagnosis leading to appropriate treatment is critical.

Meconium ileus is diagnosed if the newborn is not passing feces within an appropriate period after birth, and the meconium obstruction is detected by medical imaging techniques. In addition to visualizing the meconium, air-filled loops of intestines are also visible. Because postoperative gut immobility is considered a normal occurrence, obstruction due to postoperative ileus is of concern only if the ileus lasts more than three days after abdominal surgery.

How Is Intestinal Obstruction Treated?

The treatment of obstruction is determined by its cause. Patients with all types of intestinal obstruction are hospitalized, and the contents of the stomach are suctioned out through a nasogastric tube (a plastic tube

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

inserted through the nose and down the esophagus into the stomach). Air is injected down the tube and listened to with a stethoscope over the abdomen to ensure that the tube has been directly inserted into the stomach and did not enter the respiratory system instead.

After the stomach contents have been removed, a barium or air enema may be attempted to relieve mechanical obstructions such as intussusception. Surgery is often necessary to remove mechanical obstructions. If strangulation has occurred, the damaged bowel tissue is removed entirely and the remaining parts are connected together in a process known as resection. Obstructions caused by tumors or scar tissue are removed. Hernias are repaired. Approximately 300,000 intestinal obstruction repair surgeries are performed each year in the United States. After surgery, antibiotic therapy is used to prevent infection from forming at the surgical site.

For nonmechanical obstruction, surgery is not performed. Dehydration and any electrolyte abnormalities are corrected. Medications that are known to decrease the motility of the intestines such as narcotic pain killers are stopped. Other drugs used to increase intestinal motility are applied if necessary. Postoperative ileus sometimes responds to the antibiotic erythromycin, which is known to increase intestinal motility as well as function as an antibiotic. Meconium ileus also responds to medication, but the insertion of a rectal thermometer may be sufficient to stimulate peristalsis and make further treatment unnecessary.

Resources

Organization

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/000260.htm>.

Intestinal Parasites

Intestinal parasites in humans live a part of their life cycle within a person, in certain tracts and systems having to do with digestion.

What Are Intestinal Parasites?

Parasites are organisms such as worms or insects that must live on or inside another organism to survive. An animal or plant harboring a parasite is called its host. Parasites live at the expense of the host and may cause illness. Human intestinal parasites specifically live a part of their life cycle within a person, in certain tracts and systems having to do with



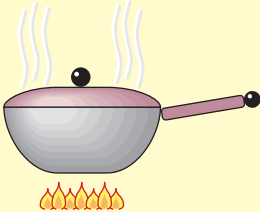

Microorganisms	Usual Sources	Preventive Measures
Bacteria		
<i>Salmonella</i> bacteria	<ul style="list-style-type: none"> • Eggs, poultry, and meat 	 <p data-bbox="1123 604 1426 716">Wash hands frequently, especially before cooking, after changing diapers, and after using the bathroom.</p>  <p data-bbox="1168 976 1375 1031">Promptly refrigerate cooked foods.</p>  <p data-bbox="1098 1283 1453 1367">Cook foods to recommended temperatures and reheat leftovers to at least 165 degrees Fahrenheit.</p>  <p data-bbox="1098 1629 1453 1818">When traveling in developing countries, drink only bottled water. Avoid eating raw fruits and vegetables, food from street vendors, and unpasteurized dairy products. Before traveling, check with a doctor about recommended vaccines.</p>
<i>Staphylococcus aureus</i> bacteria	<ul style="list-style-type: none"> • Contaminated meat, poultry, and egg products left at room temperature 	
<i>Shigella</i> bacteria	<ul style="list-style-type: none"> • Food contaminated with contaminated feces 	
<i>Campylobacter jejuni</i> bacteria	<ul style="list-style-type: none"> • Undercooked poultry, contaminated water, and unpasteurized milk 	
<i>E. coli</i> bacteria	<ul style="list-style-type: none"> • Undercooked ground beef and vegetables, contaminated water, unpasteurized dairy products, and juices 	
<i>Clostridium difficile</i> bacteria	<ul style="list-style-type: none"> • Contaminated feces and surfaces 	
<i>Listeria monocytogenes</i> bacteria	<ul style="list-style-type: none"> • Vegetables grown in contaminated soil, raw or undercooked meat, contaminated water, unpasteurized milk, and milk products 	
<i>Clostridium perfringens</i> bacteria	<ul style="list-style-type: none"> • Contaminated food stored without sufficient refrigeration 	
Viruses		
Rotavirus	<ul style="list-style-type: none"> • Contaminated feces 	
Hepatitis A virus	<ul style="list-style-type: none"> • Water contaminated by sewage, shellfish from contaminated water, and fruits and vegetables grown in contaminated soil 	
Parasites/Protozoa		
<i>Entamoeba histolytica</i> parasite	<ul style="list-style-type: none"> • Contaminated food, water, and feces 	
<i>Giardia intestinalis</i> protozoa	<ul style="list-style-type: none"> • Contaminated water and feces 	
<i>Cyclospora cayatanensis</i> parasite	<ul style="list-style-type: none"> • Foods grown in contaminated soil or water 	

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Both public water supplies and natural water sources can become contaminated with human or animal waste (mainly from dogs and beavers) harboring *Giardia lamblia* that causes giardiasis. The disease causes stomach upset and diarrhea when the parasite attaches itself to the lining of the digestive system, where it interferes with the body's ability to absorb fats and carbohydrates. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

digestion. These are: first, the gastrointestinal tract, also known as the alimentary canal, which consists of the mouth, esophagus, stomach, small intestine, colon and anus; second, the digestive system, which consists of the gastrointestinal tract and the associated, and attached, organs of digestion, including the liver and pancreas. Various intestinal parasites may infest the alimentary canal, the liver and biliary system, the pancreas, and in rare cases other organs, such as when ascarids invade the respiratory tract. Intestinal parasites may cause symptoms associated with the gastrointestinal tract such as diarrhea or states of malnutrition despite a healthy diet.

In humans, there are four major types of intestinal parasites: tapeworms (cestodes), roundworms (nematodes), flukes (trematodes), and microscopic organisms called protozoa. These parasites complete a part of their life cycle within the gastrointestinal tract, and some also travel to other parts of the body and invade other organs. While some intestinal parasites are so small they can only be seen under a microscope, others may be many feet long. There are several ways that parasites can infiltrate the human body, such as through oral ingestion or directly through the skin. A parasite life cycle involves different stages of development, such as eggs or larvae, and the adult form. Some parasites are able to enter the body through multiple routes and at multiple life cycle stages. For example, most tapeworms and roundworms lay their eggs within the human gastrointestinal tract. The eggs then pass out of the body through feces and if ingested can hatch and infest other humans with the parasite. Other parasites may enter the human body through egg and larval forms.

What Makes Intestinal Parasites a Health Issue?

Intestinal parasites are especially prevalent in the tropics. The World Health Organization (WHO) estimates that 3.5 billion people worldwide are infested with some type of intestinal parasite, and as many as 450 million of them are sick as a result. Children are most frequently infected with these parasites. Intestinal parasites spread in areas with poor sanitation and are most common in developing countries on the African, Asian, and South American continents. They are not a large problem in the United States, and Americans are most likely to get intestinal parasites when they travel abroad.

How Are Intestinal Parasites Spread?

Intestinal parasites can be acquired in many ways. Some parasites can live in the soil for extended periods. They may penetrate the body directly through the skin or if contaminated soil is ingested accidentally on food items (such as unwashed fruit or vegetables). Other parasites live in animals, such as pigs and cows. People can become infested by eating undercooked meat or drinking unpasteurized milk (milk that has not been processed with heat to kill parasites and bacteria). The eggs of some intestinal parasites pass through the human gastrointestinal tract into the feces. The parasites then spread to other people through unintentional contact with the fecal matter.

Depending on the type of parasite, a person may become infested by touching his or her mouth after contact with feces that contain the organism (such as when changing a diaper or doing laundry) or a contaminated area. Drinking water or swimming in water that has been contaminated are other common routes of infestation. These infestations often occur in outbreaks, where several people have been exposed to the same source and display symptoms at the same time, which is especially likely if many people come into contact with the same supply of contaminated food or water.

What Are Some Common Intestinal Parasites?

Tapeworms (Cestodes) Human tapeworm infestations usually are caused by eating meat or fish contaminated with worm larvae but may also be caused by ingesting soil or water contaminated with human fecal matter containing the eggs. Meat contaminated with tapeworm larvae contains the larvae in cyst form. Like other intestinal parasites, these worms frequently cause infestations in areas with poor sanitation, where livestock animals are exposed to contaminated soil or fish to contaminated water and contain the parasites within their body tissues.

There are three common species of tapeworms: *Taenia saginata* (beef tapeworm), *Taenia solium* (pork tapeworm), and *Diphyllobothrium latum* (freshwater fish tapeworm). After humans ingest contaminated tapeworm encysted meat or fish, the larvae travel to the intestines, where they latch onto the intestinal lining and gradually grow into adults. The largest tapeworms can measure more than 20 feet long in some cases. The worms shed their eggs into the feces, from which they find their way into soil and water, are ingested by animals or fish, and reenter the cycle.

Symptoms of a tapeworm infestation are often mild or nonexistent but can include abdominal pain, diarrhea, and malnutrition. The fish tapeworm is often noted for causing vitamin B12 deficiencies. The pork tapeworm is known for leaving the human gastrointestinal tract in larval form and migrating to other parts of the body to create cysts of worm larvae in human body tissues. While cysts may form in any body tissue, the most commonly affected part of the body is the central nervous system*. The condition of having a tapeworm cyst in the brain is known as neurocysticercosis and may cause seizures*, blindness, or other nervous system abnormalities. Cysts may also form in the heart, eye, or other locations. If the larvae in the cysts die, the body may calcify the region as part of the healing process. Calcified cysts may also cause health problems.

Ascariasis (Nematode) Ascariasis is caused by *Ascaris lumbricoides*, an intestinal roundworm. It is one of the most common intestinal parasites in areas with poor sanitation, affecting people in all parts of the world. In the United States, ascariasis is rare but occurs in rural parts of the Southeast. The life cycle of *Ascaris lumbricoides* begins when an adult worm lays its eggs in the intestines of an infected person. The eggs leave

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **endemic** (en-DEH-mik) describes a disease or condition that is present in a population or geographic area at all times.

the body through the feces and can live in soil for up to two years. When people eat raw food containing this contaminated soil, they may ingest the eggs, which hatch in the stomach as larvae. Part of the life cycle of the larvae is to migrate outside the gastrointestinal tract. The larvae invade the walls of the gastrointestinal tract, migrate through the blood to the lungs and then to the throat, where they are swallowed. Eventually, they pass into the intestines, where adult worms form and begin the cycle again. The adult can grow to be more than 12 inches long and can live one to two years in the small intestine of the gastrointestinal tract.

Ascariasis often causes no symptoms or mild stomach pain and bloating. If individuals are heavily infested with a greater worm load, they may experience more severe pain. Some people may also experience a cough or breathing problems when the larvae move through their lungs. People often discover they have ascariasis when a worm passes in their bowel movements, when they cough up a worm, or when a worm crawls out through the nose. This can be frightening, but the ascaris worm usually does not cause permanent damage to the body. However, because of the relatively large size of adult worms, they may partially block the gastrointestinal tract as well as the ducts leading from the biliary tract (tract that transports bile and enzymes for food digestion) and cause more serious health problems.

Strongyloidiasis/Threadworm (Nematode) Strongyloidiasis is caused by a type of roundworm commonly referred to as the threadworm, *Strongyloides stercoralis*. Although the route of infestation can be fecal-oral, it is most commonly from contact with contaminated soil where the larvae of the parasite can burrow directly through the skin. The larvae travel to the lungs, are coughed up into the mouth, swallowed, and enter the intestines. In the intestines the worm matures to adulthood and begins laying eggs. What is special about this parasite is that the eggs can hatch inside the intestines and the worm can continue to cycle through many generations without leaving the body (called the autoinfective cycle), which causes an infestation that can last for decades. In individuals with weakened immune systems*, particularly those taking drugs such as corticosteroids that depress the immune system, strongyloidiasis can become overwhelming. A great number of larvae may invade the lungs and other organs. This problem is called the hyperinfection syndrome and, although rare, can be fatal.

Strongyloidiasis is endemic* to the tropics and is especially prevalent in West Africa, the Caribbean, and Southeast Asia. Symptoms may include a rash and itch at the site of penetration, diarrhea that may be intermittent with constipation, abdominal discomfort, and vomiting. During the period that larvae are migrating through the lungs there may be cough, difficulty breathing, and low grade fever. Chronic strongyloidiasis may cause a physical sign known as larva currens (racing larva), a wavy-shaped wheal on the skin that extends from the region around the anus as far as the upper thighs and abdomen. These wheals are indicative of larvae invading the skin in the anal region.

Hookworm (Nematode) Hookworms are a type of roundworm and a common intestinal parasite. The Centers for Disease Control and Prevention estimates that one billion people worldwide have hookworm infestations, although improved sanitation reduced the number of cases in the United States. Two species can infest humans: *Ancylostoma duodenale* and *Necator americanus*. The hookworm eggs hatch into larvae in the soil. Hookworms can directly penetrate human skin. Humans may become parasitized by walking barefoot in or touching contaminated soil, as well as ingesting food with contaminated soil on it. The hookworm larvae travel to the lungs via the bloodstream. The larvae then travel to the throat and are swallowed, in a similar fashion to the ascaris worm. When they reach the small intestine, the larvae latch onto the intestinal walls and suck blood. There they mature and eventually lay eggs, which pass out of the body in the feces. Hookworms can live for one to two years in the body.

A rash or itching at the site where the larvae entered the skin may signal hookworm infestation, followed by mild cramping and diarrhea. Heavily infested people may lose their appetite, lose weight, and have abdominal pain. Hookworms may cause serious problems, including malnutrition and anemia (low red blood cell count) from intestinal bleeding. Newborns, young children, pregnant women, and malnourished individuals are most susceptible to these complications.

Dogs and cats may carry their own types of hookworm *Ancylostoma ceylanicum* and *Ancylostoma braziliense*. These hookworms occasionally pass on to humans who come in contact with soil contaminated with cat or dog feces. This type of infestation, called cutaneous* larva migrans or creeping eruption, involves the hookworm larvae burrowing into the skin

* **cutaneous** (kyoo-TAY-nee-us)
related to or affecting the skin.



◀ Two species of hookworm that can infect humans. *Ancylostoma duodenale* (left); *Necator americanus* (right). Custom Medical Stock Photo, Inc. Reproduced by permission.

and causing severe itching, but the worms do not invade any deeper into the tissues. The condition resolves without treatment after several weeks or months.

Enterobiasis/Pinworm (Nematode) Enterobiasis, also known as pinworm infestation, is caused by a staple-size worm known as *Enterobius vermicularis*. It is the most common worm infestation in the United States and is found primarily in children. Outbreaks of pinworm often occur in schools and daycare centers. From there, infested children may spread the worms to their family members.

Pinworms live in the rectum, at the end of the large intestine. They come out at night to lay eggs on the perineum, the area around the anus and genitals. The eggs can spread to sheets and clothing, where they remain with the potential for about two weeks to invade a new host. Infestation occurs when people touch a contaminated area and then their mouths. Itching of the perineum is the most common symptom of pinworm infestation, which can lead to sleeplessness and irritability. Frequently, however, infected individuals show no signs of infestation.

Trichinosis (Nematode) Trichinosis arises from several varieties of roundworms of the genus *Trichinella*. Although once very common, trichinosis was in the early 2000s relatively rare in the United States, with the CDC reporting an average of just 38 cases per year. Trichinosis is more common in developing countries. *Trichinella* larvae live encysted in the tissues of pigs and wild animals. When people eat their meat raw or undercooked, the larval cysts travel to the stomach, where acid dissolves the walls of the cysts and releases the immature, larval worms. They migrate to the small intestine, mature to adults, and lay eggs. Once the eggs hatch, the worms travel through the bloodstream to muscles, where they burrow in, forming new cysts. This ends the cycle in humans.

The first symptoms of trichinosis appear one to two days after infestation and include stomach pain, extreme tiredness, nausea, diarrhea, vomiting, and fever. Headaches, chills, swelling of the eyes, cough, muscle aches and pains, and constipation (infrequent bowel movements) may follow. People with severe infestations also may have heart problems or trouble breathing.

Giardiasis (Protozoan) Giardiasis is the most common waterborne parasitic infection in the United States. Caused by *Giardia intestinalis*, a single-cell protozoan (also known as *Giardia lamblia*), this infection can lead to diarrhea, cramping, and an upset stomach. *Giardia intestinalis* lives in humans and animals. People become infected by drinking or swimming in contaminated water or by accidental oral contact with the feces of an infected person in food or from the hands. Infested individuals may quickly spread the parasite if they do not wash their hands properly. Giardiasis occurs most frequently in settings where contaminated feces can be spread easily, such as in children or the elderly in diapers, which is

especially a problem in daycare centers and institutional settings such as nursing homes. Some people who are infected do not become sick but still can pass the infection on to others. In those who do develop symptoms, stomach pain, bloating, flatulence (gas), and watery diarrhea usually start one to two weeks after infection. About half the people who are infected also lose weight because the parasite interferes with the absorption of fat in the diet, which results in fatty, foul smelling stools. The illness often lasts two to six weeks, or longer in people who are sick with another disease. People most at risk for infection include children, travelers, homosexual men, and those with a compromised immune system. Giardiasis is diagnosed by examining a stool sample. If this method fails and giardiasis is still suspected, then tests for special enzymes in the stool are performed.

Amebiasis (Protozoan) Amebiasis is caused by a single-cell protozoan parasite called *Entamoeba histolytica* and occurs mainly in areas with poor sanitary conditions. The *Entamoeba* parasite has two life cycle forms: the motile (moving) form is responsible for the damage caused inside the gastrointestinal tract, whereas the cyst form is responsible for transmission of amebiasis. Amebiasis spreads when eggs are ingested through contaminated food or water or by touching surfaces contaminated with feces and then touching the mouth. It also can spread through certain types of sexual contact. Symptoms such as mild diarrhea and stomach pain may occur one to four weeks after an infestation, but only one in ten infested individuals develops symptoms.

Amebic dysentery, a more severe form of the illness, is caused when the parasites physically invade and damage the intestinal walls, which causes bloody diarrhea, extreme stomach pain, and fever. Rarely, the infestation spreads to other body organs, particularly the liver. In the liver, amebas may form large abscesses, areas of infection walled off from the rest of the body. Abscesses may also form in the brain. Cases in the United States usually are seen in people who have recently arrived from or traveled to remote areas.

Cryptosporidiosis (Protozoan) Cryptosporidiosis is caused by the protozoan *Cryptosporidium parvum*. Infestation usually occurs from ingestion of soil or water contaminated with fecal matter. Symptoms of cryptosporidiosis include diarrhea with frequent, watery, sometimes explosive bowel movements; loss of appetite; stomach cramps; bloating; nausea; fever; vomiting; and weight loss. The diagnosis can be made by examining a fecal sample under a microscope to view the organism. If the illness is not treated, its symptoms may return. Individuals with weak immune systems, such as those with AIDS*, have the most severe health problems from cryptosporidiosis and usually require treatment. However, the organism can infect people with normal immune systems and is one of the most common causes of protozoal diarrhea in the world. In individuals with healthy immune systems, the symptoms usually resolve on their own without treatment.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **endoscope** (EN-doh-skope) is a tool for looking inside parts of the body. It consists of a lighted tube and optical fibers and/or lenses.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

How Are Intestinal Parasites Diagnosed?

Physicians may use fecal samples, sometimes taken a day or two apart, to diagnose intestinal parasitic diseases. The feces are examined for evidence of parasites, such as eggs, larvae, or adult forms. Blood samples may also be taken to check for antibodies made by the body against specific parasites. Physicians may also use a medical instrument called an endoscope* that allows them to view the internal structures of the gastrointestinal tract and to examine the intestines for infection. To detect pinworms, physicians often request that patients take a tape test. For this test, patients briefly apply a piece of transparent tape to the skin around the anus in the early morning, the time right after the worm has laid its eggs. The tape is removed and examined at the doctor's office for any eggs that might be sticking to it.

How Are Intestinal Parasites Treated?

Some cases of intestinal parasites require little or no treatment, and the parasites eventually disappear on their own. Other cases require drug intervention with antibiotics or anthelmintics (drugs used to fight parasitic infections). Medication used to treat the illnesses varies with the type of infestation. In most cases, patients can remain at home and maintain a normal schedule. Children with infestations must stay out of daycare until they have been treated adequately and can no longer spread the parasites. Patients experiencing diarrhea are usually advised to drink plenty of fluids to avoid dehydration*. Infants and young children are particularly vulnerable to dehydration and nutrition problems when they become infested. Antidiarrheal medicine is usually not recommended because it may keep the parasites in the body longer. More severe cases of infestations may require treatment in the hospital. In individuals with weak immune systems (such as AIDS patients and people undergoing chemotherapy*), infants, and the elderly, parasitic infestations can be fatal.

How Is Intestinal Parasite Infestation Prevented?

Intestinal parasite infestation is best prevented through high standards of personal hygiene, which includes frequent and thorough hand washing, especially after changing diapers, after going to the bathroom, and before handling food. In areas known for parasites that live in the soil and burrow directly through the skin, wearing shoes may prevent parasites from entering the body. Individuals who travel to foreign countries known to have parasite problems are advised to drink and brush their teeth with bottled water and avoid eating raw fruits and vegetables, food from street vendors, and unpasteurized dairy products. In addition, cooking all food until it is steaming hot kills parasites. Avoiding swimming in bodies of fresh water such as ponds, rivers, and lakes in these areas can minimize the risk of contact with contaminated water.

▶ See also **Amebiasis** • **Ascariasis** • **Giardiasis** • **Hookworm** • **Tapeworm** • **Trichinosis**

Resources

Books and Articles

Kucik, Corry Jeb, Gary L. Martin, and Brett V. Sortor. “Common Intestinal Parasites.” *American Family Physician* 69, no. 5 (March 1, 2004): 1161–68. Also available at <http://www.aafp.org/afp/20040301/1161.html>

Organizations

Center for Food Safety and Applied Nutrition, Food and Drug Administration. 5100 Paint Branch Parkway, College Park, MD, 20740. Toll free: 888-SAFEFOOD. Web sites: <http://www.cfsan.fda.gov>; <http://www.cfsan.fda.gov/~mow/intro.html>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

Intracranial Bleeding

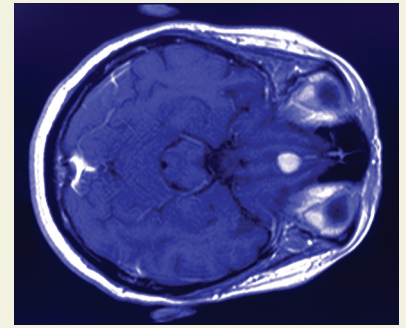
Intracranial bleeding refers to the accumulation of blood within the skull due to rupture of a blood vessel.

What Is Intracranial Bleeding?

The brain is covered by layers of membranes (meninges*), which are called (from the innermost layer) pia mater, arachnoid, and dura. In intracranial bleeding, blood can accumulate in spaces between these layers. Intracranial bleeding can be “extra-axial,” meaning the blood collects between the pia and arachnoid (subarachnoid hemorrhage); between the arachnoid and dura (subdural*); or between the dura and skull (epidural* hemorrhage). Intracranial bleeding can be “intra-axial” when blood accumulates within the brain substance (intracerebral hemorrhage or ICH) or in the spaces within the brain (ventricles) where fluid, called cerebrospinal fluid*, circulates. The bleeding of the brain’s ventricular system is called intraventricular hemorrhage. In general, intracranial bleeding refers to bleeding within the brain or the ventricles.

What Is the Source of Intracranial Bleeding?

At the base of the brain lies the Circle of Willis, a network of interconnecting arteries* that routes blood to the cerebrum, a vital part of the brain that has such jobs as directing the body’s movements; processing



▲ Cerebral magnetic resonance image (MRI) showing an intracranial bleed or stroke. *Edward Kinsman/Photo Researchers, Inc.*

- * **meninges** (meh-NIN-jeez) are the membranes that enclose and protect the brain and the spinal cord.
- * **subdural** (sub-DOO-ral) means under the dura, the covering of the brain.
- * **epidural** (ep-I-DOO-ral) means above or outside the dura, the covering of the brain.
- * **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.
- * **artery** An artery is a vessel that carries blood from the heart to tissues in the body.

- * **vein** is a vessel that carries blood to the heart. Veins have greater capacity and thinner walls than arteries and contain valves that prevent blood from flowing backward and away from the heart.
- * **hypertension** (HI-per-ten-chen) is abnormally high arterial blood pressure.
- * **trauma** refers to a wound or injury, whether psychological or physical. Psychological trauma refers to an emotional shock that leads to lasting psychological damage.
- * **cerebellum** (se-re-BEL-um) is the back portion of the brain that is responsible for muscle coordination and balance.
- * **brain stem** is the part of the brain that connects to the spinal cord. The brain stem controls the basic functions of life, such as breathing and blood pressure.

information from the eyes, ears, nose, and taste buds so that a person can see, hear, smell, and taste; allowing a person to learn and to remember; and helping a person to communicate. The Circle of Willis is formed by anterior (front), middle, and posterior (rear) cerebral arteries (one on each side of the brain), the anterior communicating artery (between the two anterior cerebral arteries), and the posterior communicating artery (between the middle and posterior cerebral artery on each side). Each of these arteries subdivides into smaller branches that penetrate the brain substance and give rise to “end arteries.” These end arteries are often the source of bleeding in intracerebral hemorrhage and subarachnoid hemorrhage. Subdural hemorrhage can occur either from a vein* or an artery, and epidural hemorrhage occurs from rupture of one of the arteries (called the middle meningeal artery) that supplies blood to the meninges.

How Common Is Intracranial Bleeding?

Each year, about 12 to 15 intracerebral hemorrhages occur per 100,000 people in the United States. Intracerebral hemorrhages account for 8 to 13 percent of all strokes. Intracerebral hemorrhage is more common in Asians, Hispanics, and African Americans.

In addition, older people are more likely to experience an intracerebral hemorrhage, and the incidence of intracerebral hemorrhage doubles with each decade above the age of 55. This is primarily because the percentage of people with hypertension* increases as the population ages, and hypertension is a risk factor for intracerebral hemorrhage.

What Causes Intracranial Bleeding?

Risk factors for intracranial bleeding include old age, hypertension, high alcohol intake, membership in high risk groups (for instance, African Americans experience intracerebral hemorrhage 1.4 times as often as Caucasians), and use of blood thinners. Trauma*, hypertension, and amyloid angiopathy (amyloid deposits formed on walls of blood vessels in central nervous system) are the most common causes.

Intracranial bleeding may result from trauma, such as penetrating injuries, including skull fractures in which the fractured bone protrudes into the brain or acceleration-deceleration injuries that result from motor vehicle accidents. Such traumatic hemorrhages can be epidural, subdural, subarachnoid, or intracerebral. Traumatic hemorrhage in children often results from so-called shaken baby syndrome, in which a parent or other stronger individual violently shakes a child, causing the thin-walled blood vessels in the head to rupture.

Many people who experience non-traumatic intracerebral hemorrhage have hypertension. Individuals with hypertension are two to six times more likely to have such a hemorrhage, because hypertension weakens the wall of the blood vessel, making it more vulnerable to spontaneous rupture. The common areas for a hypertensive hemorrhage are deeper parts of the brain, which include the basal ganglia, cerebellum*, brain stem*, and ventricles.

Intracranial bleeding can also result from a condition called cerebral amyloid angiopathy. This condition, which is a disease of older patients, causes material to build up along blood vessel walls, which leads to their rupture. These ruptures primarily occur in the parietal and occipital areas (the upper middle and the back) of the cerebral cortex* and cerebellum.

Intracranial bleeding due to malformations* of the blood vessels, especially in young patients, arise from certain bulges, called aneurysms, in blood vessel walls; from a tangle of abnormal veins (cavernous malformations), or from a tangle of abnormal arteries and veins (arteriovenous malformations). When children have intracranial bleeding that is not the result of a trauma, the culprit is often an arteriovenous malformation, which is a birth defect. Scientists are unsure exactly what causes it, but a family history of certain medical conditions may make a child more likely to experience an arteriovenous malformation. Such a malformation may occur at various locations on the body, but the most frequent location is the head. Treatment for these malformations may include a type of radiation therapy called proton-beam radiation, a non-surgical technique called embolization that injects material to block blood vessels, or the surgical removal of the problem area.

If the blood becomes excessively thin (coagulopathy) due to certain disorders such as liver failure, to the use of blood thinners (such as anticoagulants or a common stroke medication called tissue plasminogen activator, or t-PA), or to deficiency of blood-clotting elements such as platelets*, intracranial bleeding occurs. Hemorrhage can also occur in a part of the brain that is dying due to the blockage of the supplying artery (ischemic stroke). Acute rise in blood pressure due to certain drugs such as cocaine* or to strokes* can also cause intracranial bleeding. Other causes for bleeding into brain are tumors* and obstruction of the venous outflow of the brain (cerebral sinus thrombosis*). In premature births*, the lining of the ventricles is very thin and immature and can lead to intraventricular bleeding or to bleeding in an especially fragile part of a newborn's brain called the *germinal matrix*.

What Are the Symptoms and Signs of Intracranial Bleeding?

Symptoms and signs of intracranial bleeding develop over minutes to hours and become worse with time. Many patients have headaches, some of which result when blood irritates the meninges. In subarachnoid hemorrhage, the headache is sudden and intense (*thunderclap headache*). Vomiting is common, and some but not all patients may also experience nausea* before the vomiting. About 10 percent of patients have convulsions*.

Doctors may be able to pinpoint the location of the intracranial bleeding by checking the patient for certain telltale signs, including unequal pupils, limb weakness, various vision problems, and neck stiffness. Patients can be alert, in stupor* and sometimes even in a

- * **cerebral cortex** (suh-REE-brul KOR-teks) is the part of the brain that controls functions such as conscious thought, listening, and speaking.
- * **malformation** (mal-for-MAY-shun) is an abnormal formation of a body part.
- * **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.
- * **cocaine** (ko-KAYN) is a stimulant, a drug that produces a temporary feeling of alertness, energy, and euphoria.
- * **strokes** are events that occur when a blood vessel bringing oxygen and nutrients to the brain bursts or becomes clogged by a blood clot or other particle. As a result, nerve cells in the affected area of the brain cannot function properly.
- * **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.
- * **thrombosis** is the formation or development of a blood clot or thrombus.
- * **premature birth** (pre-ma-CHUR) means born too early. In humans, it means being born after a pregnancy term lasting less than 37 weeks.
- * **nausea** (NAW-zha) refers to a feeling of being sick to one's stomach or needing to vomit.
- * **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.
- * **stupor** is a state of sluggishness or impaired consciousness.

- * **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.
- * **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.
- * **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.
- * **angiogram** (AN-jee-o-gram) is a test in which x-rays are taken as dye is injected into the body, showing the flow of blood through the heart and blood vessels.
- * **catheter** (KAH-thuh-ter) is a small plastic tube placed through a body opening into an organ (such as the bladder) or through the skin directly into a blood vessel. It is used to give fluids to or drain fluids from a person.
- * **clotting** is a process in which blood changes into a jellylike mass that stops the flow of blood.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.
- * **echocardiogram** (eh-ko-KAR-dee-uh-gram) is a diagnostic test that uses sound waves to produce images of the heart's chambers and valves and blood flow through the heart.

coma*. Blood pressure becomes high, even among those patients who have not previously had a problem with hypertension. The bleeding in intracerebral hemorrhage usually continues for several hours, and the signs and symptoms of the hemorrhage may heighten. In the ensuing days, swelling of the brain occurs around the bleeding site, and water may accumulate there, too. Over time, this added pressure from the blood and water pushes on the brain, shifting it to the opposite side or downward in the skull, causing damage to other, previously normal parts of the brain that were not affected initially. This shifting is called *brain herniation* and can result in death due to damage of the vital centers in the brainstem.

How Is Intracranial Bleeding Diagnosed?

Intracranial bleeding is a medical emergency. If a person has symptoms of intracranial bleeding, someone should immediately call 911 so medical professionals can take the patient to the emergency room. There, doctors will diagnose the condition by asking either the patient or relatives (if the patient is in a coma) a series of medical questions, by conducting a detailed physical and neurological (nervous system) exam, and most importantly by examining the brain. Doctors may conduct this examination with a computerized tomography* scan, which can detect blood within the brain, the ventricles, or in the subarachnoid, subdural or epidural space, and can detect any associated fractures in case of trauma. It also helps the doctor rule out ischemic stroke, which is actually more common.

Once the patient is stabilized, the doctor may order other forms of brain imaging such as a magnetic resonance imaging* scan, CT angiogram*, or catheter* angiogram to look for the cause of bleeding. Such brains scans are especially useful for diagnosing arteriovenous malformations in children.

Laboratory tests to determine the cause of bleeding include blood counts and clotting* tests to detect coagulopathy or infections, a blood chemistry profile to detect liver* or kidney* failure, and toxicology tests to detect alcohol or drug intoxication. The doctor may also order an electrocardiogram to detect heart rhythm abnormalities and an echocardiogram* to look at the function and structure of the heart and to check for evidence of long-standing hypertension. In some instances when subarachnoid hemorrhage or brain infection is suspected, the doctor may also order a spinal tap* to look for blood or bacteria* in the cerebrospinal fluid.

How Is Intracranial Bleeding Treated?

Treatment usually begins in the emergency room and continues in the intensive care unit. The treating team usually consists of the emergency room physician, a neurologist (a nerve specialist), an intensive care specialist, and in some cases, a neurosurgeon.

Medical therapy is aimed at controlling the blood pressure, protecting the airway in comatose patients by inserting a breathing tube connected

to a ventilator*, treating convulsions, and finally, using medications to decrease brain swelling. In cases of coagulopathy, the patient typically receives vitamin K, fresh frozen plasma, clotting factors, and platelets to restore the normal clotting mechanism.

In selected cases (such as rapid deterioration due to a superficial hemorrhage in a young patient, bleeding into the cerebellum, subdural or epidural hemorrhage), a doctor may recommend surgery to remove the clot. For intraventricular hemorrhage, the patient will undergo a bedside procedure that inserts a catheter into the ventricles to drain blood and cerebrospinal fluid. In addition, medical professionals will surgically clip aneurysms or block them off with metal coils to prevent re-rupture. Both techniques are often used for aneurysms of the Circle of Willis. Patients may need a small hole in their windpipe (a tracheostomy*) to help them breathe and/or a feeding tube directly into the stomach so they can receive nutrition.

Once patients survive intracranial bleeding, they need rehabilitation. For this process, a rehabilitation expert will lead a team of physical and occupational therapists*, speech therapists, and a nutritionist. Patients may go to an inpatient rehabilitation center, a nursing home, or in some cases, to their home, depending to their level of disability and how likely they are to recover well.

What Is the Prognosis for Intracranial Bleeding?

Intracranial bleeding is a fatal disease in several instances, and patients may die even before they can get medical attention. Death usually results from brain herniation or from medical complications such as pneumonia*. In some gravely ill elderly patients, the family members may opt to withdraw life support based on the patient's previously expressed wishes of not wanting to live on life support. Overall, about 50 percent of patients die within 30 days of intracranial bleeding, and those who survive have a long road of rehabilitation ahead of them.

Can Intracranial Bleeding Be Prevented?

One of the best ways for people to prevent intracranial bleeding is to protect themselves from trauma to the head. Children should wear all recommended protective gear when playing sports, which includes wearing a helmet that fits properly and is worn correctly when they ride a bicycle. Everyone should use seat belts when riding in a vehicle.

▶ See also **Aneurysm • Hyperlipidemias • Hypertension • Stroke**

Resources

Books and Articles

Senelick, Richard C., and Karla Dougherty. *Living with Stroke: A Guide for Families*, 3rd ed. Clifton Park, NY: Delmar Cengage Learning, 2001.

* **spinal tap** also called a lumbar puncture, is a medical procedure in which a needle is used to withdraw a sample of the fluid surrounding the spinal cord and brain. The fluid is then tested, usually to detect signs of infection, such as meningitis, or other diseases.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **ventilator** (VEN-tuh-lay-ter) is a machine used to support or control a person's breathing.

* **tracheostomy** (tray-kee-AHS-tuh-me) refers to a small opening through the neck into the trachea, or windpipe, which has been made to allow air to enter the lungs more directly. The surgical procedure to create a tracheostomy is usually performed when a person's upper airway is narrowed or blocked or when there are other problems causing breathing difficulty.

* **physical and occupational therapists** are professionals who are trained to treat injured people by means of activities designed to help them recover or relearn specific functions or movements and restore their abilities to perform the tasks of daily living.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

* **colitis, ulcerative** (ko-LIE-tis, UL-sir-ah-tiv) a common form of inflammatory bowel disease that causes inflammation with sore spots or breaks in the inner lining of the large intestine (colon). Symptoms include cramping, bleeding from the rectum, and diarrhea.

Stein, Joel. *Stroke and the Family: A New Guide*. Cambridge, MA: Harvard University Press, 2004.

Organizations

American Academy of Neurology. 1080 Montreal Avenue, St. Paul, MN, 55116. Telephone: 612-695-1940. Web site: <http://aan.com>.

American Stroke Association, National Center. 7272 Greenville Avenue, Dallas, TX, 75231. Toll free: 888-478-7653. Web site: <http://strokeassociation.org>.

Irritable bowel syndrome (IBS)

Irritable bowel syndrome (IBS) is a chronic disorder that occurs when the intestines do not function correctly. A person with IBS may experience abdominal pain that often is accompanied by alternating episodes of constipation and diarrhea.*

Georgia Goes Solo

Playing the flute was Georgia's favorite activity. When she got to college, Georgia majored in music and performed regularly with the college orchestra. Until her senior year, Georgia always was healthy and able to make it to concerts, but then she began to have problems with her bowel movements. Either she was running to the bathroom constantly because she had diarrhea, or she suffered from constipation. Her symptoms began to interfere with rehearsals and concerts, so she went to the college health center. The doctor was able to rule out inflammatory bowel disease but did diagnose irritable bowel syndrome. The doctor prescribed medication for Georgia and referred her to a nutritionist and a stress-management program. By graduation, Georgia was able to play a flute solo without having to worry about rushing off to the bathroom.

What Is Irritable Bowel Syndrome?

Irritable bowel syndrome is a disorder in which the nerves that control the muscles of the intestine are unusually sensitive, causing the bowels to function improperly. The result is abdominal discomfort and an altered pattern of bowel movements (either diarrhea or constipation). About 10 to 15 percent of Americans are affected by IBS.

IBS, which is also called spastic colon or spastic bowel, is not contagious; therefore, a person cannot catch it from someone who has it. A person with IBS may experience considerable distress and discomfort from abdominal cramping, gas, constipation, and/or diarrhea, and for some people, these symptoms can seriously disrupt their daily lives. IBS does not, however, lead to other intestinal diseases such as cancer* or ulcerative colitis*.

The cause of IBS is unknown. Diet, drugs, stress, or emotional factors can trigger symptoms, and these triggers vary from person to person. The syndrome is about twice as common in women as in men and usually begins in early adulthood.

How Is IBS Diagnosed and Treated?

Diagnosis To diagnose a person as having IBS, the doctor must determine through medical history, physical examination, and diagnostic tests that the patient does not have another disease such as Crohn's disease, ulcerative colitis, or an infection that might be causing the symptoms. Typically, a person with IBS reports some or all of the following symptoms to the doctor:

- abdominal pain or cramping
- constipation*
- diarrhea* (may alternate with constipation)
- a feeling that the bowel movement is incomplete
- mucus in the stool
- bloated feeling in the abdomen
- considerable gas

Treatment While no cure is available for IBS as of 2009, various methods can be effective in controlling the symptoms. Doctors may prescribe medication to relieve diarrhea and constipation. Changes in diet help many people control their symptoms. People with IBS often benefit from practicing stress-reduction techniques, because stress can lead to symptoms in some people. Other people with IBS help manage their condition by seeking supportive psychological counseling.

▶ See also **Colitis • Constipation • Diarrhea • Gastroenteritis • Inflammatory Bowel Disease**

Resources

Books and Articles

Miskovitz, Paul, and Marian Betancourt. *The Doctor's Guide to Gastrointestinal Health: Preventing and Treating Acid Reflux, Ulcers, Irritable Bowel Syndrome, Diverticulitis, Celiac Disease, Colon Cancer, Pancreatitis, Cirrhosis, Hernias and More*. Hoboken, NJ: Wiley, 2005.

Organizations

American Gastroenterological Association. 4930 Del Ray Avenue, Bethesda, MD, 20814. Telephone: 301-654-2055. Web site: <http://www.gastro.org/wmspage.cfm?parm1=4032>.

* **constipation** is the sluggish movement of the bowels, usually resulting in infrequent, hard stools.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

International Foundation for Functional Gastrointestinal Disorders.

P.O. Box 170864, Milwaukee, WI, 53217-8076. Toll free: 888-964-2001. Web site: <http://www.iffgd.org>.

National Digestive Diseases Information Clearinghouse. 2

Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: http://digestive.niddk.nih.gov/ddiseases/pubs/ibs_ez/index.htm.

J

Jaundice

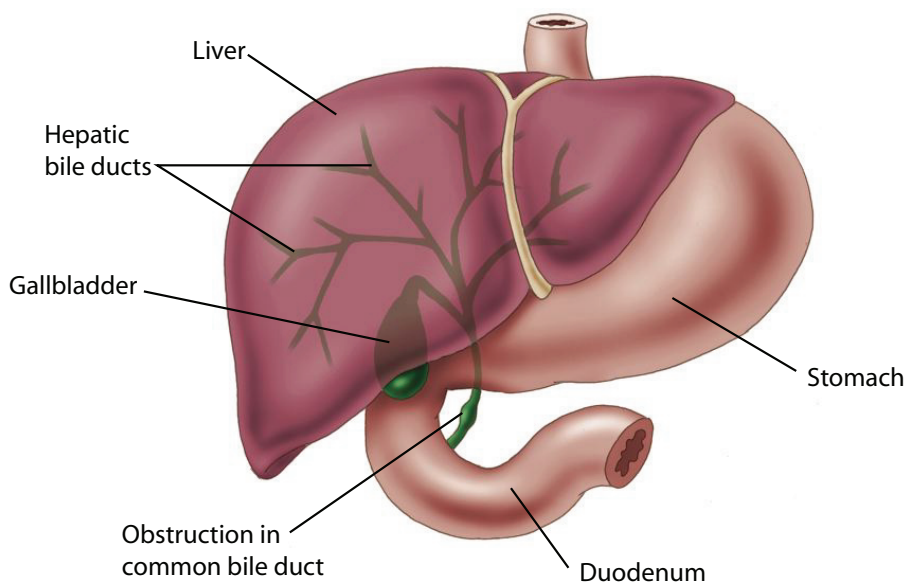
Jaundice (JAWN-dis) is a yellowish discoloration of the skin and of the whites of the eyes. It is caused by accumulation in the body of a bile pigment called bilirubin (bil-e-ROO-bin). Jaundice is not itself a disease, but it is a sign of several disorders that affect the liver, the blood, the gallbladder, or bile, which is a fluid secreted by the liver to aid in the digestion of fats. The medical term for jaundice is icterus (IK-ter-us).

What Are Bilirubin and Bile?

When a person is in good health, the bile pigment* bilirubin is formed from the normal breakdown of hemoglobin (HE-mo-glo-bin), which is the oxygen-carrying substance in red blood cells. This process occurs naturally as old red blood cells wear out and are replaced in the body. Bilirubin is then carried in the bloodstream to the liver, where it is combined with bile.

Bile, which is also called gall, gets its greenish-yellow color from bilirubin. Bile is a fluid secreted by the liver to aid in the digestion of dietary fat. Bile is stored in the gallbladder. When it is needed for digestion, the

* **pigment** (PIG-ment) is a substance that imparts color to another substance.



◀ Anatomy of the liver. An obstruction in the bile duct may lead to jaundice. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **hemolytic** (he-mo-LIT-ik) refers to destruction of red blood cells with the release of hemoglobin into the bloodstream.

* **hepatocellular** (hep-a-to-SEL-ular) refers to the cells of the liver.

* **physiologic** (fiz-ee-o-LOJ-ik) refers to an organism's healthy and normal functioning.

* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

gallbladder pushes it out into the small intestine through a tube called a bile duct. Much of the dark color of stool is the result of bile pigments.

What Causes Jaundice?

There are different kinds of jaundice, but they all occur when the process described above is disrupted and causes too much bilirubin in the blood.

Hemolytic jaundice Hemolytic* jaundice occurs when the rapid breakdown of too many red blood cells results in the overproduction of bilirubin. This may occur in such diseases as malaria, sickle-cell anemia, and septicemia (sep-ti-SEE-me-a), or blood poisoning.

Hepatocellular jaundice Hepatocellular* (liver) jaundice occurs when damage to the liver lessens its ability to remove bilirubin from the blood. Hepatocellular jaundice commonly occurs in cases of hepatitis, cirrhosis of the liver, and liver cancer. Swallowing or inhaling poisonous chemicals and advanced alcoholism can also produce jaundice from liver damage.

Obstructive jaundice Obstructive jaundice, a common form, occurs when the bile duct from the gallbladder to the small intestine narrows or becomes blocked, causing bilirubin to back up and accumulate in the blood. Obstructive jaundice may result from gallstones, injuries, tumors, or inflammation that affects the bile ducts.

Physiologic jaundice of the newborn Physiologic* jaundice sometimes occurs when newborn babies have too much bilirubin in the blood. This form of jaundice usually disappears within a few days as the infant's liver matures in its ability to handle bilirubin.

Is Jaundice a Disease?

Jaundice is not itself a disease, but it is a sign of several disorders that affect the liver, the blood, the gallbladder, or bile. Other signs and symptoms of disease may occur along with jaundice. For example, the urine* may be dark brown owing to the excretion of bilirubin or the stool may be nearly white owing to lack of bilirubin, which produces the normal brown color. Blockage of the bile ducts may also cause intense itching as bile products accumulate in the skin. In hepatitis and other liver diseases, jaundice may be only one among many signs and symptoms.

How Is Jaundice Diagnosed and Treated?

Anyone whose skin becomes abnormally yellow needs to see a doctor to find out why. Making a medical diagnosis may include special blood tests to determine whether the liver is diseased or whether too many red blood cells are being destroyed. A urine sample may be taken to test for bilirubin. A liver biopsy, in which a tiny tissue sample is removed for analysis, may be performed. Ultrasound scanning, which uses sound waves to look inside the body, may be used if the doctor is looking for gallstones

BILE, GALL, AND “THE JAUNDICED EYE”

The words “bile,” “gall,” and “jaundice” have all been associated with negative emotions: bile with anger, gall with insolence and audacity, and jaundice with distaste or hostility, as when one views someone or something with “a jaundiced eye.”

These usages all derive from an ancient concept—first applied to medicine by the Greek practitioner Hippocrates (ca. 470 B.C.E.–ca. 377 B.C.E.) who proposed that different states of the body and mind were caused by “humors,” or body fluids, one of which was black bile.

Bile is quite bitter-tasting. Thus, the term “good humored” came to mean having a pleasant disposition, while “ill humored” came to mean surly or irritable.

or other causes of obstruction. After diagnostic testing, an appropriate treatment plan is chosen according to the disorder identified as the cause of the jaundice.

▶ See also **Alcoholism • Gallstones • Hepatitis • Malaria • Pancreatitis**

Resources

Organization

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/jaundice.html>.

Jaw Grinding See *Temporomandibular Joint (TMJ) Syndrome*.

Jet Lag

Jet lag is a disruption of the body’s internal biological clock that occurs when people cross time zones.

Jet lag is a common affliction that affects airplane travelers who cross time zones. The body’s internal clock is “set” for the time zone in which a person lives. The light and dark schedule regulates many body functions, including when the body feels hungry and sleepy. In the past, when people

* **insomnia** abnormal inability to get adequate sleep.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

traveled by train, ship, horse, or wagon, long-distance trips took months, during which time their bodies continually adjusted their internal clock. With air travel, however, it is possible to cross 8 or 10 time zones in a matter of hours. Thus, the traveler's body becomes confused: a person in the new setting may want to sleep even though it is early morning or may want to start the day in the middle of the night.

A contributing factor to jet lag is the stress that air travel places on the body. Most passengers cope with cramped, uncomfortable seating. Even though the cabin is pressurized, it is still like being at 8,000 to 10,000 feet in elevation. The lower air pressure causes minor effects such as headache, body aches, and insomnia*. The air aboard airplanes is usually dry, which causes minor dehydration*. These stresses and the change in time zones result in jet lag.

Although there is no cure for jet lag, there are strategies that can help minimize it. During long flights, travelers should drink plenty of water and get up and walk around the plane occasionally. It can also help to begin to adjust eating and sleeping schedules to the hours of the destination before the trip.

▶ See also **Sleep Disorders**

Resources

Organization

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905.

Web site: <http://www.mayoclinic.com/health/jet-lag/DS01085>.

Jock Itch See *Fungal Infections; Ringworm.*

K

Kaposi's Sarcoma See *AIDS and HIV Infection*.

Kawasaki Disease

Kawasaki disease is an inflammatory illness in children that involves the body's blood vessels. The disease is characterized by high fever, swollen glands, and a rash, and it may lead to complications affecting the heart.

What Is Kawasaki Disease?

For children in the United States, Kawasaki disease is the leading cause of acquired heart disease, that is, heart disease that is not present at birth but develops later in life. In 1967 the Japanese pediatrician Tomisaku Kawasaki (b. 1925) first described the illness. He called it mucocutaneous (myoo-ko-kyoo-TAY-nee-us) lymph node syndrome, but later it became better known as Kawasaki disease. Even after many years of research, the cause of this disease as of 2009 remained unknown, but doctors suspected that an infectious microorganism* may trigger the onset of inflammation in the body. Kawasaki disease sometimes occurs in outbreaks, often in late winter or spring, and can resemble diseases such as measles or scarlet fever*, which suggests a possible link to an infectious organism.

Kawasaki disease can cause inflammation of blood vessels, mucous membranes (moist linings of the mouth, nose, eyes, and throat), lymph nodes*, and the heart. Although it eventually clears up on its own, if left untreated it can damage the blood vessels that supply the heart muscle. Kawasaki disease is associated with a one in five risk of coronary aneurysms*. This blood vessel damage can lead to a heart attack, especially in very young children.

How Common Is Kawasaki Disease?

As many as 3,500 children are hospitalized with Kawasaki disease each year in the United States. Four out of five children who get the disease are younger than five years of age, and the disease is extremely rare in children older than 15. Kawasaki disease develops in boys about twice as often as in girls. It is more common in children of Asian descent, although it occurs in all races.

* **microorganism** is a tiny organism that can be seen only by using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

* **scarlet fever** is an infection that causes a sore throat and a rash.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **coronary aneurysm** (KOR-uh-nair-e AN-yuh-rih-zum) is an abnormal stretching and weakening of a blood vessel that supplies blood to the heart. If it breaks open, it may cause serious damage to the heart, sometimes leading to death.

- * **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.
- * **echocardiogram** (eh-ko-KAR-dee-uh-gram) is a diagnostic test that uses sound waves to produce images of the heart's chambers and valves and blood flow through the heart.
- * **coronary arteries** (KOR-uh-nair-e AR-tuh-reez) are the blood vessels that directly supply blood to the heart.
- * **blood clots** are thickenings of the blood into a jelly-like substance that helps stop bleeding. Clotting of the blood within a blood vessel can lead to blockage of blood flow.
- * **gamma globulin** (GAH-muh GLAH-byoo-lin) is a type of protein in the blood that contains the antibodies produced by the cells of the body's immune system that help defend the body against infection-causing germs, such as bacteria and viruses.
- * **Reye's syndrome** (RYES SIN-drome) is a rare condition that involves inflammation of the liver and brain, and sometimes appears after illnesses such as chicken pox or influenza. It has also been associated with taking aspirin during certain viral infections.
- * **angiograms** (AN-jee-o-grams) are tests in which x-rays are taken as dye is injected into the body, showing the flow of blood through the heart and blood vessels.
- * **stress test** measures the health of a person's heart while the heart is intentionally stressed by exercise or medication.

Is Kawasaki Disease Contagious?

The disease itself has not been proved to be contagious. Doctors suspect, however, that an infectious microorganism may trigger it and that the organism might be contagious. Nonetheless, it is rare for more than one child in a family to have Kawasaki disease.

What Are the Signs and Symptoms of the Disease?

Kawasaki disease has distinctive features. A high fever, often more than 104 degrees Fahrenheit, usually appears first and lasts for at least five days. Afterward, signs of Kawasaki disease show up in stages and may include a red rash over the entire body; cracked lips; inflamed lining of the mouth; and a red, swollen tongue. Infected children may also have reddened and swollen hands, feet, fingers, and toes, with peeling skin; conjunctivitis in both eyes; sore, stiff joints; and swollen lymph nodes in the neck. Some children experience abdominal pain and diarrhea as well. The earliest phase of the disease, including fever and rash, usually lasts 10 to 14 days. The later phase, with peeling skin and slowly easing joint pain, can persist up to two months. Heart problems, if they occur, are more likely to show up during this time.

Making the Diagnosis

No single laboratory test can identify Kawasaki disease, so doctors make the diagnosis based on the child's symptoms and a physical examination: five days of high fever, accompanied by most of the associated signs mentioned above. Blood tests help support the diagnosis and include tests to determine the numbers of white blood cells (cells that respond to infection) and platelets* and tests that detect inflammation in the body. An echocardiogram* and a chest x-ray are performed to look for evidence of damage to the heart and coronary arteries*.

How Do Doctors Treat Kawasaki Disease?

Kawasaki disease is treated in the hospital. Children typically are given high doses of aspirin to decrease inflammation, prevent blood clots* in the heart's blood vessels, and lessen fever and joint pain. A one-time dose of intravenous gamma globulin* is also given to lower the risk of heart problems, particularly coronary aneurysms. (Even though aspirin is an important part of the treatment for Kawasaki disease, children normally are not given aspirin for minor fever or pain, because Reye's syndrome*, a dangerous condition, has been linked to aspirin use in children.)

Much of the treatment for Kawasaki disease focuses on keeping the patient comfortable while the illness runs its course. After the disease clears up, children still need follow-up testing to make sure it has not caused heart disease. They may have additional echocardiograms or angiograms* to examine the heart for damage and sometimes a stress test* to check the heart's function.

What Are the Possible Complications of Kawasaki Disease?

Up to 25 percent of children with untreated Kawasaki disease may experience complications that involve the heart and coronary arteries. With treatment, that risk goes down to less than 5 percent. Babies younger than one year and children older than nine years have the greatest risk of heart problems. By far the most serious complication of Kawasaki disease is coronary aneurysm. If an aneurysm clots or, more rarely, bursts in a blood vessel supplying the heart muscle, it can cause a heart attack or even death. Kawasaki disease can affect the heart in other ways as well, leading to myocarditis* or an irregular heartbeat.

Can Kawasaki Disease Be Prevented?

Because little was known about its cause as of 2009, there were no proven ways to prevent Kawasaki disease.

▶ See also **Heart Disease • Myocarditis/Pericarditis**

Resources

Organizations

American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Toll free: 888-346-3656. Web site: <http://www.nlm.nih.gov>.

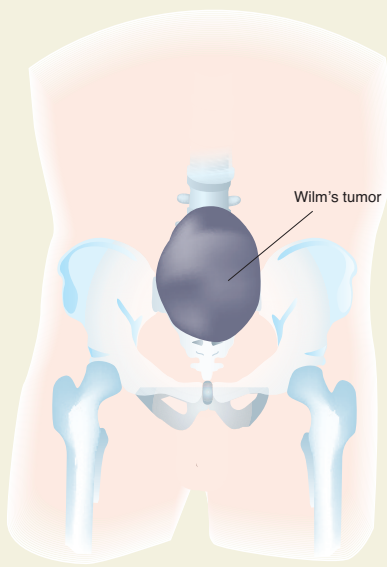
Kidney Cancer

Kidney cancer occurs when cells in the kidney divide without control or order, forming a growth called a tumor and sometimes spreading to other parts of the body.

What Are The Kidneys?

The kidneys are two bean-shaped organs located near the spine. Their main function is to filter salts, excess water, and impurities from the blood, producing the liquid waste called urine. Urine drains from the kidneys through a tube called the ureter to the bladder where it is stored until it leaves the body through another tube called the urethra. Besides the job of filtration, the kidneys also help to produce red blood cells and to maintain healthy blood pressure.

* **myocarditis** (my-oh-kar-DYE-tis) is an inflammation of the muscular walls of the heart.



▲ Wilms' tumor, a cancerous tumor of the kidney, shown in a young child. *Illustration by Argosy. Reproduced by permission of Gale, a part of Cengage Learning.*

* **chemotherapy** (KEE-mo-THER-ə-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

If cancer develops in the kidneys, it may affect not only the kidneys but nearby organs as well, including the liver, pancreas, and large intestine. In addition, kidney cancer cells may spread through the bloodstream or lymphatic system to other parts of the body. The most common form of kidney cancer in children is Wilms' tumor, and the most common form of kidney cancer in adults is renal cell cancer.

Wilms' Tumor

Wilms' tumor, the most common cause of kidney cancer in children, begins to develop even before a child is born. As the fetus grows in the womb, the kidney cells develop into netlike structures of blood vessels and tissues that are designed to filter the blood. When these cells do not mature as they should, the baby is born with some underdeveloped cells. Usually these cells mature by the time a child is three or four. Sometimes, however, they start to grow out of control, forming a jumbled mixture of small cells called a Wilms' tumor. The tumor is named after the German doctor Max Wilms (1867–1918), who first wrote about it in 1899.

Doctors find the tumor by feeling a mass while examining a baby's belly. The baby usually has few, if any, symptoms. If the tumor has not spread out of the kidney, the outlook for the child's recovery is excellent. Most children with Wilms' tumor undergo surgery or chemotherapy*. If the cancer has spread beyond the kidney, doctors may also prescribe radiation therapy, which uses focused, high-energy rays to destroy cancer cells.

Adult Kidney Cancer

Kidney cancer in adults, which is much more common than in children, occurs only rarely in people younger than 45 years of age. Overall, medical professionals diagnose more than 50,000 cases of the disease in Americans each year. In four out of five cases, the tumor forms in the tissue responsible for filtering the blood, but it also can affect the renal pelvis, the structure that collects the urine after filtration. Unlike Wilms' tumor, kidney cancer in adults often spreads to nearby organs and to other parts of the body.

Kidney cancer is more common in people who smoke cigarettes. Exposure to certain chemicals and to medications containing the pain-reliever phenacetin appears to increase risk for the disease. Heredity can play a role, too. Many cases of kidney cancer, however, develop without apparent cause. The most common early symptoms of kidney cancer include the following:

- Blood in the urine
- Pain in the lower back
- Unexplained weight loss
- Recurring fevers
- High blood pressure

How Do Doctors Diagnose and Treat Kidney Cancer?

Diagnosis Doctors start with a medical history, physical examination, and laboratory tests of blood and urine samples. Based on their findings, they may order tests that produce pictures of the kidneys and nearby organs. They may also order additional tests, including the following:

- Intravenous pyelogram (IVP) (in-tra-VEN-us PY-e-lo-gram), which is a series of x-rays of the kidneys, ureter, and bladder that are taken after dye is injected.
- Arteriogram (ar-TER-ee-o-gram), which is a similar test that creates images of the network of blood vessels in and around the kidney.
- Imaging tests, such as CT scans*, MRIs*, and ultrasound*.

If a doctor suspects kidney cancer, a surgeon will perform a biopsy by inserting a thin needle into the tumor and removing a sample of tissue to be examined under the microscope. If these cells turn out to be cancerous, doctors need to find out whether the cancer has spread beyond the kidney. Kidney cancer cells often spread through the bloodstream or the lymph nodes*, which filter the infection-fighting fluid called lymph. Doctors may order more imaging tests to examine nearby organs and to check for swollen lymph nodes in the chest and abdomen. They may also order chest x-rays and bone scans because the cancer tends to spread to the lungs or the bones.

Treatment How the disease is treated depends on whether it has spread beyond the kidney. If it has not spread elsewhere, the most common treatments are surgery and radiation therapy. Surgery involves removing part or all of the kidney, a procedure called nephrectomy (nef-REK-tom-ee). The remaining kidney generally is able to perform the work of both kidneys.

Kidney cancer that has spread to other parts of the body can be very difficult to treat. Two treatment options are biological therapy and chemotherapy. Biological therapy, also called immunotherapy, attempts to boost the body's own natural defenses against the cancer. Medical professionals prescribe immune boosters, such as Interleukin-2 and interferon. Chemotherapy delivers anti-cancer drugs into the person's bloodstream through a needle or in pill form.

These treatments have helped only a small percentage of people with advanced kidney cancer. Occasionally, however, some patients experience spontaneous remission, which means that the disease partially or completely disappears for short periods of time or permanently. Although spontaneous remission is rare among patients with kidney cancer, it is still much more common in this type of cancer than in other types of cancers. Because the body in some cases has the ability to fight off kidney cancer on its own, scientists may consider good candidates for immunotherapy. Immunotherapy encourages the body's internal defense mechanism, the immune system, in its fight against a disease. In the early 2000s researchers were conducting studies and clinical trials (research studies with volunteer

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **MRI** short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

patients) to test new treatment approaches. One of these is a vaccine made from a patient's own tumors. This vaccine stimulates the immune system to fight that patient's disease specifically.

In addition to these treatment options, people with advanced kidney cancer and their caregivers may find support groups to be a valuable resource.

▶ See also **Cancer: Overview • Hypertension • Tumor**

Resources

Books and Articles

Campbell, Steven C., et al. *100 Questions & Answers about Kidney Cancer*. Sudbury, MA: Jones and Bartlett, 2009.

Organizations

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-227-2345. Web site: http://www.cancer.org/docroot/CRI/CRI_2x.asp?sitearea=&dt=22.

Kidney Cancer Association. 1988 Momentum Place, Chicago, IL, 60689-5319. Toll free: 800-850-9132. Web site: <http://www.kidneycancer.org>.

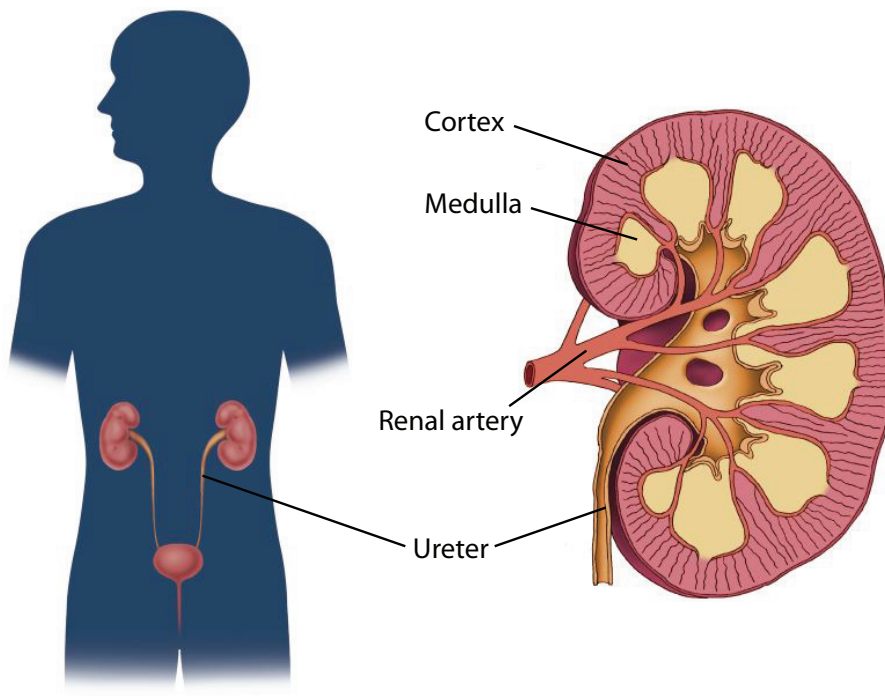
National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://cancernet.nci.nih.gov/cancertopics/types/kidney>.

Kidney Disease

Kidney disease refers to any condition affecting how well the kidneys work. Kidney diseases range from mild infections that can be treated with antibiotics to chronic (long-lasting) diseases that cause the kidneys to deteriorate and ultimately to stop working.

Structure and Function of the Kidneys

The kidneys are a pair of bean-shaped organs located in the back of the abdominal cavity right above the waist. One lies on each side of the spinal column, and each kidney holds about a million nephrons (NEF-rons). The nephrons perform one of the kidneys' primary jobs: filtering waste out of the blood. Each nephron contains a tiny blood vessel, or capillary, called a glomerulus (glom-ER-you-luss). The glomerulus sits inside a chamber that is known as Bowman's capsule, and the capsule lies within a tangle of small tubes, or tubules. Blood enters the glomerulus, and water and small molecules



The kidneys are located on both sides of the spinal column just above the waist. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

(including ions) filter out of the blood and into Bowman's capsule. From there, this fluid of water and small molecules moves into the tubule system, specifically the part known as the proximal convoluted tubule. While the fluid travels through this tubule, the blood re-absorbs, or resorbs, the nutrients and much of the water from the liquid. At this point, the liquid is known as urine. The urine then travels from the proximal tubule into the loop of Henle (HEN-lee), which is a section of tubule that has a hairpin turn. The loop of Henle removes additional water and ions from the urine, making the urine even more concentrated. From there, the urine enters the next part of the tubule system, the distal convoluted tubule. The urine eventually exits the tubule system and flows into a larger collecting tube, called the ureter (yu-REE-ter), and then on to the bladder. The bladder stores the urine until it empties out of the body when the person urinates.

In all, the kidneys perform a number of functions, chiefly filtering the blood, removing wastes to create urine, and adjusting the chemical and fluid balance in the body by controlling the concentration of urine. The kidneys also are involved in regulating the effects of vitamin D on the body and in stimulating bone marrow to create new red blood cells. In addition, the kidneys participate in the control of blood pressure through the renin-angiotensin (REN-in ann-gee-o-TEN-sin) system. The kidneys help to regulate blood pressure by secreting renin, which is an enzyme. Renin is involved in the production of angiotensin, a hormone that controls blood pressure by changing the size of certain blood vessels. When these blood vessels become smaller, blood pressure rises.

When the kidneys are damaged by disease, some or all of these functions can be impaired. If both kidneys do not function properly, a person can become very ill; when they fail to function at all, a person will die



▲
Organ for transplant. If kidney disease leads to kidney failure, a kidney transplant may be necessary. *Michelle Del Suercio/Custom Medical Stock Photo, Inc. Reproduced by permission.*

What Is Dialysis?

When the kidneys stop filtering blood properly because of injury or disease, hemodialysis (hemo means blood) is the most common treatment. A dialysis machine acts as an artificial kidney and connects to a patient via needles and tubes. Blood pumps from the person into the machine where filters do the job of the kidney and remove wastes and excess water. Once the blood has been filtered, it returns to the patient's body through a vein. Some people need dialysis temporarily while their kidneys heal, but many more depend on it permanently to stay alive. The only alternative to dialysis for these people is a kidney transplant.

without treatment. Fortunately, the human body has two kidneys, and if one is damaged or even missing, the other is capable of performing all of the functions quite well. Most people who have only one healthy kidney can live a normal life. Sometimes certain people develop slightly higher blood pressure, however; so a doctor may want to monitor them a bit more carefully than those people who have two kidneys.

Is Kidney Disease a Common Health Problem?

Kidney disease is a major health problem in the United States. According to a 2007 study by researchers at Johns Hopkins University, about 13 percent of the U.S. population has chronic kidney disease, although most remain unaware of it. This figure represents a 3 percent increase over the estimate in 1994. In 2005, more than 485,000 individuals had dialysis treatments or a kidney transplant, resulting in medical costs of approximately \$32 billion, according to the U.S. Renal Data System of the National Institutes of Health. In addition, more than 400,000 U.S. residents have end-stage renal disease (ESRD), the most severe form of kidney disease.

What Are the Different Types of Kidney Disease?

Kidney diseases are divided into three categories: congenital disorders that appear at the time of birth; chronic disorders that may develop gradually over many years; and acute disorders that occur suddenly.

Congenital Disorders Some people are born with a kidney disorder, which is called a congenital disease. They may have one kidney missing, two on one side, or two ureters (the tube that carries urine from the kidney to the bladder) for one kidney. In some cases, the two kidneys may be connected at their base to form a single horseshoe-shaped kidney. The human body usually can adjust to these abnormalities because it can function with one kidney.

Mild Conditions Can Become Serious Chronic kidney diseases are very serious conditions because they cause the kidneys to deteriorate over time. Glomerulonephritis (glom-er-u-lo-ne-FRY-tis) is a condition in which the glomeruli (glom-ER-you-li)—the plural of glomerulus—become inflamed. It often accompanies other diseases such as diabetes* and high blood pressure, or it can develop as the result of a bacterial infection or a disease that affects the immune system. The immune system makes proteins called antibodies to fight infection. In glomerulonephritis, these antibodies become trapped in the glomeruli causing them to become inflamed. Glomerulonephritis is treatable under certain circumstances, but in other cases it may progress and cause severe kidney damage.

Many people who have kidney disease develop anemia, a condition in which an individual has too few of the red blood cells that carry oxygen to cells and organs in the body. This condition occurs when the kidneys do not make enough of the hormone erythropoietin (ee-rith-ro-po-EE-tin). Erythropoietin stimulates the bone marrow to produce the right amount

of red blood cells. Anemia can also result when a patient loses blood from hemodialysis.

In addition, cancer or tumors in the kidneys or a condition called polycystic kidney disease (PKD) can stop the kidneys from functioning properly over time. PKD is a genetic disorder that results in the growth of numerous liquid-filled sacs, called cysts, in the kidneys. These cysts can take the place of functioning kidney tissue and prevent the kidneys from doing their job. Eventually, many of these diseases lead to end-stage renal disease (ESRD), a condition in which the kidneys shut down.

Acute Kidney Failure Acute, or sudden, kidney failure can result from many factors, including injury that greatly reduces blood flow, severe dehydration, exposure to chemicals and drugs that are poisonous to the kidneys, infections, tumors, and kidney stones.

Pyelonephritis (PY-el-o-ne-FRY-tis), or infection of the kidney, is a common type of acute kidney disease. Its symptoms can include pain in the back or abdomen, fever, and frequent or painful urination. Medical professionals can treat it effectively with antibiotics. Another well-known condition is kidney stones, which are hard crystals made of chemicals that separate from the urine and build up in the kidney. Small kidney stones can pass out of the body without medical assistance, but larger stones require a procedure that breaks them into smaller pieces so that they can leave the body in the urine. People may recover from these kidney diseases without permanent damage to the kidneys. If left untreated, however, these diseases can cause permanent damage and kidney failure.

How Is Kidney Disease Diagnosed and Treated?

Medical professionals determine the type and extent of kidney disease through a number of methods: blood tests, urinalysis, kidney imaging (such as x-rays and MRIs*), and renal (kidney) biopsy, which involves taking a sample of tissues to examine under a microscope.

The treatment for kidney disease varies based on the underlying cause. For example, an infection might require antibiotics, whereas a tumor would demand surgical removal. Medical professionals can treat chronic conditions with drugs to reduce symptoms in cases in which the disease cannot be cured. A restricted diet also may help alleviate symptoms. Complete kidney failure requires dialysis two or three times per week or a kidney transplant.

▶ See also **Glomerulonephritis • Kidney Stones • Nephrotic Syndrome**

Resources

Books and Articles

Cleveland Clinic Foundation. *The Cleveland Clinic Foundation Creative Cooking for Renal Diet*. Willoughby, OH: Senay, 2006.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **MRI** short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

Organizations

National Kidney Disease Education Program. 3 Kidney Information Way, Bethesda, MD, 20892. Toll free: 866-454-3639. Web site: <http://nkdep.nih.gov>.

National Kidney Foundation. 30 East Thirty-Third Street, New York, NY, 10016. Toll free: 800-622-9010. Web site: <http://www.kidney.org>.

Kidney Infection See *Urinary Tract Infections*.

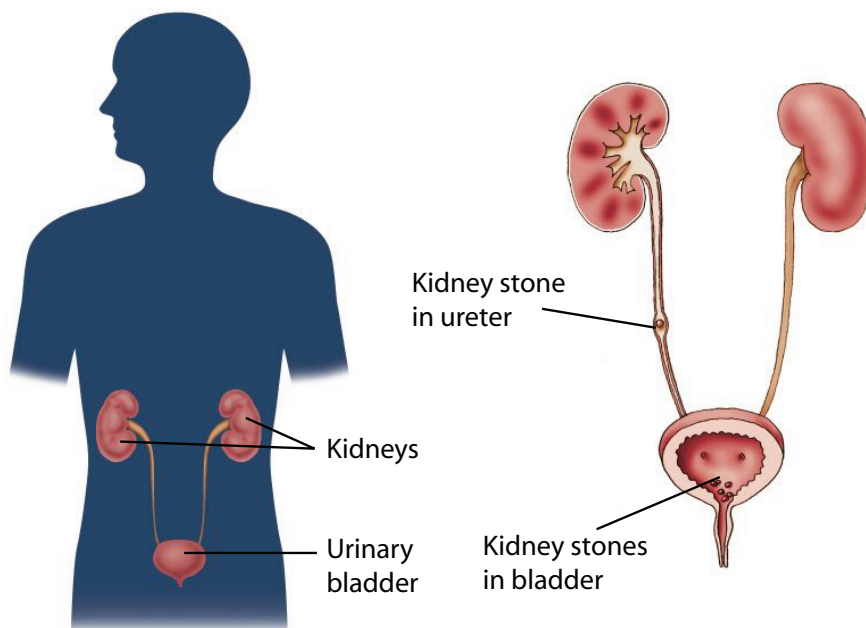
Kidney Stones

Kidney stones are composed of crystals formed by chemicals that separate out of the urine, harden, and build up in the kidney. Most people pass kidney stones out of the body without requiring medical treatment, but in severe cases, they might need surgery.

What Is a Kidney Stone?

The kidneys are bean-shaped organs about the size of a juice-box that are located on either side of the spine toward the back of the abdomen above the waist. They filter water, salts, and waste products out of the blood to make

Kidney stones may develop in the kidneys or in the urinary tract if crystals of calcium phosphate or calcium oxalate that have separated out from urine grow too large to pass out of the body. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



urine, and they maintain the body's water and ion* levels. When the ratio of water and ions in the urine is out of balance, kidney stones can form.

Kidney stones can be as small as a grain of sand or as big as a golf ball. There are four kinds of kidney stones:

- Stones may be made from calcium. Calcium is an important part of a good diet and promotes healthy bones and muscles. If a person's body does not flush out extra calcium, as it should, the calcium can combine with other chemicals in the urine (a common chemical is the mineral oxalate) and then crystallize and adhere to the lining of the kidney. The crystals can also stick to one another and form hard masses, or stones, of various sizes.
- Struvite stones are made from a combination of ammonia, which is a waste product in the urine, and the mineral magnesium. A common cause for these stones is an infection in the urinary system.
- Uric-acid stones form when the urine is too acidic. A common cause for these stones is a diet that contains too much meat.
- Although rare, stones can also be made of cystine, an amino acid which is a building block of protein. Usually, people who have cystine stones also have a family history of them.

The causes of kidney stones often are unknown. However, urinary tract infections, several metabolic disorders, and a family history of kidney stones may make a person more likely to develop them. People who have certain other conditions or genetic disorders may also develop kidney stones. These problems include the following:

- Hyperparathyroidism is a condition caused by overactive parathyroid glands. Located in the neck, these four tiny glands normally regulate calcium levels. When they are overactive, calcium imbalances can occur and this condition can lead to the formation of kidney stones.
- Gout causes an increase in the amount of a certain acid (uric acid) in the urine. This condition can result in the development of kidney stones.
- Cystinuria, a genetic disorder, causes an excess of cystine in the urine, a disease that can trigger stone formation.
- Renal tubular acidosis is a condition in which the kidneys fail to transfer enough acid from the blood to the urine. The blood remains too acidic, and over time, this problem can lead to kidney stones.

What Happens When People Have Kidney Stones?

Symptoms The smallest kidney stones can pass out of the body in the urine without the person even knowing it. The passing of larger stones can cause severe pain, and people have described it as the worst pain they have ever experienced. The pain occurs when the stone moves from the kidney through the ureter*(yu-REE-ter), a tiny tube that conveys urine from the

* **ions** are positively or negatively charged elements or compounds, like hydrogen, sodium, potassium, and phosphate, which are necessary for cellular metabolism.

* **ureters** (YOOR-eh-ters) are tube-like structures that carry urine from the kidneys to the bladder.

Did You Know?

- Kidney stones are mentioned in the Hippocratic (hip-o-KRAT-ik) oath taken by doctors when they begin their medical careers.
- Scientists have found what they think is a kidney stone in a 7,000-year-old Egyptian mummy.
- Approximately 10 percent of all people are likely to have a kidney stone at some time.
- Kidney stones occur in men more often than in women.
- Kidney stones usually affect people who are between 20 and 40 years of age.
- Doctors sometimes ask people with kidney stones to cut back on foods and drinks that contain calcium and oxalate. These may include some fruits and vegetables, some dairy products, coffee, chocolate, tea, and cola drinks.

* **sonograms** (SON-o-gramz) are images or records made on a computer using sound waves passing through the body.

kidney to the bladder. In addition to sharp pain in the back and side, other symptoms may include nausea, vomiting, fever, chills, and blood in the urine. Large kidney stones can be life-threatening if they block the urinary tract and obstruct the flow of urine from the body. The blockage can cause urine to back up into the kidney and cause it to swell in a condition known as hydronephrosis (HY-dro-na-FRO-sis). This problem must be corrected, or it can result in infection, as well as serious kidney damage.

Diagnosis Doctors can typically diagnose kidney stones based on the patient's medical and family history and a physical examination. In some cases, a doctor may also use x-rays and sonograms*, along with analyses of blood and urine to make the diagnosis.

Treatment Most kidney stones pass through the urinary tract on their own, and individuals typically help the process by drinking lots of water and taking pain medication. If the stones are very large (more than 0.5 inches in diameter), doctors can use various techniques to break up the stones while they are inside the kidney or ureter so that the smaller pieces can pass out without further medical intervention. One technique is extracorporeal shockwave lithotripsy (LITH-o-TRIP-see), which uses high-energy sound waves. These shock waves pass harmlessly through the body and break the stone into tiny particles, which the patient can then eliminate in the urine without pain. Surgery (nephrolithotomy) is rarely necessary.

How Are Kidney Stones Prevented?

Kidney stones usually affect people between the ages of 20 and 40. Approximately 10 percent of people experience kidney stones, and once a person has had one kidney stone, he or she has about a 70 to 80 percent chance of developing another. Once a person has passed a stone, a doctor tries to find out what kind it is, often by asking patient who has passed a stone at home to bring it in for laboratory analysis. This information may help the doctor determine why the person is developing the stones. In many cases, individuals can reduce their chances of developing more stones by changing their diet, drinking more water, and/or taking certain kinds of medication. Scientists have explored how certain urinary proteins are involved in stone formation. Their research as of 2009 showed that some proteins can keep the stone-associated chemicals from crystallizing out of urine and, therefore, prevent stone formation.

▶ See also **Gout • Kidney Disease • Metabolic Disease**

Resources

Books and Articles

Rodman, John S., et al. *No More Kidney Stones: The Experts Tell You All You Need to Know about Prevention and Treatment*, rev. ed. Hoboken, NJ: Wiley, 2007.

Organizations

National Kidney and Urologic Diseases Information Clearinghouse.

3 Information Way, Bethesda, MD, 20892-3580. Toll free: 800-891-5390. Web site: http://kidney.niddk.nih.gov/kudiseases/pubs/stones_ez.

National Kidney Foundation. 30 East Thirty-third Street, New York, NY, 10016. Toll free: 800-622-9010. Web site: <http://www.kidney.org>.

* **nervous system** is a network of specialized tissue made of nerve cells, or neurons, that processes messages to and from different parts of the human body.

Kuru

Kuru is a disease of the nervous system that is extremely rare in the 21st century but that once was common among people in certain tribes in Papua, New Guinea, who practiced cannibalism.

Mystery in New Guinea

In the 1950s, a strange disease of the nervous system* was killing people in certain tribes in the highlands of New Guinea, an island north of Australia in the Pacific Ocean. The American scientist Daniel Carleton Gajdusek (b. 1923) traveled to New Guinea to study the disease, which the people there called kuru. Eventually, he traced the problem to cannibalism, the eating of human flesh by another human. In this case, cannibalism took the form of a ritual in which people ate the uncooked brains of relatives who had died. Today, those New Guinea tribes no longer practice this ritual, and kuru has practically disappeared.

Gajdusek thought that kuru was passed from a dead person's brain to a living person by a slow virus that takes years to cause symptoms. Many scientists later dismissed this theory. Instead, they speculated that kuru is caused by a prion, a type of protein that can cause infection. Kuru belongs to a group of human and animal diseases of the brain, known as transmissible spongiform (SPUN-ji-form) encephalopathies (en-sef-a-LOP-a-theez), that may be caused by prions. The word "spongiform" refers to the way infected brains develop holes until they look like sponges under a microscope. The most common such disease in humans is Creutzfeldt-Jakob disease.

What Are the Symptoms?

People with kuru have trouble controlling their movements, and this problem gets worse over time. Their arms and legs may appear stiff, or they may have rapid muscle spasms. Occasionally, their muscles may twitch or jerk uncontrollably, or their fingers, hands, toes, and feet may move in a slow, writhing motion. As the disease gets worse, people with kuru may start to lose their mental abilities, such as thought, memory, and concentration. Death usually occurs within 3 to 12 months. Kuru is



▲ Aminou, a four-year-old boy suffering from Kwashiorkor, July 31, 2005, at the Médecins Sans Frontières (Doctors without Borders) therapeutic feeding center in Maradi, Niger. Aminou died three days later. *Francis Temman/AFP/Getty Images.*

extremely rare, but in the early 2000s it continued to fascinate scientists who study related diseases.

▶ See also **Prion Diseases**

Resources

Books and Articles

Klitzman, Robert. *The Trembling Mountain: A Personal Account of Kuru, Cannibals, and Mad Cow Disease*. New York: Plenum Trade, 1998.

Organization

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824.. Web site: <http://www.ninds.nih.gov/disorders/kuru/kuru.htm>.

Kwashiorkor

Kwashiorkor (kwash-ee-OR-kor) is a type of severe malnutrition that affects young children aged one to four years but which is also found in older children and adults, living in extreme poverty in tropical and subtropical parts of the world. The condition develops among people who have high starch diets without sufficient protein, especially among individuals who are suffering from famine. A nursing baby gets protein in the mother's milk; however, in such dire conditions if the mother stops nursing one child upon the birth of another, the older of the two may develop this protein deficiency. The name of this condition translates as "rejected one," meaning that the older child is replaced at the breast by the newborn. Kwashiorkor produces such physical characteristics as small stature, weight loss, discolored and puffy skin on arms and legs and sometimes on the face, thin and reddish-blond-discolored hair, large and swollen abdomen (commonly called bloated belly), thin arms and legs, and pigment loss.

Tanya's Story

Tanya lived outside Tubmanburg in Liberia with her parents and four older brothers and sisters. Her family was poor, and her parents had a hard time feeding all of the children. Nevertheless, Tanya was a healthy infant because she was breastfed; breast milk contains all of the protein and other nutrients a baby needs. But when Tanya was just over a year old, her mother had another baby and Tanya could no longer breastfeed. Instead, she had to eat the only food available: white rice, cassava, and yams. These foods contain mostly carbohydrates and have almost no protein. Because

of the lack of protein in Tanya's diet, she developed kwashiorkor: Her stomach was bloated, her arms and legs got thin, her skin flaked, and she was very weak. Tanya is typical of many children whose families are too poor to feed their children a complete diet. Overcrowded, unhygienic, and poverty-stricken conditions directly contribute to children being at risk of developing kwashiorkor.

In the 1980s and 1990s, civil wars in Liberia dislocated hundreds of thousands of people and devastated the country's economy. Without labor laws to protect them, children work long hours to help their families. Some companies in Liberia have been accused of ruining the environment in order to increase their profits, activity that further hurts the poorest residents in the area. These larger factors in her society affect Tanya's health, too.

What Is Kwashiorkor?

Kwashiorkor is a disease caused by the lack of protein in a child's diet. It is a type of protein-energy malnutrition (PEM) that is widespread throughout regions where the diet is composed almost exclusively of starchy foods such as rice, yams, maize, cassava, or plantains. People afflicted with kwashiorkor are often deficient in such nutrients as folic acid, iodine, iron, and vitamin C and in such antioxidants as albumin, polyunsaturated fatty acids, and vitamin E. Children living in extreme poverty, such as those suffering through famine or existing in refugee camps, are at increased risk for kwashiorkor.

British physician and pediatrician Cicely Delphine Williams (1893–1992) first described kwashiorkor to the scientific community in 1935 after treating villagers in the area later called Ghana. Williams found first-born children often developed the condition after they were weaned before a second child was born. Thus, the term “kwashiorkor” was derived from a word used in Ghana that means “rejected one.” However, it was not globally recognized as a serious disease until the late 1940s. In the early 2000s Kwashiorkor usually develops after a baby is weaned from protein-rich breast milk (for any reason) and switched to protein-poor foods. In extreme poverty and during famines and wars that displace populations from farmland to refugee camps, protein-rich foods are not available.

What Are the Symptoms of Kwashiorkor?

Children with kwashiorkor have degraded skin conditions such as edema (excess water retention in body tissues that causes swelling and bloating); inflammation of the skin (dermatitis); flaking and peeling skin that contains whitish patches; skin pigment changes; thinning and brittle hair along with lack of curliness and color; and hair that is easily pulled out. Afflicted children have loss of appetite and diarrhea and are usually weak, irritable, and lethargic.

In many cases muscle mass shrinks, and incidence of infections increases due to a weakened immune system. If left untreated, kwashiorkor causes

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be woken up, and cannot move, see, speak, or hear.

* **oncotic pressure** is the pressure difference of blood plasma and tissue fluid.

* **Starling forces** are hydrostatic and oncotic pressures that control fluid movements in capillary membranes.

enlargement of the liver due to fat buildup, loss of fluids (dehydration) from the bloodstream even when the child has edema, stunted growth, and diminished size of all tissues and organs except for the liver. It also can result in jaundice*, drowsiness, and lowered body temperature, along with lowered mental development. If dietary protein is not supplied to offset malnourishment, the child eventually goes into shock* and coma* and then dies.

Symptoms of kwashiorkor result from a lack of amino acids, which are the building blocks of protein. The amino acids are not present in sufficient quantities for the body to produce the various proteins needed for the body to develop normally.

For example, albumin is an important protein; it plays a vital role in maintaining oncotic pressure* within blood vessels. Oncotic pressure is maintained by the presence of proteins, such as albumin, which helps to keep fluids within the capillaries. However, in kwashiorkor sufferers, the level of albumin is low and more fluid flows out of the capillaries than into them; thus, the fluid tends to accumulate in the tissues. Consequently, these fluids are not available to be used for hydration of the body.

When medical staff and resources are available, kwashiorkor patients are given intravenous fluids to increase fluid balances lost from sweating and urine output and to replace losses from vomiting and diarrhea. Medical professionals would also monitor blood constituents such as albumin that maintain what are called Starling forces*.

How Is Kwashiorkor Treated?

An international team of medical workers traveling in Liberia saw Tanya sitting on the ground too tired to play and realized the extent of her malnutrition. They took her to the hospital in Tubmanburg, where she was kept warm and given fluids to replace those she had lost. Initially, she was given small amounts of milk and vitamin and mineral supplements. Zinc supplements helped stop her skin from flaking. After the edema went away, the doctors gave her a high-calorie diet rich in protein.

Of the children who are hospitalized and treated for kwashiorkor, 85 percent survive. Most children properly treated for kwashiorkor early enough recover completely. However, children who develop kwashiorkor before the age of two years, like Tanya, in areas where medical help is not available usually experience stunted height and growth potentials and diminished mental capabilities.

Tests that can be given to diagnose kwashiorkor include urinalysis (tests on urine); serum creatinine (blood test to evaluate kidney function); creatinine clearance (comparison test of creatinine in urine and blood); blood, urea, nitrogen test (to evaluate thyroid function); serum potassium (blood potassium test); arterial blood gas test (to measure oxygen and carbon dioxide in blood); total protein levels test (to measure protein in blood), and complete blood count (to measure concentration of white

and red blood cells and platelets). The most routine test identifies total plasma protein level, especially with respect to plasma albumin. Such tests available commonly in many hospitals may not be available to individuals in areas suffering from extreme poverty.

Individuals in shock should have their blood volume immediately replenished and their blood pressure constantly monitored. When stabilized, these patients should slowly be given carbohydrates, simple sugars, and fats. Later, proteins, vitamins, and minerals should be given. Milk products should be given. If the patients are lactose intolerant, an enzyme lactase supplement should be substituted.

Can Kwashiorkor Be Prevented?

Because kwashiorkor is a dietary deficiency condition, it can be prevented by individuals consuming a well-balanced diet that consists of appropriate amounts of fat (at least 10% of total calories), carbohydrates, and protein (around 12% of total calories). However, extreme poverty, natural disasters, and wars all too often make it impossible for poor people to enjoy well-balanced diets.

International efforts to provide medical support and food have been unable to meet the severe demands of huge populations. These efforts also include teaching people how to grow other kinds of foods, how to combine available foods to maximize protein intake, and contraception* methods to limit family size. These approaches address the ongoing problem of malnutrition. Within industrial countries, such as the United States, kwashiorkor is rare. When it does occur in developed countries, the cause is often child abuse.

▶ See also **Dietary Deficiencies • Jaundice**

Resources

Books and Articles

Marotz, Lynn R. *Health, Safety, and Nutrition for the Young Child*. Clifton Park, NY: Thomson Delmar Learning, 2005.

Rigo, Jacques, and Ekhard E. Ziegler, eds. *Protein and Energy Requirements in Infancy and Childhood*. Basel, Switzerland: Karger, 2006.

Stratton, Rebecca J. *Disease-related Malnutrition*. Cambridge, MA: CABI, 2003.

Organization

Health24. P.O. Box 2434, Cape Town, 8000, South Africa. Web site: http://www.health24.com/journey/First_year/3277-3282-3323,16382.asp.

* **contraception** (kon-tra-SEP-shun) is the deliberate prevention of conception or impregnation.

L

Lactose Intolerance

Lactose intolerance (also known as hypolactasia) is the inability to digest lactose, the main sugar contained in milk and other dairy products. This inability occurs as a result of a low level of the enzyme lactase, which aids in the metabolism of lactose.

Erin's Story

Erin's favorite food had been ice cream since her first birthday. On her thirteenth birthday, the rocky road sundae with hot fudge went down without a hitch, but an hour later she felt awful. She had cramps and diarrhea*, and, even more embarrassing, gas. Erin's friend, whose mother had the same reaction to milk products, explained that she probably was becoming lactose intolerant, meaning that she could not digest all of the natural sugar in the ice cream.

What Is Lactose Intolerance?

Lactose intolerance refers to the inability of the small intestine to break down the sugar lactose (LAK-tos) due to a lack of or too little of the enzyme* lactase (LAK-tays). Lactose is a complex sugar found in milk products. Normally, when lactose reaches the small intestine, it is broken down into the simple sugars glucose (GLOO-kose) and galactose (ga-LAK-toz) by a protein, or enzyme, called lactase. Simple sugars can be absorbed easily through the wall of the small intestine into the bloodstream, but larger, more complex sugars such as lactose cannot. If someone is lactose intolerant, that person's intestine does not make enough lactase or the lactase it does make does not work properly.

If lactose is not broken down, it absorbs water, so that the water cannot pass through the intestinal wall into the bloodstream. This extra fluid remaining in the bowel causes diarrhea. Also, bacteria (microorganisms) in the colon convert lactose to lactic (LAK-tik) acid in a process called fermentation (fur-men-TAY-shun). Fermentation causes bowel movements to be acidic and burn, and it also causes gas, bloating, and cramps. Lactose intolerance is not dangerous, but it is uncomfortable.

Lactose intolerance is not the same as cow's milk intolerance, and they are in fact, not related. Lactose intolerance is a condition associated with the digestive system. An intolerance to cow's milk, however, is actually an allergic reaction and it is associated with the immune system.

Nutrition Facts	
Serving Size: 1 cup (236mL)	
Servings Per Container: 4	
Amount Per Serving	
Calories 90	Calories from Fat 0
% Daily Value*	
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol less than 5mg	1%
Sodium 130mg	5%
Total Carbohydrate 13g	4%
Dietary Fiber 0g	0%
Sugars 12g	
Protein 9g	
Vitamin A 10% • Vitamin C 0% • Calcium 30%	
Iron 0% • Vitamin D 25%	
*Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your caloric needs:	
	Calories: 2,000 2,500
Total Fat	Less Than 65g 80g
Sat Fat	Less Than 20g 25g
Cholesterol	Less Than 300mg 300mg
Sodium	Less Than 2,400mg 2,400mg
Total Carbohydrate	300g 375g
Dietary Fiber	25g 30g
Calories per gram:	
Fat 9 • Carbohydrate 4 • Protein 4	
INGREDIENTS: NONFAT MILK, LACTASE ENZYME, VITAMIN A PALMITATE AND VITAMIN D3.	
PRODUCED UNDER LICENSE FROM	
LACTAID®, INC., PLEASANTVILLE, NJ 08232	
DISTRIBUTED BY:	

▲ The Nutrition Facts panel on a carton of lactose-free milk shows lactase enzyme as the second ingredient after milk.
©Leonard Lessin/Peter Arnold, Inc.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

* **enzyme** (EN-zime) is a protein that helps speed up a chemical reaction in cells or organisms.

Nondairy Sources of Lactose

Milk, cheese, butter, and ice cream are obvious sources of lactose, but lactose is often added to the following items:

- Baked goods, including bread, and mixes for baked goods
- Instant breakfast drinks, potatoes, and soups
- Lunch meats
- Margarine
- Nonfat dry milk powder
- Powdered coffee creamer
- Many prescription drugs
- Processed breakfast cereal
- Salad dressing
- Many snack foods
- Whey
- Whipped toppings

* **congenital** (kon-JEH-nih-tul) means present at birth.

Types of Lactose Intolerance

There are three major types of lactose intolerance. *Primary lactose intolerance* is a normal consequence of development and aging. The amount of the lactase contained in the small intestinal lining, or mucosa, varies among racial groups and even among individuals. Characteristically the amount of lactase falls as individuals age. Therefore, the capacity to digest lactose varies among people especially as they get older. In people with primary lactose intolerance the intake of lactose has exceeded the normally diminishing capacity to digest the sugar. *Secondary lactose intolerance* is associated with damage to the small intestinal mucosa and, therefore, loss of the lactase contained within the cells. Diseases such as Crohn's disease or celiac disease, which severely damage the small intestinal mucosa, may result in lactose intolerance. The third type of lactose intolerance is congenital* in nature. Babies having a lactase deficiency present at birth are usually diagnosed as having lactose intolerance during early infancy.

Who Becomes Lactose Intolerant?

Doctors estimate that 30 to 50 million people in the United States are lactose intolerant. Up to 75 percent of people of African, Mexican, and Native American ancestry develop lactose intolerance, as do 90 percent of people of Asian ancestry. People of other ancestry are affected less by the problem.

How Is Lactose Intolerance Diagnosed?

Doctors use three tests to diagnose lactose intolerance. After a person eats or drinks something containing lactose, the doctor can do the following:

- Test for a low level of glucose in the bloodstream, which would show that lactose was not broken down properly and absorbed (lactose intolerance test)
- Test for a lot of hydrogen in exhaled breath, a sign that bacteria are fermenting lactose (hydrogen breath test)
- Test for acidic bowel movements, also a sign that fermentation is occurring (stool acidity test); usually used to test infants and small children

Living with Lactose Intolerance

Symptoms vary from person to person and depend on the amount of lactose eaten. Trial and error helps people learn what not to eat or how much they can eat without becoming ill. Avoiding milk products should eliminate symptoms of lactose intolerance, but people on such a diet must get calcium and vitamin D from other sources. Nonprescription products containing lactase are available that can be taken along with milk products and help the body break down lactose.

Lactose intolerance usually can be managed by following simple strategies:

- Drink milk in small servings: 1 cup or less per serving.
- Eat cheeses that are low in lactose, such as cheddar.
- Only drink milk with meals or other foods.
- Eat active-culture yogurts, which contain less lactose than other dairy products.
- Use low-lactose or lactose-free milk.
- Take lactase enzyme tablets before consuming dairy products or add lactase enzyme drops to regular milk.

▶ See also **Diarrhea • Metabolic Disease**

Resources

Books and Articles

Dobler, Merri Lou. *Lactose Intolerance Nutrition Guide*. Chicago: American Dietetic Association, 2003.

Organizations

American Gastroenterological Association. 4930 Del Ray Avenue, Bethesda, MD, 20814. Telephone: 301-654-2055. Web site: <http://www.gastro.org/wmspage.cfm?parm1=854>.

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/lactoseintolerance>.

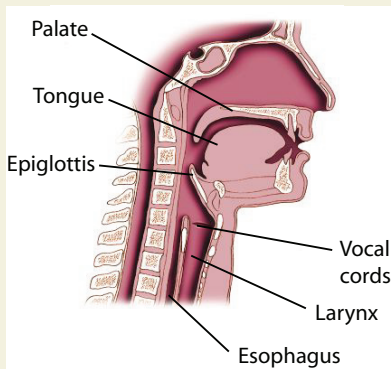
Laryngitis

Laryngitis (lair-in-JY-tis) is an inflammation of the vocal cords that causes hoarseness or a temporary loss of voice.

The Vocal Cords and Their Role in Laryngitis

The vocal cords are the two bands of muscle found inside the larynx (LAIR-inks), or voice box, located between the base of the tongue and the top of the trachea*. As they let air into and out of the lungs, the vocal cords are relaxed. When a person talks, however, the vocal cords tighten as air passes through them, causing the cords to vibrate and thereby produce sound.

* **trachea** (TRAY-kee-uh) is the windpipe—the firm, tubular structure that carries air from the throat to the lungs.



Parts of the body involved in the creation of sound and speech include the larynx, epiglottis, trachea, vocal cords, tongue, and palate. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

* **polyps** (PAH-lips) are bumps or growths usually on the lining or surface of a body part (such as the nose or intestine). Their size can range from tiny to large enough to cause pain or obstruction. They may be harmless, but they also may be cancerous.

* **acid reflux** is a condition in which stomach acid flows upward into the esophagus, often causing a burning sensation (so-called heartburn) in the upper abdomen or chest.

People who lose their voice after cheering too much at a sporting event or who begin to sound hoarse or raspy when they have a bad cold probably have laryngitis. Laryngitis refers to inflammation or irritation of the vocal cords. Inflammation causes swelling, which prevents the vocal cords from working properly, and the sounds they produce can seem strange or be hard to hear. Although laryngitis can make it difficult to communicate, it is rarely serious.

Why Do People Get Laryngitis?

Almost everyone gets laryngitis at some point, whether the condition causes a low raspy whisper or a complete loss of voice. Overusing the voice, such as yelling, speaking too loudly or for too long, and even singing, can lead to laryngitis. People who use their voice constantly, such as radio announcers, politicians, and singers, get laryngitis more often than other people do. The larynx is located along the respiratory tract*, which is why respiratory infections such as the flu (influenza) and the common cold can easily spread to the voice box and cause laryngitis. People who have allergies or who develop polyps* on the vocal cords may also experience laryngitis. Smoking, heavy drinking, inhaling harmful fumes, and acid reflux*, all irritate and inflame the vocal cords and can result in long-term or chronic laryngitis.

What Are the Signs and Symptoms of Laryngitis?

The most obvious symptoms of laryngitis are a hoarse or low voice, the inability to speak above a whisper, a raw feeling or sensation of having a lump in the throat, difficulty swallowing, and the need to clear the throat often. When laryngitis is caused by an infection such as the flu, a person may also experience sneezing, coughing, runny nose, headache, and fever.

Severe laryngitis can sometimes lead to breathing problems, especially in young children. Anyone with laryngitis who develops difficulty breathing or high fever or who is not getting better after a few days needs medical care.

How Is Laryngitis Diagnosed and Treated?

A doctor will ask about a person's symptoms and voice use to help determine whether laryngitis is the result of a respiratory infection or some other cause. In some cases, a doctor might take a close look at the vocal cords by holding a small mirror at the back of the throat. To get an even better view, a doctor might use a tiny camera on a long, thin tube that goes through the mouth or nose. This method allows the doctor to watch the vocal cords in action.

How doctors treat laryngitis depends on what is causing it. If the cause is a viral infection, antibiotics will not help, and the laryngitis will go away on its own. Doctors may recommend certain medicines to help relieve symptoms. Other tips that can help a person to feel better sooner are:

- resting the voice for several days, which means speaking rarely even a whisper, to help the vocal cords heal
- using a humidifier at home or sitting in the bathroom while a steamy shower is running, thus putting moisture into the air that can help to soothe an inflamed larynx
- drinking plenty of liquids
- getting lots of rest
- avoiding smoking or drinking alcohol

Laryngitis usually disappears after a few days, but it can last much longer and happen more often in people who are smokers or heavy drinkers or who use their voices for hours at a time in their jobs. It may take weeks of voice rest before the voice returns to normal. Such long-term hoarseness might cause complications that require speech therapy to help prevent further damage. If growths have formed on the vocal cords over time, surgery may be needed.

Preventing Laryngitis

Laryngitis is not contagious, but colds, flu, and other infections that cause it are. Doing what is possible to avoid these infections (such as frequent hand washing) decreases a person's chances of getting laryngitis.

Following these prevention basics can help maintain a healthy voice for life:

- not shouting or talking too loudly for too long
- staying away from cigarette smoke, which irritates the entire respiratory system
- keeping vocal cords from getting dry by drinking enough water every day

▶ See also **Bronchiolitis and Infectious Bronchitis • Common Cold • Influenza • Sore Throat/Strep Throat**

Resources

Organization

National Center for Voice and Speech, Denver Center for the Performing Arts. 1101 Thirteenth Street, Denver, CO, 80204.
Telephone: 303-446-4834. Web site: <http://www.ncvs.org/index.html>.

Lassa Fever

Lassa fever is a highly infectious and sometimes fatal viral disease that occurs in western Africa.

Hand Washing 101

Hand washing is one of the best ways to prevent the respiratory infections that lead to laryngitis. Rubbing the hands together, front and back, with warm, soapy water for at least 15 to 20 seconds (the length of time it takes to sing the "A-B-C Song") is much better at preventing the spread of germs than just a quick rinse.



▲ A technician draws blood and removes the spleen from a Lassa rat. Lassa fever is a hemorrhagic fever found in West Africa and spread by rodents. *Karen Kasmauski/Science Faction/Getty Images.*

Lassa Fever Statistics

Lassa fever was first identified in 1969.

■ Since 1969 Lassa fever has killed about 5,000 people a year and infected as many as 300,000 in West Africa, the only region where it is found. Those numbers may underestimate the extent of the disease because of poor reporting in some countries.

■ About 15 percent of people who are hospitalized with Lassa fever die. In some areas with high rates of Lassa fever, such as Sierra Leone and Liberia, approximately 15 percent of all hospital admissions involve people with Lassa fever.

* **infectious** means able to spread to others.

What Is Lassa Fever?

Lassa fever is an infectious* disease caused by a virus. It is named after the town in Nigeria where it was discovered. Most people infected with the virus have only mild symptoms. But one out of five people with Lassa fever becomes very ill. Lassa virus affects approximately 100,000 to 300,000 people in western Africa each year.

Lassa virus is spread to humans by the *Mastomys* rodent, which is found in the grasslands and forests of tropical Africa, as well as in human homes. A person can catch the virus by touching objects that have been contaminated with the urine and droppings of these rodents. It is also possible to catch Lassa virus by breathing air near rat droppings or by eating the rats for food. In addition, person-to-person transmission is common in village settings and in hospitals.

Symptoms of Lassa fever may include fever, pain in the chest, sore throat, cough, vomiting, and diarrhea. The virus is so infectious that medical personnel diagnosing the disease must take special precautions. One-third of people with Lassa fever develop deafness that is sometimes permanent. One percent of people infected with the virus die from it.

How Is Lassa Fever Treated and Prevented?

Lassa fever can often be successfully treated with the antiviral drug ribavirin when it is given within the first six days after infection. Because *Mastomys* rodents are found all over western Africa, however, it is unlikely that the virus can be prevented by getting rid of the rats. More promising methods of prevention include educating people about how to keep their homes free of rodents and developing a vaccine for Lassa fever.

▶ See also **Viral Infections**

Resources

Books and Articles

Powell, Michael, and Oliver Fischer. *101 Diseases You Don't Want to Get*. New York: Thunder's Mouth Press, 2005.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dvrd/spb/mnpages/dispages/lassaf.htm>.

World Health Organization. Avenue Appia 20, CH-1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/mediacentre/factsheets/fs179/en/index.html>.

Lazy Eye *See Strabismus.*

Lead Poisoning

Lead poisoning occurs when a person swallows or breathes lead, which can damage many parts of the body, especially in young children.

Timmy's Story

The year Josh turned 12, his parents bought a bigger house so that they would have a bedroom for his little brother, Timmy, who had just started to crawl. Everyone in the family was excited about the move to the house, which was in an older neighborhood with giant trees in the yards.

Josh spent many Saturday afternoons helping his dad fix up the 50-year-old house. Josh's dad knew that chips of paint from homes this age often contain lead, which could be poisonous to Timmy if he put them in his mouth. One of his first projects, then, was to scrape off the old paint and replace it with lead-free paint.

Illustration by Corey Light. Reproduced by permission of Gale, a part of Cengage Learning.

Sources of lead poisoning

Source	Description
Paint	Lead-based paint can be a hazard in older homes. Children eat peeling paint, or come in contact with it during remodeling projects.
Dust and soil	Contamination of soil is usually caused by paint, leaded gasoline, pollution from industrial sites, and smelters.
Foods	Lead can be found in imported canned foods, leaded crystal, and some ceramic dishware.
Activities	Activities such as pottery, stained glassmaking, and furniture refinishing can heighten exposure to lead.
Drinking water	Homes built before 1930 may contain lead water pipes. Newer homes may also contain copper pipes with lead solder.
Traditional remedies & cosmetics	Certain ayurvedic medications, traditionally from India and other Southern Asian countries, may contain lead. Also litargirio (a peach-colored powder used mainly in the Dominican Republic) contains high levels of lead, and the FDA warns against its usage. Kohl is another traditional cosmetic frequently containing high levels of lead.

A few months later, Timmy's doctor tested his blood during a routine checkup and found a high level of lead. His parents had not known that Timmy could get lead poisoning from lead dust as well as paint chips. Luckily, the problem was caught and treated early.

What Is Lead Poisoning?

Lead is a metal that has been mined for thousands of years. In the past, it was an ingredient in many everyday items found in or near homes, such as paint, gasoline, water pipes, and food cans. When a person swallows or breathes lead, however, it can be highly poisonous. It is especially dangerous to children ages six years and younger, partly because the bodies of such young children are changing rapidly and partly because children in this age group tend to put objects in their mouths.

Lead is poisonous because it interferes with some of the body's basic activities. To some extent, the body cannot tell the difference between lead and calcium, a mineral that helps build strong bones. Like calcium, lead stays in the bloodstream for a few weeks. Then it is deposited in the bones, where it can stay for a lifetime. Even small amounts of lead can permanently harm children over time, leading to learning disabilities, behavior problems, decreased intelligence, and other problems. Large amounts of lead can cause seizures, unconsciousness, or even death.

What Causes Lead Poisoning?

There are many familiar items in people's everyday environment that can cause lead poisoning.

Manufacturers used to put lead in paint to make it last longer and cling better to surfaces. In 1978 the sale of lead-based paint for use in homes was banned in the United States. It also became illegal to paint children's toys and household furniture with lead-based paint. However, lead-based paint is still found in more than four out of five homes built before the time of the ban. Old paint that is peeling, chipped, or chalky is a hazard. Because lead has a sweet taste, children may eat chips of lead paint. Even lead-based paint in good condition can pose a risk if it is on surfaces that children chew or that get a lot of wear and tear. Lead-based paint can also be found on old children's toys and household furniture.

The most common way to get lead poisoning is through contact with lead in the form of dust. Lead can get into dust when old paint is scraped or sanded or when painted surfaces bump or rub together. This dust can then settle on objects that people touch or children put into their mouths.

Oil companies used to add lead to gasoline to improve performance. Leaded gasoline allowed lead particles to escape into the air through car exhaust systems. In 1978 the amount of lead allowed in gasoline in the United States was cut, and cars after that used lead-free gasoline. However, the soil around roads may still contain residue of lead from leaded gasoline. Lead also can get into soil when the outside paint on old buildings flakes or peels.

Lead was once widely used in household plumbing. This lead can get into water that flows through the pipes. In 1986 and 1988, the use of lead in public water systems and plumbing was limited in the United States. However, the lead in old faucets, pipes, and solder used to connect pipes remained a problem. The amount of lead in water depends on the water's temperature (warm or hot water can contain more lead), the minerals and acid it contains, how long the water sits in the pipes, and the condition of the pipes.

Lead solder was once used to seal food cans. This lead could mix with the food inside the can. In 1995 the United States banned this use of lead solder, but it continued to be found in some imported cans.

Some other sources of lead are as follows:

- Lead-glazed pottery or leaded crystal can leach lead into foods and drinks.
- Lead smelters and other industries can release lead into the air.
- Jobs that involve working with lead can expose workers to lead dust that settles on their clothes, skin, and hair.
- Hobbies such as making pottery and refinishing furniture use lead and may expose workers to it.
- Folk medicines and homemade cosmetics sometimes contain lead.

Who Is at High Risk?

Anyone of any age can be poisoned by lead. However, the risk is greatest among young children. In the United States, about 310,000 children ages one to five years have a dangerously high level of lead in their blood. The following are some situations linked to increased risk in young children:

- Living in or regularly visiting a home built before 1950.
- Living in or regularly visiting a home built before 1978 that has chipped or peeling paint or that has been remodeled recently.
- Living with an adult whose job or hobby involves contact with lead.
- Having a brother, sister, or playmate who has had lead poisoning.

What Are the Symptoms?

Lead poisoning is not easy to detect. Sometimes no symptoms occur, and at other times the symptoms look like those of other illnesses. Some of the possible early signs of lead poisoning in children are constant tiredness or overactivity, irritability, loss of appetite, weight loss, decreased attention span, trouble sleeping, and constipation.

High levels of lead can cause seizures*, unconsciousness, or even death in children. However, most cases of lead poisoning involve much lower levels of lead. Over time, though, even low levels of lead may cause permanent damage. At low levels, lead can cause problems such as learning disabilities, behavior problems, decreased intelligence, speech problems, decreased attention span, brain or nerve damage, poor coordination, kidney damage, decreased growth, and hearing loss.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

LEAD'S ROLE IN HISTORY

Lead lasts a long time and has a low melting temperature. In ancient Rome, wealthy families had indoor plumbing with lead pipes. (The chemical symbol for lead is Pb, from the Latin word plumbum for a lead weight. The Latin word is also the root for the word “plumber.”) The Romans also lined their outside pipes and water tanks with lead, and they made lead plates and eating utensils. Roman wine makers even sweetened sour wine by adding syrup containing powdered lead.

Modern historians have suggested that lead poisoning may explain the strange behavior of several Roman emperors, including Caligula (12–41 c.e.), who squandered a fortune on public entertainment, banished and murdered relatives, made his favorite horse a public official, and declared himself a god. The decline and fall of the Roman Empire may have been due, at least in part, to lead poisoning.

Contact with lead is especially dangerous for children. However, it can be harmful for teenagers and adults as well. If a pregnant woman comes into contact with lead, it can raise her risk of illness during pregnancy. It can also cause problems, including brain damage or death, in her unborn baby. At high levels, lead in adults can cause problems such as infertility, high blood pressure, digestion problems, nerve disorders, memory problems, decreased attention span, and muscle and joint pain.

How Is Lead Poisoning Diagnosed?

Often lead poisoning has few symptoms. The only way to know whether a person has lead poisoning is to get a blood test that measures the amount of lead in the blood. Children who are not at high risk are usually tested at one and two years of age. Children who are at high risk are usually tested every six months between the ages of six months and two years, then once a year until age six. A blood test can also be done at any time on anyone who has symptoms or may have been exposed to lead.

How Is Lead Poisoning Treated?

The first step in treatment is to avoid more contact with lead. Avoiding exposure means finding and removing any sources of lead in the home. The next step is to make any needed changes in diet. Children should eat at least three meals per day because they absorb less lead when they have food in their systems. Children also should eat plenty of foods high in iron and calcium, such as milk, cheese, fish, peanut butter, and raisins. When they do not get enough iron and calcium, their bodies mistake lead for these mineral, and more lead is absorbed and deposited in their tissues.

If blood levels of lead are high enough, the doctor may prescribe a drug that chelates (KEE-lates), or binds to, lead in the body. Once lead is bound up in this way, the body can remove it through urine or bowel movements. The drug used determines how it is administered: in a vein, by shot, or by mouth.

Getting the Lead Out

The following tips can help prevent lead poisoning:

- Wash the hands often, especially after spending time outside and before eating.
- Wash the floors, windowsills, and other surfaces in the home weekly.
- Use a sponge or mop with a solution of water and all-purpose cleaner to clean up dust.
- Rinse the sponge or mop thoroughly after cleaning dirty or dusty areas.
- Keep younger children from chewing on painted surfaces, such as windowsills or cribs.
- Do not let younger children put toys and other objects with painted surfaces in their mouths.
- Have younger children play in grassy areas instead of directly on soil, which may have lead in it.
- Frequently wash a younger child's bottles, pacifiers, toys, and stuffed animals.
- Use cold tap water for drinking or cooking because lead is more likely to leach into hot water taken from the tap.
- Eat a well-balanced diet that is low in fat and high in iron and calcium.

▶ See also **Environmental Diseases**

Resources

Books and Articles

Lead Poisoning: What It Is and What You Can Do About It.
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Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/nceh/lead/default.htm>.

National Lead Information Center. 422 South Clinton Avenue, Rochester, NY, 14620. Toll free: 800-424-LEAD. Web site: <http://www.epa.gov/lead>.

Learning Disabilities

Learning disabilities are disorders that affect people's ability to interpret information that they see or hear or to link information processed in different parts of the brain. A person with a learning disability may have specific difficulties with language, visual information, or coordination, which in turn can make it very hard to read, spell, write, or do math.

What Are Learning Disabilities?

Learning disabilities differ from learning problems (which are less severe) and from intellectual disabilities (formerly called mental retardation, which refers to more global learning difficulties). Not every learning problem is a true disorder or disability. Some children are just naturally slower than others in developing certain skills, but most children usually catch up and achieve within the normal range for their age and abilities. Children who are intellectually disabled, by contrast, are not able to learn and function socially like other children their age. Their general intellectual capacity is lower than average. Children with intellectual disability have learning problems but do not truly have learning disabilities.

Children with learning disabilities typically have average or even above-average intelligence, so there is a marked difference between their intellectual ability and what they actually learn. In a sense, a person with a learning disability is like a radio that is not tuned exactly to a station. There is nothing wrong with the radio itself or with the signal coming from the station, but the sound is still fuzzy. Similarly, people with learning disabilities can see and hear as well as others, and they have normal general learning capacity, but there is a problem with the way their brains process information.

Learning disabilities are generally classified into two main categories: verbal (having to do with the uses of spoken and written words) and non-verbal (having to do with interpreting visual or spatial information).

Verbal learning disabilities Developmental speech disorders are usually diagnosed in very young children who have persistent trouble making certain speech sounds; for example, they may say “wabbit” instead of “rabbit” or “thwim” instead of “swim.” Often these speech disabilities improve with age or with the help of a speech therapist.

Developmental language disorders involve the way that children express themselves or how they understand others' speech. Children with this type of disorder may speak in short phrases instead of full sentences, call objects by the wrong names, have disorganized speech, misunderstand words, or have difficulties following directions.

Reading is a complex task in which a person has to focus attention on the printed marks, control eye movements across the page, recognize sounds associated with letters, understand words and grammar, build images and ideas, compare new ideas to what is already known, and then

store the ideas in memory. This process requires a rich, intact network of nerve cells that connect the brain's centers of vision, language, and memory. A problem in any of these areas or the connections among them can lead to difficulties with reading. Dyslexia (dis-LEKS-ee-uh), the most common and best-known of the reading disorders, affects approximately 2 to 15 percent of school-age children. Because children with dyslexia have trouble processing the smallest units of language that make up words, they may have trouble with rhyming games or with sounding out individual letters or syllables to form words.

There are other types of reading disorders that affect comprehension (kom-pre-HEN-shun), which is the ability to fully understand and interpret what one reads. A person with this type of disability can read each word but may find it hard to understand the text, form images, or relate new ideas in the text to those in memory. These reading disabilities usually are discovered at a later age than is dyslexia.

A writing disability can result from problems with any area of the brain that controls grammar, hand movement, vocabulary, and memory. Children who have trouble mastering the motor skill of writing are said to have dysgraphia (dis-GRAF-ee-uh).

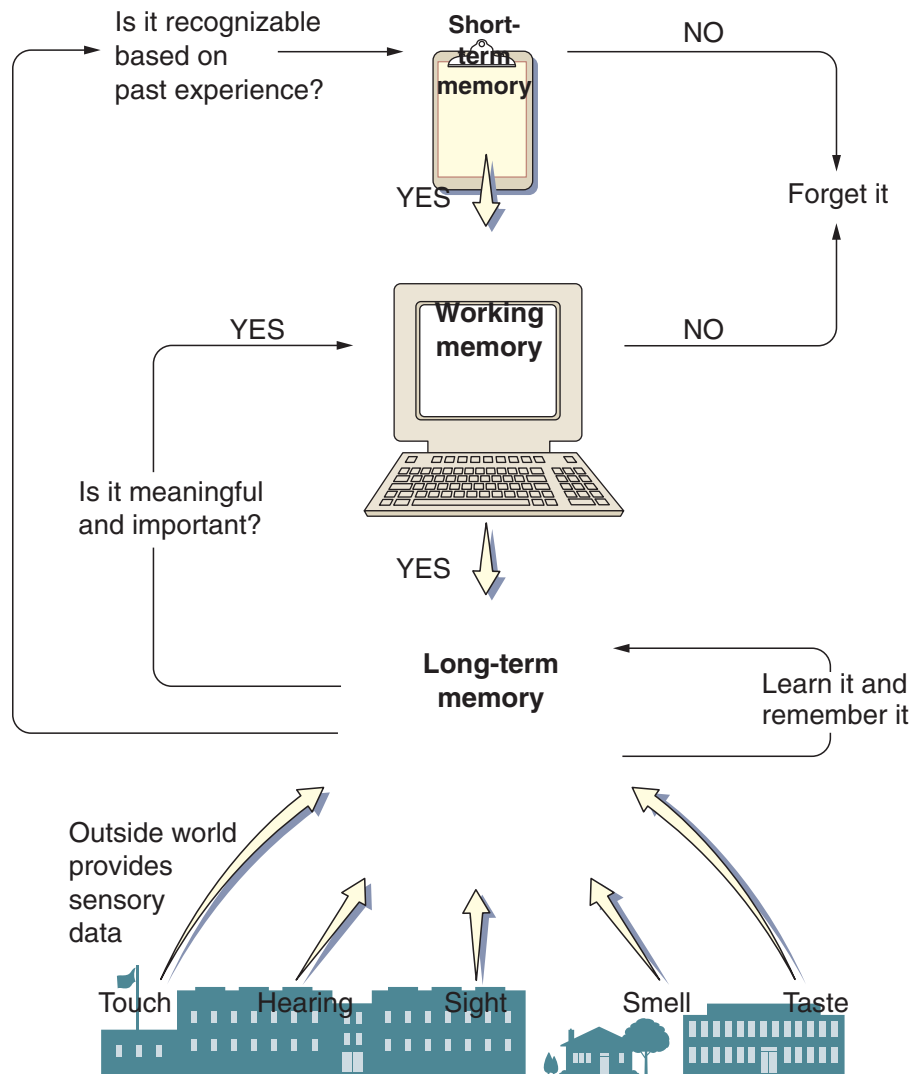
Nonverbal learning disorder Nonverbal learning disorder (also called nonverbal learning disabilities, or NVLD) is not as well understood as verbal learning disabilities. People with NVLD often have problems with visual perception, with recalling visual details, and with spatial relationships. Their eyesight is fine, but they may have trouble processing what they see; for example, a student might find it hard to follow a set of instructions demonstrated by a teacher.

Students with NVLD often find it hard to focus on nonverbal academic material as well, which can make it difficult for them to learn math (a disorder called dyscalculia (dis-KAL-kyoo-lee-uh)) and science. They may have trouble recognizing numbers and symbols, memorizing facts such as the multiplication tables, aligning numbers, and understanding abstract concepts such as place value and fractions. In both math and science class, students may have difficulty solving problems, forming complex concepts, and making educated guesses and then testing them out. Reading comprehension may be affected as well. Even though students with NVLD may read words and sentences with ease, they might not understand the underlying organization of a text. Dealing with brand-new material is likely to overwhelm children with NVLD.

Some children with NVLD have trouble in other areas as well. They may have poor motor skills and problems with coordination; for example, learning to ride a bike can be very difficult for a child with NVLD. They may also have trouble socializing with other children because they do not pick up on nonverbal social cues, such as tone of voice and body language, or they tend to make the wrong comment at a given time. Children with NVLD tend to be easily frustrated and upset. Any new situation can make them anxious because they may have more difficulty adjusting to it.

Learning involves a complex series of events. The brain receives new information from the outside world all the time, but in order to learn new information, the brain must recognize the information's importance, interpret it, analyze its meaning, and store it in memory for later use in processing new information. If the brain does not recognize new information as meaningful and important, it will discard it. Learning disorders affect different aspects of this complex process of recognizing, interpreting, understanding, and remembering new information.

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



* **attention deficit hyperactivity disorder** or ADHD, is a condition that makes it hard for a person to pay attention, sit still, or think before acting.

Other types of learning disabilities

There are many other subtypes of learning disabilities, but verbal and nonverbal learning disabilities are the two main categories. Because many aspects of speaking, listening, reading, writing, and arithmetic overlap and build on the same brain capabilities, it is not unusual for someone to have more than one disorder. For example, most disorders that hinder the ability to understand language will also interfere with learning to read, spell, and write.

Attention deficit hyperactivity disorder*, or ADHD, can also interfere with learning. Children with ADHD often have difficulty focusing on any one task for a period of time. Children with attention problems may have learning problems but attention deficits are not classified as specific learning disabilities. However, more than half of children with ADHD also have learning disabilities.

How Do People Know They Have a Learning Disability?

Parents and teachers are usually the first to notice signs of a possible learning disability. A very young child might not speak or listen as well as other children their age or might have trouble with a game's directions or other activities that other children complete with ease. The classroom teacher may notice persistent difficulties in reading, writing, or math.

The first step in diagnosing a learning disability is to rule out any other possible causes, such as vision or hearing problems or some other medical condition. Once a doctor makes sure that other problems are not causing the disability, the child might be evaluated by a psychologist* who specializes in learning disabilities. Diagnosing a learning disorder often takes time. The psychologist usually takes a careful history of symptoms, interviews the child, and gives certain tests that compare the child's level of ability to what is considered appropriate for a person of that age and intelligence.

Why Do People Have Learning Disabilities?

Why certain children develop learning disabilities and others do not remains a mystery in the early 2000s. However, researchers have speculated that learning disabilities may be traced to differences in early brain development that occur before or after birth. During brain development, a few all-purpose cells must grow into a complex organ made of billions of specialized interconnected nerve cells called neurons [NOR-ons]. Researchers are investigating possible causes for differences or disruptions in brain development that include the following:

- Alcohol, tobacco, or drug use by the mother during pregnancy
- Problems during pregnancy or delivery that may cause a decrease in the amount of oxygen that reaches the baby's developing brain
- Head injuries
- Exposure to poisonous substances in the environment, such as lead

Also, because some learning disabilities tend to run in families, researchers have explored how learning differences may be inherited.

Living with a Learning Disability

Because children with learning disabilities typically have normal or above-normal intelligence, they often can find ways to learn in spite of the disorder. They may need to attend special school programs for the learning disabled or to work with a learning specialist several hours each week while attending regular classes.

Special education teachers can help plan out what is called an Individualized Education Program, or IEP, for a learning-disabled child. This plan outlines the specific skills the child needs to develop as well as appropriate learning activities that build on the child's strengths and work

* **psychologist** (sy-KOL-uh-jist) is a mental health professional who can do psychological testing and provide mental health counseling.

around his or her difficulties. For example, a student with dyslexia might be encouraged to listen to a book on tape for English class, and a student with a writing disorder might take notes or complete an assignment using a laptop computer.

Children with learning disabilities often need emotional support because they may see themselves as stupid. They may withdraw from their classmates at school or even get into trouble because they are frustrated when learning is difficult for them. Children and their families can often benefit by working with a trained counselor or support group.

Resources

Books and Articles

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Hultquist, Alan M. *What Is Dyslexia? A Book Explaining Dyslexia for Kids and Adults to Use Together*. London: Jessica Kingsley, 2008.

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Newby, Robert F., with Carol A. Turkington. *Your Struggling Child: A Guide to Diagnosing, Understanding, and Advocating for Your Child with Learning, Behavior or Emotional Problems*. New York: Collins, 2006.

Turkington, Carol, and Joseph R. Harris. *Understanding Learning Disabilities: The Sourcebook for Causes, Disorders, and Treatments*. New York: Checkmark Books, 2003.

Organizations

LD OnLine. 2775 S. Quincy Street, Arlington, VA, 22206. Web site: <http://www.ldonline.org>.

Learning Disabilities Association of America. 4156 Library Road, Pittsburgh, PA, 15234-1349. Web site: <http://www.ldanatl.org>.

NLD on the Web!. Web site: <http://www.nldontheweb.org>.

National Information Center for Children and Youth with Disabilities. P.O. Box 1492, Washington, DC, 20013-1492. Toll free: 800-695-0285. Web site: <http://www.nichcy.org>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Telephone: 301-443-4513. Web site: <http://www.nimh.nih.gov/publicat/learndis.htm>.

Legionnaires' Disease

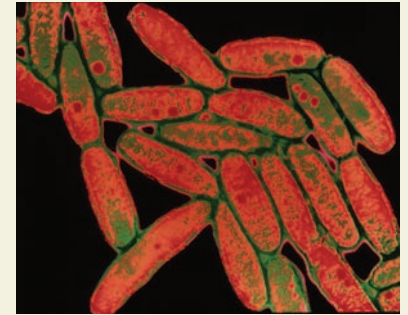
Legionnaires' (lee-juh-NAIRS) disease, also known as legionellosis (lee-juh-nel-O-sis), is a bacterial infection that can lead to a serious form of pneumonia (nu-MO-nyah), or inflammation of the lungs.

What Is Legionnaires' Disease?

In 1976 more than 200 people attending an American Legion convention at the Bellevue-Stratford Hotel in Philadelphia, Pennsylvania, suddenly came down with a mysterious illness that caused high fever, chills, and a cough. Thirty-four people died from severe pneumonia. The illness, later named Legionnaires' disease in memory of the convention attendees, was caused by a previously undiscovered bacterium that scientists called *Legionella pneumophila*, (lee-juh-NEL-uh new-MOH-fee-luh). The bacteria were found to be living in the hotel's air-conditioning system. Since the initial outbreak, several other species of *Legionella* bacteria have been discovered, some of which can cause a very similar but less serious disease. Although people often hear about outbreaks of Legionnaires' disease in public places that affect many people at once, such outbreaks actually occur more frequently on a much smaller scale. The disease can even break out in homes.

How Common Is Legionnaires' Disease?

Between 8,000 and 18,000 cases of Legionnaires' disease occur in the United States every year. It is believed that many more may go undiagnosed because the symptoms are so mild that people do not seek treatment. An outbreak is most likely to occur in summer or early fall, but it can happen at any time. The disease can affect people of all ages, but people who are middle aged or older, who smoke cigarettes, or who have chronic* lung conditions, such as emphysema*, may be at especially high risk. People with weakened immune systems, such as those who have AIDS* or cancer, or those who have undergone organ transplantation, also are at greater risk of contracting the disease.



Electron micrograph of the bacteria *Legionella pneumophila*. Worldwide, there are as many as 40 species in the family of *Legionella* bacteria. A.B. Dowsett/Photo Researchers, Inc.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **emphysema** (em-fuh-ZEE-mah) is a lung disease in which the tiny air sacs in the lungs become permanently damaged and are unable to maintain the normal exchange of oxygen and other respiratory gases with the blood, often causing breathing difficulty.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

How Does Legionnaires' Disease Spread?

Legionnaires' disease is not spread from person to person. *Legionella* bacteria live and grow in warm, stagnant (still) water, such as that found in air-conditioning systems, hot-water tanks, or whirlpool spas. People might become infected by breathing in the mist from contaminated water sources (for example, the vents of air conditioners at a hotel or the showers at a gym).

Signs and Symptoms

Symptoms of *Legionella* infection can range from mild to severe. In fact, some people infected with the bacteria may show no symptoms at all. Those who do might experience high fever, chills, and a cough that usually produces sputum (SPYOO-tum), a mixture of thick, slippery mucus (MYOO-kus) and other material coughed up from the inflamed lungs and windpipe. Some people also have extreme tiredness, muscle aches, headache, shortness of breath, stomach pain, diarrhea, and loss of appetite. Symptoms typically begin within 2 to 10 days of exposure to the bacterium. Kidney problems also may occur. *Legionella* bacteria have also been found to cause a less serious disease called Pontiac fever, which is characterized by mild flu-like symptoms, without signs of pneumonia.

How Do Doctors Diagnose and Treat the Disease?

Legionnaires' disease can be difficult to distinguish from other types of pneumonia. There are very specific tests for it, but before ordering these tests, doctors need to learn as much as possible about their patients. First, doctors ask patients about their general health and recent activities. This history helps determine whether the patient might have been exposed to *Legionella* bacteria. Doctors then perform a physical examination of patients and take chest x-rays to look for signs of pneumonia in the lungs. If a doctor suspects Legionnaires' disease at this time, more specific laboratory tests might be ordered, including blood tests, to determine whether the patient's body is producing antibodies* to *Legionella* bacteria. Cultures of fluids from the patient's lungs may be done. To perform a culture, a person's sputum is placed on special material called a culture medium. If *Legionella* bacteria are present in the sputum, the medium will help them grow so that the bacterium can be identified. A urine test also can help confirm the presence of infection. The disease is treated with antibiotics and usually requires a stay in the hospital. In the hospital, patients receive supportive care, such as oxygen if they are having trouble breathing and extra fluids to replace what has been lost during periods of high fever.

What Are the Complications of Legionnaires' Disease?

Some people with *Legionella* infection experience only mild symptoms of illness, whereas others may be hospitalized for several weeks. Afterward, they may continue to be very tired for several more months. Most people who

THE CDC IN ACTION

When Legionnaires' disease broke out at the American Legion convention in Philadelphia in the summer of 1976, theories about its cause ranged from swine flu to chemical poisoning to communist conspiracies against American veterans. As fears mounted, the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia, in cooperation with other federal, state, and local authorities, launched one of the largest joint disease investigations in history. Investigators looked at the possible sources of the outbreak and the ways the infection could have spread. Survivors were examined; bodies were autopsied; and specimens of air, water, soil, and various hotel materials were tested. Comparing tissue samples from people who had become infected with samples held in storage at the CDC, investigators were even able to link the Philadelphia cases to unidentified cases of illness dating back as far as the 1940s. Finally, in 1977, doctors isolated the culprit bacterium from the hotel's cooling tower, and federal authorities put in place new hygiene safeguards to limit future problems. The CDC continued thereafter to work in disease prevention and control, addressing such wide-ranging topics as air pollution, water contamination, and unsafe working conditions and implementing educational programs and various other strategies to protect the health of Americans.

become ill with Legionnaires' disease recover, but in people with chronic lung problems, *Legionella* can make the condition worse, leading to severe illness. Up to 30 percent of cases of Legionnaires' disease are fatal.

Can the Disease Be Prevented?

There is little that people can do to avoid becoming infected with *Legionella*. In public places, better maintenance of plumbing and air-conditioning systems, including regular inspection and cleaning, can help limit the growth of the bacteria. If there is an outbreak, government health teams step in to decontaminate the suspected source of the bacteria.

▶ See also **Bacterial Infections • Pneumonia**

Resources

Books and Articles

Zonderman, Jon, and Laurel Shader. *Legionnaires' Disease*. New York: Chelsea House, 2006.

Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/legionella/index.htm>.



▲ Cutaneous leishmaniasis affects the skin, causing sores that may look like volcanoes: they have a central pit and a raised rim. The disease can destroy tissue and lead to permanent scarring. AP Images.

* **parasite** (PAIR-uh-sites) is an organism such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

* **cutaneous** (kyoo-TAY-nee-us) related to or affecting the skin.

* **mucous membranes** are the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

Leishmaniasis

Leishmaniasis (leesh-muh-NYE-uh-sis) is a parasitic infection spread by sand flies. It causes symptoms ranging from sores on the skin to damage to internal organs.

What Is Leishmaniasis?

The disease occurs when a person becomes infected with any of several types of *Leishmania* parasite*. They spread to people through the bite of female sand flies and can cause different forms of illness, all of which are called leishmaniasis. Cutaneous* leishmaniasis affects the skin; mucocutaneous (myoo-ko-kyoo-TAY-nee-us) leishmaniasis attacks the mucous membranes* in the mouth, nose, and throat; and visceral (VIH-suh-rul) leishmaniasis (also known as systemic leishmaniasis or kala azar) damages internal organs, such as the liver* and spleen*.

Cutaneous and mucocutaneous infections can lead to severe scarring and permanent disfigurement. In patients with a mucocutaneous infection, the disease can destroy soft tissue in the mouth and nose, drastically deforming the face. The visceral form of the disease is considered the most dangerous. It can grow worse over time and is usually fatal if not treated. Leishmaniasis damages the immune system so that it cannot fight off infections; these infections are generally the cause of death, not leishmaniasis itself. In some countries, visceral disease has been found with increasing frequency among people who also have human immunodeficiency virus* infection.

How Common Is the Disease?

The infection is most common in tropical and subtropical regions, such as countries in South America, Africa, and Asia, and the number of areas where it occurs continues to grow. The Centers for Disease Control and Prevention (CDC) estimates that one and a half million people around the world contract cutaneous leishmaniasis each year and half a million people experience the more serious visceral form of the disease. Ninety percent of the visceral cases are found in just five countries: India, Nepal, Bangladesh, Sudan, and Brazil. Leishmaniasis is exceptionally rare in the United States, although a few cutaneous cases have been diagnosed in rural southern Texas.

Is It Contagious?

People cannot get leishmaniasis directly from other people. Instead, the disease spreads through the bite of blood-sucking sand flies. A fly bites an infected animal or person and takes in the parasite with its meal of blood. The *Leishmania* parasites reproduce in the fly, which can spread them when it bites another person. Sand flies are quite small—about one-third the size of a mosquito—and fly silently, so people often do not even know

the flies are nearby. Less often, the disease can be transmitted through contaminated blood in a transfusion*, by sharing or reusing needles for injecting drugs, or from a mother to her baby during pregnancy or birth.

What Are the Signs and Symptoms of Leishmaniasis?

Cutaneous leishmaniasis is marked by sores that often look like volcanoes: They have a central pit and a raised rim. They can be painful or painless and may be covered by scabs. The sores tend to appear on the face, arms, and legs, and some people have as many as 200 of them. Patients with cutaneous leishmaniasis also may have swollen lymph nodes* near the sores. In mucocutaneous cases, the lesions appear in the mouth, nose, and throat and gradually destroy the soft tissues in those areas.

The visceral form of the disease can cause lack of appetite, serious weight loss, fever (which can last from two weeks to two months), and increasing weakness. It also can lead to an enlarged spleen and liver and sometimes swollen lymph nodes. Blood tests may show that the patient has low levels of white blood cells, red blood cells, or platelets*. As the disease progresses, the skin can become dark and dry—a symptom that gave the disease the name kala azar (meaning “black fever”). In children, visceral leishmaniasis often begins suddenly, with fever, diarrhea, and cough.

How Do Doctors Make the Diagnosis?

A key to making the diagnosis is learning whether the patient has traveled to a country where leishmaniasis occurs. During the physical examination, the doctor also checks the patient’s body for the types of sores seen with the infection. The doctor may take blood samples and tissue samples from any sores that are found. These samples will be cultured*, examined for signs of the parasite, or tested for antibodies* to the parasite. For suspected cases of visceral infection, biopsies* of the abnormal tissue may be done.

What Is the Treatment?

Doctors treat the infection with prescription medications; many of these medicines contain antimony*. Cutaneous cases usually can be treated at home, but visceral disease may require hospitalization and supportive care, such as intravenous* fluids. Patients who have severe disfigurement from cutaneous, and especially mucocutaneous, leishmaniasis often need reconstructive surgery to regain a normal appearance. However, such extensive (and expensive) treatment is not available to vast numbers of people in developing countries who contract this disease.

How Long Does the Disease Last?

Although some cases of cutaneous leishmaniasis clear up without medical intervention, most cases of mucocutaneous and visceral infection will not get better without treatment. Left untreated, visceral disease typically

* **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.

* **human immunodeficiency virus** (HYOO-mun ih-myoo-no-dih-FIH-shen-see), or HIV, is the virus that causes AIDS (acquired immunodeficiency syndrome), an infection that severely weakens the immune system.

* **transfusion** (trans-FYOO-zhun) is a procedure in which blood or certain parts of blood, such as specific cells, is given to a person who needs it due to illness or blood loss.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.

* **cultured** (KUL-churd) means subjected to a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body’s immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **biopsies** (BI-op-seez) are tests in which small samples of skin or other body tissue are removed and examined for signs of disease.

* **antimony** (AN-tih-mo-nee) is an element that has properties of both metals and nonmetals and can kill or inhibit the growth of certain bacteria.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **peripheral nerves** (puh-RIH-fer-ul) are a network of nerve fibers throughout the body that send and receive messages to and from the central nervous system (the brain and spinal cord).

* **mucous membranes** are the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.

leads to death within two years. Cutaneous cases may take several months to heal, even with treatment, and may return after the treatment has been completed.

What Are the Complications of Leishmaniasis?

The cutaneous and mucocutaneous forms of leishmaniasis often cause widespread scarring. In mucocutaneous cases, destruction of tissue in the mouth and nose can lead to facial deformity. Visceral disease can damage the immune system to the point that it is unable to fight off other infections. Some patients may need to have the spleen removed if it is trapping and destroying too many of the person's blood cells, and advanced cases of disease often result in death.

Can the Disease Be Prevented?

Avoiding sand fly bites is the best way to limit the spread of leishmaniasis. In areas where the flies live, people are advised to stay inside from dusk until dawn, when the insects are most active. Wearing long-sleeved shirts, long pants, and socks and tucking pants into socks can reduce the amount of bare skin that is vulnerable to fly bites. Using insect repellent, staying in screened-in or air-conditioned areas, sleeping under mosquito netting, and spraying living areas with an insecticide to kill flies also can help lessen the risk of being bitten. But these preventative measures are often not possible for people living in extreme poverty.

▶ See also **Parasitic Diseases: Overview** • **Travel-related Infections**

Resources

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/parasites/leishmania/default.htm>.

World Health Organization. Avenue Appia 20, CH-1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/leishmaniasis/en>.

Leprosy (Hansen's Disease)

Leprosy (LEH-pro-see) is a chronic, infectious disease that damages the skin, peripheral nerves*, and mucous membranes* of the mouth, throat, and eyes. Leprosy also is known as Hansen's disease.*



Hassan Abdu Salaam, a resident since 1944 in the Abu Zaabal leprosarium, basks on a bench in the sun March 5, 2006. *Khaled Desouki/AFP/Getty Images.*

What Is Leprosy?

His equipment was inadequate and his colleagues thought his theories were laughable. Still, Gerhard Henrik Armauer Hansen (1841–1912) spent day after day bent over his microscope, determined to prove that leprosy was caused by bacteria. In 1873 the Norwegian physician identified the rod-shaped bacterium *Mycobacterium leprae* (my-ko-bak-TEER-e-um LEH-pray) as the cause of the illness. Hansen's discovery was immensely valuable in the treatment of leprosy, and it was a scientific milestone—the first proof that bacteria could cause human disease. In modern times, the use of the word “leper” is considered insulting because it defines a person by the disease he or she has. Many advocates for people with leprosy prefer to call it Hansen's disease.

The name paucibacillary (paw-sih-BAH-sih-lair-e) Hansen's disease comes from the Latin word *pauci*, meaning few, and it is used to describe a mild form of leprosy. Paucibacillary Hansen's disease begins in the peripheral nerves and spreads to the skin, causing patches of skin to become numb and hypopigmented, which means that the skin has lost its coloring and appears white. Multibacillary (mul-tie-BAH-sih-lair-e) Hansen's disease is a more severe form of the disease. Multibacillary Hansen's disease also causes skin lesions (LEE-zhuns), or patches of damaged tissue; nodules, or lumps; and thickening of the skin. Without treatment, this type of leprosy can worsen, resulting eventually in severe skin and tissue damage and disfigurement.

How Common Is Leprosy?

Throughout human history leprosy has caused untold suffering. Even after Hansen's groundbreaking discovery, the disease remained unchecked in many parts of the world. In 1991 the World Health Organization

* **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.

* **neurocutaneous** (nur-o-kyoo-TAY-nee-us) means affecting the skin and nerves.

(WHO) began a global campaign to reduce the number of cases of leprosy. A decade later the organization announced that it had reached its goal. In 2007 there were 224,717 cases of leprosy worldwide. From 2002 to 2007 the number of new cases of leprosy dropped at an average rate of nearly 20 percent per year. The disease is most common in tropical and subtropical regions, and in 2007 it remained a particular problem in Angola, Brazil, Central African Republic, Democratic Republic of Congo, India, Madagascar, Mozambique, Nepal, and the United Republic of Tanzania. Leprosy is most common in densely populated areas with poor sanitation and health care, and children are at greater risk than adults of getting the disease. In the United States about 200 cases are reported each year, many of them in people who have recently immigrated.

Is the Disease Contagious?

Leprosy is contagious but does not spread easily. Researchers believe that *Mycobacterium leprae* is transmitted from person to person via respiratory droplets, bits of moisture that leave the mouth or nose when a person laughs, talks, sneezes, or coughs. Most people seem to have a natural immunity* that enables them to resist the disease. Of those in whom leprosy is diagnosed, most have had prolonged and close contact with someone who has an active infection. Once a person with leprosy has been taking medication for three or four days, the disease is no longer active or contagious.

What Are the Signs and Symptoms?

Leprosy begins as an infection in the nerve endings and spreads gradually; the skin near the infected nerves may become numb and hypopigmented, meaning lacking in color or pigment. In severe cases, these skin lesions become wider and thicker. The muscles in the hands and feet can become weak or paralyzed (unable to move) because of damage to the peripheral nerves. That loss of sensation can lead to accidental injury because a person loses the withdrawal reflex that helps protect against injury from hot or sharp objects. Left unchecked, the most severe form of the disease can progress, producing large, disfiguring nodules and enlarged facial features that give a person the lion-like appearance associated with severe leprosy.

How Is Leprosy Diagnosed?

Leprosy is not difficult to diagnose once it is suspected. A procedure in which a tiny piece of skin is scraped or cut away and then examined under a microscope usually reveals the presence of *Mycobacterium leprae* in the multibacillary form of leprosy. (The bacteria may not be found using this method in milder, paucibacillary disease.) The procedure can be done quickly and relatively painlessly in a doctor's office or clinic. It is an important part of the diagnosis because in the early stages of the disease leprosy lesions look very much like skin damage caused by other neurocutaneous*

3,000 YEARS OF LEPROSY

Leprosy has left a record of pain, suffering, and death that dates back thousands of years. Archeologists have uncovered skeletal remains with erosion in the bones of the nose that is characteristic of leprosy. Researchers translating from ancient Indian and Chinese texts have found descriptions of the disease. As explorers and military men roamed the globe, the germ that causes leprosy traveled with them. Researchers believe that in the first century B.C.E., Roman soldiers fighting in Egypt carried the disease back to Italy. In the Middle Ages, the disease spread from Italy throughout Europe. During the Crusades, a series of wars spanning the eleventh to the thirteenth centuries, European soldiers and travelers carried the disease as far as Jerusalem in the Middle East. The disease continued to follow the paths of conquering armies. The Spanish conquistadors and the slave trade brought the disease to North and South America, and European colonists probably spread the disease to islands in the Pacific Ocean.

diseases. The presence of the characteristic lesions, accompanied by a history of living in areas where the disease is common, incline doctors to suspect the diagnosis.

Can Leprosy Be Treated?

Early diagnosis and treatment are essential for stopping the spread of leprosy to other people and preventing long-term damage to the patient. Doctors most often prescribe multidrug therapy (MDT), combining two or three drugs that kill the bacteria: dapsone (DAP-sone), rifampicin (rye-FAM-pih-sin), and clofazimine (klo-FAY-zuh-mein). The MDT approach has been preferred since the early 1980s, when researchers noticed that the bacterium was becoming resistant to some treatments. Patients may take the drugs for as little as six months or as long as two years. Patients who have become disfigured or who experience disabilities may need surgery to correct these problems.

What Are the Complications and Course of Leprosy?

With MDT, paucibacillary Hansen's disease can be cured within 6 to 12 months and multibacillary Hansen's disease within two years. Untreated, leprosy can cause blindness, permanent nerve damage, and deformity. People may lose the use of their hands or feet because over time decreased sensation may result in repeated injuries to the limbs.

How Can Leprosy Be Prevented?

Despite centuries in which people with leprosy were vilified, shunned, and even isolated in far-off communities called leper colonies, there is no need to separate people with leprosy from the rest of society to avoid the spread

of infection. MDT treatment is more effective and far more humane, and it has been determined that leprosy is much less contagious than once was believed. Hand washing, disinfection, and monitoring of close contacts are recommended to help prevent the spread of the disease.

▶ See also **Bacterial Infections • Skin Conditions**

Resources

Books and Articles

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Lynette, Rachel. *Leprosy*. Farmington Hills, MI: KidHaven Press, 2006.

Sehgal, Alfica. *Leprosy*. Philadelphia, PA: Chelsea House, 2006.

Organizations

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/leprosy>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/lep/en>.

Lesbian Health See *Gay, Lesbian, Bisexual, and Transgender Health*.

Leukemia

Leukemia (loo-KEY-me-a) is a type of cancer in which the body produces a large number of immature, abnormally shaped blood cells. It usually affects the white blood cells, or leukocytes (LOO-ko-sites), which help the body fight infections and other diseases.

Sam's Story

Sam had been looking forward to the basketball season for weeks. Now that it had actually started, though, he was having trouble keeping up during practice and in games. He just did not have the energy that he usually had, and he felt pain in his joints like never before. He found that he always needed to ask the coach to give him breaks during games. His

teammates accused him of being out of shape, but Sam knew that it was more than that. His mother noticed that, even though he was playing less, he had more bruises than he did last season. Eventually, Sam had to sit out for a few weeks with a bad case of what appeared to be the flu: He felt constantly weak and tired, and he kept getting fevers. His mother decided that it was time to see the doctor and figure out what was going on.

After hearing about Sam's symptoms, the doctor ran some blood tests. These showed that Sam had leukemia, and further testing indicated that it was a type called acute lymphocytic (lim-fo-SIT-ik) leukemia, or ALL. This is the most common type of leukemia in children.

Overall, leukemia accounts for about 30 percent of cancer cases in children. However, like most other types of cancer, it is much more common in adults. More than 40,000 adults and about 3,800 teenagers and children in the United States are diagnosed with leukemia each year.

What Is Leukemia?

Leukemia is a type of cancer that affects the bone marrow, the soft, spongy center of the bone that produces most of the three types of cells in the blood. They are as follows:

- the white blood cells, or leukocytes, which help the body fight infections and other diseases
- the red blood cells, or erythrocytes (e-RITH-ro-sites), which carry oxygen from the lungs to the body's tissues and take carbon dioxide from the tissues back to the lungs
- the platelets, which help form blood clots that control bleeding.

Normally, the marrow produces these cells in an orderly, controlled way as the body needs them. With leukemia, however, the process gets out of control. In most cases, the marrow produces too many immature white blood cells (called blasts) that are abnormally shaped and cannot carry out their usual duties. This symptom explains why the disease is called "leukemia," which literally means "white blood." As these blasts multiply and crowd the bone marrow, they interfere with the production of other types of blood cells. When the blasts move into the body, they can collect in different places, causing swelling or pain.

Different types of leukemia occur:

- Acute (a-KUTE) leukemia gets worse quickly, with fast multiplication of abnormal, immature blasts.
- Chronic (KRON-ik) leukemia worsens gradually. Abnormal blasts are present, but they are more mature and can carry out some of their functions.
- Lymphocytic leukemia affects certain white blood cells called lymphocytes (LIM-fo-sites), which control the body's immune response by finding and destroying foreign substances.
- Myelogenous (my-e-LOJ-e-nus) leukemia affects other types of white blood cells in the bone marrow.

Understanding Leukemia Lingo

Many of the terms associated with leukemia, including the name of the disease itself, are derived from the Greek language. Breaking down the words into their Greek roots makes them easier to understand.

- **Leuk-** or **leuko-** means white or colorless and is used to form the words leukemia and leukocyte.
- **-emia** means blood and is found in the words leukemia and anemia.
- **-cyte** means cell and is used to form the words leukocyte, erythrocyte, and lymphocyte.
- **Erythr-** or **erythro-** means red. Erythrocytes are red blood cells.
- **Chron-** or **chrono-** means time. Chronic leukemia develops over a long period of time.

- * **risk factors** are any factors that increase the chance of developing a disease.
- * **radiation** is energy that is transmitted in the form of rays, waves, or particles. Only high-energy radiation, such as that found in x-rays and the sun's ultraviolet rays, has been proven to cause human cancer.
- * **radiation therapy** is a treatment that uses high-energy radiation from x-rays and other sources to kill cancer cells and shrink cancerous growths.
- * **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

In all, the disease has four main forms: acute lymphocytic leukemia (ALL), acute myelogenous leukemia (AML), chronic lymphocytic leukemia (CLL), and chronic myelogenous leukemia (CML). Another less common form is called hairy cell leukemia, a chronic condition in which the cells develop projections that look like tiny hairs.

What Causes Leukemia?

In most cases of leukemia, doctors cannot pinpoint a specific cause. However, researchers have identified a few possible risk factors*. Studies have shown that people who are exposed to high or repeated doses of radiation*, such as Japanese survivors of the atomic bomb dropped at Hiroshima during World War II, and people with other types of cancer who have been treated with radiation therapy*, are more likely to develop leukemia. Workers who are exposed to certain chemicals, such as benzene that is used in certain manufacturing processes, also develop leukemia more frequently. In addition, researchers have explored whether certain viruses may play a role in the disease.

Researchers also are examining how a person's genes* may be involved in causing leukemia. In studying the cells of people who have the disease, researchers have found that they often share certain genetic abnormalities.

Some people have suggested a possible connection between childhood leukemia and the low-energy waves given off by high-voltage electric power lines, but numerous studies have not shown a relationship.

GERTRUDE ELION: WOMAN OF SCIENCE

Gertrude Belle Elion (1918–1999) was a research chemist who patented more than 45 drugs including the first leukemia-fighting drug 6-mercaptopurine, Azathioprine (Imuran), a drug that helps the body accept transplanted organs, Trimethoprim (Septra), for bacterial infections, and Acyclovir (Zovirax), a drug used to fight herpes.

Elion's grandfather died of stomach cancer when she was 15-years old, and she decided then to become a cancer researcher. After graduating *summa cum laude* (with highest honors) in chemistry from Hunter College, she was rejected for jobs by 15 institutions where it was believed that research positions should be filled by men. Elion worked as a lab assistant, food analyst, and teacher, and received her master's degree in chemistry from New York University. Finally in 1944, she was hired by the pharmaceuticals company Burroughs Wellcome (now GlaxoSmithKline) to work with George H. Hitchings. It was during her 39-year career there that Elion made most of her scientific advances.

In 1988 Gertrude Elion was awarded the Nobel Prize in Medicine with Hitchings and Sir James Black. After she retired, Elion continued to do research and teach.

What Are the Symptoms of Leukemia?

When someone has leukemia, the abnormal, immature white blood cells that form cannot help the body fight off infections. As a result, the person may have frequent infections and develop flu-like symptoms, such as fever and chills. As these cells keep multiplying and move out into the body, they tend to collect in the lymph nodes* or in organs such as the liver* or spleen*. This symptom may cause pain and swelling. If the cells collect in the central nervous system (the brain and spinal cord), they may cause headaches, vomiting, confusion, loss of muscle control, or seizures.

The oversupply of white blood cells also interferes with the normal production of red blood cells and platelets, causing bleeding problems and a condition called anemia (a-NEE-me-a). Individuals may look pale or feel weak and tired. They may also bleed or bruise easily or find that their gums are swollen or bleeding. Other possible symptoms of leukemia include loss of appetite and/or weight; tiny red spots under the skin; sweating, especially at night; and bone or joint pain.

How Is Leukemia Diagnosed?

Doctors who see patients with these symptoms usually start by doing a full physical exam and feeling for swelling in the liver, the spleen, and the lymph nodes under the arms, in the groin, and in the neck. They may also take a sample of blood and examine it under a microscope to see what the cells look like and to determine the ratio of mature cells to immature cells. Although blood tests may reveal that a patient has leukemia, they may not show what type it is. To check further for leukemia cells or to identify what type of leukemia a patient has, a doctor may have to perform a bone marrow aspiration*. In this test, the doctor inserts a needle into a large bone, usually the hip, and removes a small sample of bone marrow to examine under a microscope for leukemia cells.

If leukemia is present, the doctor may order additional tests to look for abnormal cells in other parts of the body. A spinal tap involves taking a sample of the fluid that fills the spaces in and around the brain and spinal cord, so that it can be checked for leukemia cells. Chest x-rays and special scans can reveal signs of the disease elsewhere in the body.

How Is Leukemia Treated?

Once acute leukemia is diagnosed, doctors start treating it right away because it tends to worsen quickly. The goal is to bring about a complete remission, which means that the patient's bone marrow and blood no longer show any evidence of leukemia. Doctors can then give further treatment to help prevent a relapse, which means a return of the signs and symptoms of the disease after a period of improvement. In the early 2000s, many people with acute forms of leukemia are cured. Just a few decades before, medical professionals considered acute lymphocytic leukemia to be incurable.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.

* **aspiration** (as-puh-RAY-shun) is the sucking of fluid or other material out of the body, such as the removal of a sample of joint fluid through a needle inserted into the joint.

* **Identical twins** are twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.

Medical professionals can sometimes detect chronic leukemia through a routine blood test before symptoms appear. People with chronic leukemia may not need treatment right away if they are not having symptoms yet, and doctors continue monitoring the disease until treatment is needed. Doctors usually cannot cure chronic leukemia, but they can control it.

Chemotherapy The most common treatments for leukemia are chemotherapy (kee-mo-THER-a-pee), radiation therapy, and/or bone marrow transplantation. In chemotherapy, patients take one or more anticancer drugs, often by mouth or intravenously (through a tube in one of the veins). In certain cases, doctors need to inject the drugs directly into the fluid that surrounds the brain and spinal cord. Chemotherapy can cause side effects, such as hair loss, nausea, fatigue, or easy bruising, depending on the drugs used. Most side effects go away gradually between treatments or after treatment stops.

Radiation therapy In radiation therapy, doctors use a special machine to deliver high-energy rays that damage cancer cells and stop them from growing. They can direct the rays to one specific area of the body where leukemia cells have collected, such as the spleen, or to the whole body. Like chemotherapy, radiation therapy can cause temporary side effects, such as fatigue, hair loss, nausea, or red, dry, itchy skin.

Bone marrow transplantation In bone marrow transplantation, doctors give high doses of chemotherapy and radiation to destroy all of the patient's bone marrow. Doing so kills the cells that are the source of the cancer. They then give the patient healthy bone marrow from a donor whose tissue is similar. Ideally, the donor is an identical twin* or sibling. They also might give bone marrow that was removed from the patient earlier and specially treated to eliminate leukemia cells. A patient who has a bone marrow transplant usually stays in the hospital for several weeks. The risk of infection is high until the transplanted bone marrow begins to produce enough white blood cells.

Biological therapy Another treatment is biological therapy, which uses substances produced by the body to increase its ability to fight off leukemia. In the early 2000s, scientists had identified several of these substances that are involved in the immune response, which is the body's way of protecting itself from infections and other diseases. Scientists can produce some of these substances in the lab and use them to help the body defend itself against leukemia and other forms of cancer. As of 2009 one drug had been particularly successful in treating some forms of adult and pediatric chronic myelogenous leukemia. The drug imatinib mesylate works by targeting an abnormal protein that is involved in the overproduction of abnormal white blood cells. The drug is designed to rid the blood of the abnormal white blood cells and allow healthy blood cells to return in good numbers.

Living with Leukemia

Living with leukemia can be difficult. Not only can the disease make someone feel sick, but many of the treatments can, too. Fortunately, though, these treatments often make the disease go into remission. Patients who are in remission still need to see their doctors often for follow-up exams and tests. That way, if the leukemia comes back, medical professionals can detect it as early as possible.

Having leukemia can be difficult emotionally, too. Patients are scared when they find out they have a form of cancer and worry about what the future may hold. Some people withdraw, get angry, or become depressed. With the support of family, friends, support groups, and health professionals, however, a spirit of realistic optimism can win out.

▶ See also **Cancer: Overview • Immune Deficiencies • Radiation Exposure Conditions**

Resources

Books and Articles

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Shotel, Jay, and Sue Shotel. *It's Good to Know a Miracle: Dani's Story: One Family's Struggle with Leukemia*. New York: Gordian Knot Books, 2008.

Organizations

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-227-2345. Web site: <http://www.cancer.org>.

Leukemia and Lymphoma Society. 1311 Mamaroneck Avenue, White Plains, NY, 10605. Telephone: 914-949-5213. Web site: <http://www.leukemia.org>.

National Bone Marrow Transplant Link. 29209 Northwestern Highway, Number 624, Southfield, MI, 48034. Toll free: 800-LINK-BMT. Web site: <http://www.nbmtlink.org>.

National Cancer Institute. NCI Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov/cancertopics/wyntk/leukemia>.

Lice

Lice are tiny insects that can be found on the scalp, body, pubic area, or clothing and whose bites may lead to severe itching.



▲ Head louse clinging to a human hair seen under an electron microscope. CNRI/Photo Researchers, Inc.



▲ Human hair infested with *Pediculus humanus capitis* (louse) nits. The condition is known as pediculosis. *St. Bartholomew's Hospital/Photo Researchers, Inc.*

* **parasites** (PAIR-uh-sites) are organisms such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

A Lousy Deal

Lice are tiny insects found on the hairy parts of the body or in clothing. A single one of these insects is known as a louse, and the eggs of a louse are known as nits. The bites of these insects can cause an allergic reaction that results in severe itching. Judging from the way people talk, lice are not too popular. When people have an awful day, they say it was lousy. When they make a mess of things, they say they have loused up. When they are overly critical, they are said to be nit-picking.

What Are Lice?

The medical term for having lice is pediculosis (pe-dik-yoo-LO-sis). Lice are parasites* (PAIR-a-sites) that feed on human blood. There are three types of lice that live on humans:

- Head lice (*Pediculus humanus capitis*), usually found on the scalp
- Body lice (*Pediculus humanus corporis*), usually found in clothing and bedding from which they travel to the skin to feed, sometimes called clothing lice
- Pubic (PYOO-bik) lice (*Phthirus pubis*), found in the pubic area, surrounding the genitals, also known as crab lice because of their appearance under a magnifying glass

Who Gets Lice and How?

Lice are a common problem. Anyone can get lice. They are easily spread from person to person. Head lice are spread by close contact with a person who already has them. They also can be passed by sharing combs, brushes, hats, barrettes, pillows, headphones, and the like. Head lice are especially common in young children and their families. They may spread quickly among children in school or camp. They are not a sign of dirtiness or poor hygiene.

Body lice usually are passed through contact with clothing and bedding in which the lice are living. They are more likely to be found in people who live in crowded conditions where clothes are not changed or washed very often. Pubic lice usually are spread by close physical contact involving the genital area, such as sexual contact, so typically they are found in people who are sexually active. In rare cases, they may be picked up from bedding or clothing.

What Are the Symptoms?

Head lice do not cause serious medical problems. They usually are found on the scalp. Often they are seen at the back of the neck and around the ears. In a few cases, head lice are found on the eyelashes or eyebrows. The bite of the head louse can cause an allergic reaction that is annoying. The first sign of trouble usually is severe itching on the part of the body where the lice are biting. It may take as long as two to three weeks for the itching to start. Although it may be difficult, a person with lice should

try not to scratch, because doing so can spread the lice to other parts of the body. It also can lead to infection if germs enter the sores caused by scratching. Another possible sign of lice is a tickling feeling of something moving in the hair.

Although lice are tiny, they can be seen with the naked eye if a person looks closely. The nits, or eggs, are tiny yellow or white ovals firmly attached to the hair near the scalp. They may be confused with dandruff or drops of hair spray, but nits are much harder to detach from the hair than either of these. Nits take about a week to hatch into baby lice, known as nymphs. These babies turn into adults in another seven days or so. Adult lice have six legs and are about the size of a sesame seed. They can live for up to 30 days on a person.

Body lice are hard to see on the body, because they burrow into the skin. They are usually easiest to see in the seams of clothing, from which they travel to the skin to feed. Body lice are known to transmit three disease: epidemic typhus, trench fever, and epidemic relapsing fever. Body lice are less common than head lice. They tend to spread in conditions such as refugee camps or after natural disasters when many people are crowded together in colder climates and lack bathing and laundry facilities.

Pubic lice are found on the skin and attached to the hair in the pubic area around the genitals. Pubic lice are not known to transmit any diseases.

How Are Lice Treated?

Lice usually can be identified by sight. If the lice themselves are not seen, finding nits close to the scalp proves that a person has lice. The treatment for lice involves using a special shampoo, cream rinse, or lotion that contains a medicine that kills lice. Such medicines are known as pediculicides (pe-DIK-yoo-li-sides). Some are sold over the counter, but others are sold only with a doctor's prescription. Home remedies that do not include a louse-killing medicine may not always work.

When using a louse-killing medicine, individuals should read the label and follow the instructions carefully. These medicines may be harmful if not used correctly and should be used with adult supervision, as follows:

- Remove all clothing before the treatment.
- Apply the product according to instructions.
- Do not use a regular cream rinse or combination shampoo-conditioner first.
- Do not wash the hair again for a few days.
- Put on clean clothing after the treatment.

Special combs are used to help remove any leftover nits from the hair, which can be a tedious and time-consuming process. The louse-killing medicine may need to be used again in 7 to 10 days to make sure that no nits have survived. If the treatment does not work, people should talk to a doctor. They should not use extra amounts of medicine or more treatments than suggested.

What Else Can Be Done?

These steps must be followed along with the use of lice-killing shampoos, rinses, or creams to help prevent the spread of lice to others:

- Machine wash in hot water all clothing and bedding that the person with lice touched during the two days before treatment.
- After washing, put the clothes and bedding in a dryer on the hot cycle for at least 20 minutes.
- Dry clean any clothes that cannot be washed.
- Store any clothing, bedding, or stuffed animals that cannot be washed or dry cleaned in a sealed plastic bag for at least two weeks.
- Soak combs and brushes for about an hour in rubbing alcohol or Lysol, or wash them in soap and hot water.
- Vacuum the floors and furniture.
- Inform the school about students who have lice. Keep affected children home until 24 hours after treatment or as long as the school requires.
- Check other people who have had close contact with a person with lice for signs that they may have caught lice.
- Regarding pubic lice, affected individuals should inform all sex partners from the month before treatment and these individuals should be treated as well.

How Can Head Lice Be Prevented?

These steps can help prevent the spread of head lice:

- Never share combs and brushes.
- Always bring a personal sleeping bag and pillow to a sleep-over.
- Do not try on a friend's hat or headphones.
- If your head itches, have someone check it for lice immediately; do not wait.

▶ See also **Parasitic Diseases: Overview** • **Sexually Transmitted Diseases (STDs)**

Resources

Books and Articles

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Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/lice>.

National Pediculosis Association. P.O. Box 610189, Newton, MA, 02461. Toll free: 866-323-5465. Web site: <http://www.headlice.org>.

Liver and Biliary Tract Cancers

Liver and biliary tract cancers are cancers of the liver and/or the biliary tract.

What Are Liver and Biliary Tract Cancers?

Liver and biliary tract cancer are malignancies* of the liver*, and/or the biliary tract*, the system of tubes that carry digestive juices (bile) between the liver, gall bladder*, and small intestine.

What Causes Liver and Biliary Tract Cancer?

Liver cancer can be primary, meaning that it originates in the liver from liver cells, or secondary, meaning that it occurs due to the spread or metastasis of cancer cells from some other organ. Because the body's entire blood supply is filtered through the liver, the organ is particularly

- * **malignant** (ma-LIG-nant) a condition that is severe and progressively worsening.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **biliary tract** (BIH-lee-ah-ree) refers to the organs and ducts, including the liver and gallbladder, that produce, store, and transport bile, a substance which aids in digestion.
- * **gall bladder** is a small pear-shaped organ on the right side of the abdomen that stores bile, a liquid that helps the body digest fat.
- * **metabolize** refers to the processes within the body that are involved in converting food into energy and waste products.
- * **pancreas** (PAN-kree-us) is a gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.

ABOUT THE LIVER AND BILIARY TRACT

The liver is the body's largest internal organ. It is located in the abdomen under the right lung, protected by the ribs on that side of the body. All of the body's blood circulates through the liver, which serves a variety of important functions, including acting as a filter to remove waste products from the body, breaking down (metabolize*) nutrients and other substances (including drugs) into usable parts, storing nutrients, producing chemicals necessary for normal blood clotting, and secreting digestive juices into the small intestine.

The biliary tract is the system of tubes that carries bile from the liver to the small intestine. Tubes or ducts from the gall bladder and from the pancreas* also empty into the main liver duct. The gall bladder and the pancreas also contribute important products that are involved in the process of digestion.

- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.
- * **chronic** (KRAH-nik) lasting a long time or recurring frequently.
- * **hepatitis** (neh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.
- * **cirrhosis** (sir-O-sis) is a condition that affects the liver, involving long-term inflammation and scarring, which can lead to problems with liver function.
- * **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

susceptible to receiving cancer cells that originate in other body organs. Lung, breast, and colon cancers are particularly likely to spread to the liver. In the United States, only about 2 percent of all cancers are due to primary liver cancer.

There are a number of different types of primary liver cancers. Seventy-five percent of all primary liver cancers arise in the most prominent type of liver cell, called the hepatocyte. These cancers are called hepatocellular carcinoma. Ten to 20 percent of all primary liver cancers are the type called cholangiocarcinomas, meaning that the cancer has originated in the cells that line the bile-carrying tubes or ducts. More rare forms of primary liver cancer originate in the blood vessels of the liver and are called angiosarcomas or hemangiosarcomas. These types of liver cancer are usually found only after they have already spread significantly. They are difficult to treat and frequently fatal within a few months after diagnosis.

Who Gets Liver and Biliary Tract Cancer?

In the United States, about 21,370 people are diagnosed with primary liver cancer and bile duct cancer every year, and about 18,410 people die of the disease annually. Over the course of their lifetimes, about one in 114 men and one in 250 women develop the disease.

Men are twice as likely as women to develop a primary liver cancer. In the United States, people over 50 years of age are also at higher risk of liver cancer; in Africa and Asia, people between 20 and 50 years of age are at high risk of developing liver cancer. Other risk factors for the development of liver cancer are diabetes*, obesity*, chronic* hepatitis*, family history of liver cancer, exposure to aflatoxin (a toxic substance produced by fungi that grow on crops such as corn, soybeans, and peanuts), diseases of the liver or bile ducts (such as cirrhosis* of the liver or the bile duct disease called primary sclerosing cholangitis), arsenic in the water supply (as can occur in some developing countries), use of anabolic steroids or male hormones, use of birth control pills, excess alcohol consumption, smoking, and exposure to toxic substances (particularly those used in plastics manufacturing).

What Are the Symptoms of Liver and Biliary Tract Cancer?

Symptoms of liver and biliary tract cancer include unintentional weight loss; decreased appetite; a sensation of fullness after eating only a small quantity; abdominal swelling, especially in the area of the liver (on the right side of the abdomen); pain in the abdomen, sometimes stabbing through to the back and or shoulder; yellow cast to the whites of the eyes and/or the skin (jaundice*); itchy skin; dark urine; significant loss of energy, weakness, fatigue; nausea and vomiting; fever, chills, and/or night sweats; increased severity of symptoms associated with pre-existing hepatitis or liver cirrhosis.

How Is Liver and Biliary Tract Cancer Diagnosed?

Liver and biliary tract cancer may be suspected based on the presence of characteristic symptoms, as well as due to knowledge of the individual's personal or family history. A physical examination may reveal tenderness or swelling in the area of the liver. Blood tests may be ordered to see whether the liver is functioning properly and to test for levels of a substance called alpha-fetoprotein, which is elevated in liver cancer. Tests such as an ultrasound*, computerized tomography* (CT) scan, or MRI* may be performed in order to visualize the liver and look for tumors. An angiogram involves the use of dye, which is injected into an artery; the dye goes through the liver's blood circulation, allowing x-rays to reveal the presence of liver tumors and demonstrating which blood vessels are feeding those liver tumors. A biopsy may be performed in order to remove a small sample of liver tissue, either with a very thin needle (fine needle aspiration), a hollow needle (core biopsy), through a tiny incision during laparoscopic surgery, or through a classical incision during an open operation. Examination of this tissue under a microscope allows identification of the specific type of cancer cell.

How Is Liver and Biliary Tract Cancer Treated?

Liver and biliary tract cancer is treated in various ways. Surgery may be used to remove tumors. Chemotherapy involves the use of drugs that are toxic to the cancer cells (but also, unfortunately, often to normal cells as well). Radiation therapy uses x-rays to shrink tumors. Embolization is a technique in which the blood vessels that feed liver tumors are injected with a substance that blocks the blood flow to the tumors, thus depriving the cancer cells of the oxygen and nutrients they require to grow. Cryosurgery uses extremely cold temperatures to kill abnormal tissue within the liver, whereas ablation uses radio-wave-generated heat or injections of alcohol to kill tumor cells. In cases in which the liver cancer is completely confined to the liver, liver transplant may be considered.

Can Liver and Biliary Tract Cancer Be Prevented?

The risk of developing liver and biliary tract cancer can be lowered by making sure that people are vaccinated against hepatitis B; avoiding behaviors that increase the chance of being exposed to hepatitis C (such as sharing dirty needles, having unprotected sex, or receiving contaminated blood transfusions); improving food storage (to decrease aflatoxin exposure); discouraging smoking and excess alcohol use; and purifying drinking water.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **MRI** short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

▶ See also **Cancer: Overview**

* **emphysema** (em-fuh-ZEE-mah) is a lung disease in which the tiny air sacs in the lungs become permanently damaged and are unable to maintain the normal exchange of oxygen and other respiratory gases with the blood, often causing breathing difficulty.

Resources

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Sleisenger and Fordtran's Gastrointestinal and Liver Disease, 8th ed.
Lanham, MD: Saunders, 2006.

Organizations

- American Cancer Society.** P.O. Box 22538, Oklahoma City, OK, 73123. Toll free: 866-228-4327. Web site: <http://www.aafp.org/afp/20040701/123.html>.
- American Liver Foundation.** 75 Maiden Lane, Suite 603, New York, NY, 10038. Toll free: 212-668-1000. Web site: <http://www.liverfoundation.org>.
- National Cancer Institute.** Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov/cancertopics/wyntk/liver>.

Lockjaw See *Tetanus (Lockjaw)*.

Lou Gehrig's Disease See *Amyotrophic Lateral Sclerosis*.

Lung Cancer

Lung cancer is an abnormal growth of cells in the lungs, usually caused by smoking cigarettes, that frequently spreads to other parts of the body and is often fatal.

Even the Marlboro Man Was not Immune

In the 1960s, actor David McLean was hired to portray the Marlboro Man, a macho, cigarette-smoking cowboy, in television and print advertising for the tobacco company Philip Morris. McLean smoked many packs of cigarettes to get the right, ruggedly handsome look for each ad, and later he continued to receive boxes of cigarettes as gifts from the company. McLean had begun smoking at age 12, and he never was able to quit. In 1985 he began to suffer from a lung condition called emphysema* due to smoking,

and in 1993 he was diagnosed with cancer of the right lung. By 1995 the cancer had spread to his brain and spine. McLean died that year at age 73.

Fast Facts about Lung Cancer

Lung cancer is the world's top cancer killer, claiming 1.3 million lives and accounting for 15 percent of all newly diagnosed cancers in the United States each year. A difficult cancer to treat, lung cancer is responsible for 30 percent of all cancer deaths per year. Nearly three of every four people who are newly diagnosed with lung cancer die within two years. The single biggest cause of lung cancer is cigarette smoking.

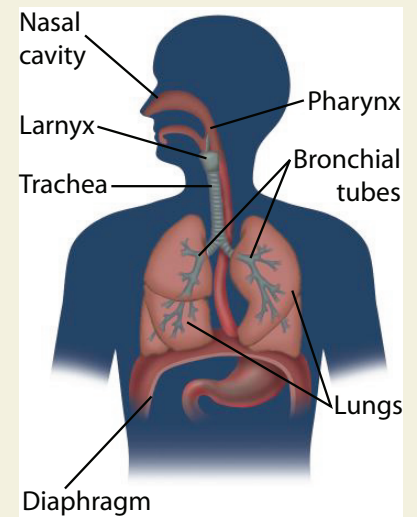
How Do the Lungs Work?

The lungs allow people to breathe by bringing air in and out. Lungs take in oxygen and get rid of carbon dioxide, a gas that is a waste product of the body. The lungs are two sponge-like organs in the chest. The right lung has three sections, called lobes, and the left lung has two. A lining, called the pleura (PLOOR-a), surrounds the lungs and helps protect them. Air travels into the lungs through the trachea (TRAY-kee-a) (also called the windpipe), which divides into two tubes called bronchi (BRONK-eye), which in turn divide into small branches called bronchioles (BRON-kee-oles). At the distant tips of these branches are millions of tiny air sacs called alveoli (al-VEE-o-lye), which look like little buds. These structures together make up the lungs.

How Does Lung Cancer Start?

Lung cancer usually starts in the lining of the bronchi. However, it can begin in any other part of the lungs. The disease takes a long time to develop. Lung tissue, like other kinds of body tissue, contains DNA*. This material that people inherit from their parents contains the instructions, or genes*, for everything the cells do. Gene changes, called mutations, can cause normal cells in the lungs to behave abnormally and to form cancers. Some genes tell cells when to grow, and others tell them when to stop growing. Mutations in these genes may tell cells to grow too much, or they may fail to tell them to stop growing. In either case, the result is cells that are out of control. The cells have repair mechanisms to correct the faulty signals, but when a cell is growing very fast, errors may slip past.

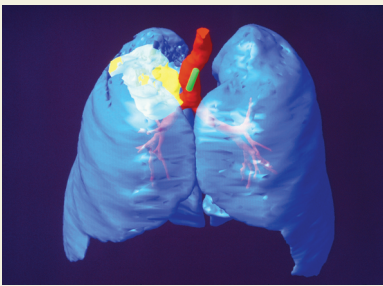
Most of the mutations that occur in lung cancer are not believed to be changes that are inherited from a person's parents. Instead, the mutations seem to occur during the person's lifetime. However, it is possible for a person to inherit a reduced ability to break down certain kinds of cancer-causing chemicals. Because cases of lung cancer sometimes cluster in families, scientists think some lung cancers may develop due to a combination of genes and cigarette smoking. In other words, people who have inherited certain genes and who also smoke might be more likely to develop lung cancer than other people who smoke but do not have



▲
Anatomy of the respiratory system.
Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.



▲
Color-enhanced CT scan showing what lung cancer looks like inside the body. Healthy lung tissue is shown in blue and the major air passages are in red. The cancerous lung tumor is yellow and the green rod is the tube (endoscope) that the doctor uses to view the tumor and to plan the surgery to remove it.
Volker Steger/Siemens/Photo Researchers, Inc.

Young People and Smoking

A study published in the *Journal of the National Cancer Institute* in 1999 showed that lung cancer patients who had started smoking before age 15 had twice as many DNA changes in their lung tissue as those who started after age 20. The message from this study is that smoking at a very young age may be especially likely to cause permanent lung damage.

those genes. The specific genetic factors that increase risk for lung cancer remained unclear as of 2009. A large study of 5,000 persons, funded by the National Institutes of Health, searched for genes that increase the risk of lung cancer in people who smoke or have been exposed to various environmental agents.

Who Gets Lung Cancer?

In the United States, there are more cases of lung cancer each year than cases of breast cancer, prostate cancer, and colon cancer combined. In 2003, 105,508 men and 84,798 women in the United States were diagnosed with lung cancer. It was estimated that in 2008, 215,020 people (114,690 men and 100,330 women) would find out they have the disease.

Lung cancer occurs more often in men (78.5 cases per 100,000 men in 2003) than in women (51.3 cases per 100,000 women in 2003). Black men are 50 percent more likely to get lung cancer than white men. This trend does not hold for women; rates of lung cancer are about the same in white and black women. Hispanics, who are less likely to smoke cigarettes, get lung cancer less often than either whites or blacks. Lung cancer is a concern in Asian and Native American populations, too. The disease is rare in people under age 45, because lung cancer takes years to develop. The number of cases increases with age, particularly after age 65.

More people die from lung cancer each year than from any other kind of cancer. The American Cancer Society estimates that in 2008, 40,480 people would die from breast cancer, 28,660 people from prostate cancer, and 50,330 from colon cancer, but 161,840 people from lung cancer. While men are more likely to die from lung cancer than women, in the late 20th century, women were catching up. In 1979 only 26 percent of lung cancer deaths occurred in women, but by 2003 this figure had increased to 43 percent.

The rates of death from lung cancer vary by state. For example, in 2002 Utah had the lowest rate of lung cancer deaths: 20.1 lung cancer deaths for every 100,000 women and 38.1 deaths for every 100,000 men in 2002; whereas Kentucky had the highest rate, with 73.0 lung cancer deaths for every 100,000 women and 133.8 deaths for every 100,000 men. Louisiana, Mississippi, Arkansas, Tennessee, Indiana, and West Virginia had high rates of death from lung cancer. These differences in death rates correspond to cigarette smoking trends: states with higher rates of cigarette smoking have higher rates of death from lung cancer. In addition, the American Cancer Society stated that the states with the highest death rates from lung cancer were states without strong public health programs that discouraged tobacco use. In the 1990s the death rate from lung cancer in people 30 to 39 years of age fell by 19 percent in California and 28 percent in Oregon after those states developed strong anti-tobacco programs. During those same years, the rate of death from lung cancer increased in states with weak anti-tobacco programs, including West Virginia, Kentucky, and Missouri.

What Causes Lung Cancer?

More than 80 percent of lung cancer is caused by smoking. Tobacco smoke damages cells in the lungs of smokers in ways that can lead to cancer. Smokers are 10 times more likely than non-smokers to get lung cancer, and the longer a person has been smoking, the greater the risk. Breathing second-hand smoke, the smoke given off by burning cigarettes or exhaled by smokers, causes about 3,400 lung cancer deaths each year.

At least 15,000 deaths from lung cancer each year are caused by radon gas. Radon occurs naturally in soil and rocks that contain uranium. Radon gas seeps into homes through cracks and other openings. It is estimated that 8 million homes in the United States have unsafe levels of radon. Radon in homes cannot be seen or smelled, but it can be measured with a simple test kit.

People who have worked with asbestos, a substance once widely used as an insulating material that was later banned in the workplace and in home products, also have a higher risk of getting lung cancer. Other risk factors for the disease include cancer-causing chemicals in the workplace.

What Happens When People Have Lung Cancer?

Symptoms Symptoms of lung cancer often do not appear until the disease is advanced. Many times, the cancer is discovered when a person gets a chest x-ray for an unrelated reason. When symptoms do occur, they are so general that many conditions could cause them. Possible symptoms include a cough that does not go away, chest pain, hoarseness, bloody sputum*, and shortness of breath. The only way to find out for sure whether cancer is causing these symptoms is to be examined medically.

Diagnosis The doctor will perform a physical exam and if lung cancer is suspected will probably order a chest x-ray. The doctor may also take a sample of sputum to be examined for abnormal or cancerous cells. In addition, if a tumor* is found on the x-ray, the doctor can perform a biopsy* of the lung tissue. This procedure uses special instruments to remove a small sample of abnormal tissue from the lung for examination under a microscope.

How Is Lung Cancer Treated?

Staging First, tests are done to find out how advanced the cancer is and if it has spread. Based on these tests, the cancer usually is assigned a Roman numeral from I to IV. This process is called staging. The smaller the number, the less the cancer has spread. The larger the number, the more it has spread and the more serious disease. This system is used for most types of lung cancer, including the types called squamous cell cancer, large cell cancer, and adenocarcinoma. One-fourth of lung cancers are a type called small cell lung cancer. Instead of getting a Roman numeral,

* **sputum** (SPYOO-tum) is a substance that contains mucus and other matter coughed out from the lungs, bronchi, and trachea.

* **tumor** (TOO-mor) is an abnormal growth of body tissue that has no known cause or physiologic purpose. A tumor may or may not be cancerous.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

So Long, Joe Camel

For a long time, cigarette advertising on billboards was a familiar feature of the American landscape. One of the most famous signs was a 72-foot-high billboard in New York's Times Square that showed Joe Camel puffing out smoke rings, which was displayed for 25 years.

During the 1980s one in three billboards advertised tobacco. However, in 1999, as part of a \$206 billion agreement between tobacco producers and 46 states to settle lawsuits related to smoking, cigarette makers and outdoor advertising companies removed tobacco billboards all over the United States.

* **chemotherapy** (KEE-mo-THER-ə-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

this type is rated as either limited (not widespread) or extensive (in both lungs, for example, and spread to distant organs).

The best treatment for lung cancer is determined by the type of cancer, the stage, and the person's overall health. Treatment usually consists of a combination of surgery, chemotherapy*, and radiation therapy.

Surgery For cancer that has not spread, surgery offers the chance of a cure by removing the diseased part of the lung. However, some tumors cannot be removed by surgery due to their size or location, and some patients cannot have surgery for other health reasons.

Chemotherapy Chemotherapy is the use of anticancer drugs to kill cancer cells. The drugs are given into a vein or as pills. Because these drugs enter the bloodstream and can reach all areas of the body, they may be useful for treating cancer that has spread beyond the lungs. Chemotherapy can have side effects, however, including nausea (a feeling of wanting to throw up) and hair loss. Not everyone reacts to chemotherapy in the same way. Usually, the side effects disappear and hair begins to grow back when the treatment is over.

Radiation therapy Radiation therapy is the use of high-energy x-rays to kill or shrink a tumor. In lung cancer patients who are not healthy enough for surgery, radiation may be the main treatment. For other patients, radiation may be used after surgery to kill small areas of cancer cells too tiny to be seen during surgery. Radiation can make a person feel tired, and the skin in the treated area may look first sunburned, then tan. The skin eventually returns to normal.

Can Lung Cancer Be Prevented?

No smoking The best way to prevent lung cancer is by not smoking. People who do not smoke should not start, and people who do smoke should quit. Because the nicotine in cigarettes is so addicting, it is not easy to quit, but it is well worth the effort. Simply switching to "low tar" or filtered cigarettes does not prevent cancer, nor does it diminish the addictive properties of nicotine. People should also avoid breathing in other people's smoke. In addition, people can test their home for radon, find out whether cancer-causing chemicals are used in their workplace, and take steps to protect themselves.

Advances anticipated in the 21st century Researchers are looking at new approaches to chemotherapy, surgery, and radiation and trying to find the best combinations of therapies. For example, chemotherapy followed by surgery and radiation helps some patients to live longer. Giving two types of chemotherapy at the same time or giving chemotherapy and radiation at the same time instead of sequentially is another promising approach. In the early 2000s, studies were testing a type of radiation therapy in which smaller doses are given more often in hopes

of killing more cancer cells. Treatments that help the patient's immune system* fight lung cancer more effectively was also a focus of research. In addition, gene therapy* may one day be able to repair the genetic mutations that lead to lung cancer.

Research also explored ways to prevent lung cancer in people at high risk by using vitamins, foods, and medications, but the results as of 2009 were not very helpful. Researchers also looked into ways of detecting lung cancer earlier. As of 2009, prevention seemed to offer the greatest chance for fighting lung cancer. The best prevention is not to start smoking, but if people do smoke, then the best choice is for them to quit.

Living with Lung Cancer

Some people recover from lung cancer, but even in the least severe cases, only 50 percent of people with lung cancer are living five years after their diagnosis. When all cases of lung cancer are taken together, including both most severe and least severe cases, the survival rate at five years drops to 15 percent. This statistic explains why it is so important not to start smoking and for smokers to quit smoking.

Because of the low rate of cure, lung cancer patients typically have concerns about whether the cancer will come back after treatment and how long they will live. People need their lungs to breathe, so in advanced cases, as the cancer takes up more and more of the space usually occupied by air, breathing becomes difficult. In addition, growth of the cancer around certain nerves may cause severe pain. Medications can relieve this pain, and patients should not hesitate to ask for them.

▶ See also **Cancer: Overview • Tobacco-Related Diseases • Tumor**

Resources

Books and Articles

Quick Facts Lung Cancer: What You Need to Know—Now, from the Experts at the American Cancer Society. Atlanta, GA: American Cancer Society, 2007.

Raez, Luis E., and Orlando E. Silva. *Lung Cancer: A Practical Guide.* Edinburgh, NY: Saunders, 2008.

Organizations

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-ACS-2345. Web site: <http://www.cancer.org>.

American Lung Association. 1301 Pennsylvania Ave. NW, Suite 800, Washington, DC, 20004. Toll free: 800-LUNG-USA. Web site: <http://www.lungusa.org>.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **gene therapy** is a treatment that works by altering genes.



▲
Dark red mottled areas on a woman's cheeks caused by Lupus Erythematosis.
Custom Medical Stock Photo, Inc.
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* **rheumatologist** (roo-ma-TOL-o-jist) is a doctor who specializes in disorders involving the connective tissue structures of the body.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://cancernet.nci.nih.gov/cancertopics/types/lung>.

Lupus

Lupus (LOO-pus) is a chronic (long-lasting) disease that causes inflammation of connective tissue, the material that holds in place the various structures of the body.

Julia's Story

"Oh, not again!" shouted 18-year-old Julia, her toothbrush falling into the sink with a clatter. It was the fifth morning this week that it had slipped from her hands. She had been waking up with achy, puffy hands, and she was finding it hard to grip objects with her stiff fingers. A few weeks later, when filling out a form for a back-to-school physical, she wrote about her stiff hands and also mentioned that she had been feeling really tired all summer. Her doctor suggested she get some blood tests and called Julia's mother a few days later with a referral to a rheumatologist*. He suspected that Julia had lupus.

What Is Lupus?

Lupus is one of several diseases that are grouped under the collective term of collagen vascular diseases. Collagen vascular diseases are those that affect the connective tissues, materials that hold the various structures of the body in place. Specifically, lupus causes inflammation of connective tissues in the body. The medical name for lupus is lupus erythematosus (er-i-thee-ma-TO-sus).

Lupus is divided into two main types:

- Discoid lupus erythematosus (DLE), which mostly causes red-dened patches on the skin
- Systemic lupus erythematosus (SLE), which affects the skin but also involves other tissues and organs.

A third condition, called lupus vulgaris, is unrelated to lupus erythematosus. It is a rare form of tuberculosis that typically produces nodules, or small lumps, on the skin.

Who Gets Lupus?

Lupus is a disorder that occurs worldwide and in people of all ages. In the United States, the Lupus Foundation of America estimates that 1.5 to 2 million, and possibly more, Americans have some form of the disease.

In the United States, lupus is more prevalent among people of African, American Indian, Asian, and Latino ancestry than in people of European descent.

Although members of both sexes can get lupus, more than 9 out of 10 people who have the disease are women. Like Julia, most women show their first signs of the disorder between the ages of 15 and 25.

What Causes Lupus?

Lupus is not a contagious disease. One person cannot catch it from another, and nobody needs to avoid being near someone who has lupus.

In 5 to 10 percent of cases, certain prescription drugs, such as those used for irregular heartbeat or high blood pressure, can cause symptoms of SLE. (The symptoms usually go away when the drugs are discontinued.) Medical professionals most often see this condition, which they call drug-induced lupus, in elderly patients.

For the remaining 90 percent of SLE cases and in all instances of DLE, the cause or causes of the disorder remained unclear as of 2009. Although many people who have studied lupus agreed that it is an autoimmune disorder, which is a reaction of the immune system against one's own body, they still had many questions because the causes of immune disorders were not well understood. Researchers and medical professionals did, however, believe that some factors can play a role in the development of lupus.

One of those factors is heredity. Researchers determined that a person with a close relative who has SLE is slightly more likely to develop the disease than someone who does not. For instance, about 5 percent of children born to a parent with lupus develop the disease themselves. Scientists explored the genetic connection and found genes on two chromosomes that show connections to lupus among some families.

Certain environmental influences may play a part in the onset of lupus. Researchers believe that bacteria, viruses, extreme stress, sunlight, certain antibiotics, or food additives may trigger autoimmune responses in some individuals. Nonetheless, not everyone gets lupus because they caught a particular virus or bacterium, are stressed, took a certain antibiotic, or ate a certain food.

In addition, the fact that women are much more likely to get lupus than men suggests that hormones may also be associated with the disorder.

What Are the Symptoms of Lupus?

The signs and symptoms of lupus vary greatly in different individuals, both in the parts of the body involved and in the degree of severity. The symptoms may also come and go and may disappear for weeks or months at a time. Although lupus occurs much more frequently in women than in men, the symptoms in males are no less severe than in females.

Discoid lupus erythematosus The mildest and most common form of lupus, DLE usually involves only the skin. It produces a rash of thickened, scaly reddish patches on the face and sometimes other parts of the

Did You Know?

- The name “lupus erythematosus” comes from the word “lupus,” which is Latin for “wolf,” and the word “erythema,” which refers to reddened skin. In the past, people thought that patients with the facial rash looked as though they had been bitten or scratched by a wolf.
- The large majority of lupus patients are women.
- Lupus is not contagious.
- No one symptom or one test is enough to tell whether someone has lupus.
- Many lupus patients develop arthritis.
- Many people with lupus have to stay out of the sun.
- Most lupus patients can lead nearly normal lives.

What Is an Autoimmune Disorder?

Nearly everyone is familiar with allergies such as hay fever and asthma, either in their own experience or that of friends or family. An autoimmune disorder is rather like a kind of allergy, except that the immune system attacks parts of one's own body instead of outside substances such as dust and pollen.

The normal function of the immune system is to protect the body from invading microorganisms or toxic substances. To perform this function, it produces antibodies and special white blood cells (lymphocytes) that recognize and destroy the intruders. In autoimmune disorders, these responses (for reasons that were not fully understood as of 2009) occur against the body's own cells, tissues, and organs. This reaction can produce a number of problems, including rheumatoid arthritis, a type of diabetes, and lupus.

* **arthritis** (ar-THRY-tis) refers to any of several disorders characterized by inflammation of the joints.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

body. Often the rash spreads in a characteristic butterfly-shaped pattern over the cheeks and bridge of the nose. After a few weeks or months, when healing has taken place, dark-colored or pale scars may remain. If the condition extends to the scalp, the person may lose some of his or her hair.

Sunlight tends to trigger and worsen the rash of lupus. In DLE, the patches sometimes nearly disappear during the winter months. Most people who have DLE are otherwise in good health. The condition only rarely progresses to SLE.

Systemic lupus erythematosus People with SLE may have the same type of rash as those with DLE, and they may lose hair as well. In SLE, however, the skin lesions may spread and cause damage to the mucous membranes, such as those in the nose or under the eyelids, and other tissues. Some SLE patients, however, do not get these skin problems.

Arthritis* may be the first symptom in some people with SLE. In fact, SLE is medically classified in the same family of diseases as rheumatoid arthritis; they are both collagen vascular diseases. Rheumatoid arthritis is a disorder that causes painful inflammation in the joints. Other early symptoms of SLE may include weakness, extreme fatigue, fever, sensitivity to sunlight, and loss of weight. In addition, about 40 percent of people who have lupus get Raynaud's disease, which can cause sudden numbness or coldness in the fingers or toes. Although it is less common, some patients with SLE also have another collagen vascular disease, called scleroderma. Doctors sometimes call this combination mixed connective tissue disease, or MCTD. Unlike lupus, scleroderma is characterized by a thickening and in some cases a hardening of the skin.

SLE may also affect internal organs, which frequently causes serious disorders. People with SLE commonly have problems with kidney function, and if the kidneys fail, they may experience uremia (yoo-REE-me-a), or the buildup of toxic substances in the blood. Uremia can be fatal. SLE may also have an impact on the nervous system and cause psychological problems, seizures*, or other symptoms. It can also involve the lungs, heart, liver, and blood cells.

In some cases, people with lupus also have certain antibodies, called anti-phospholipid (AN-ti-fos-fo-LIP-id) antibodies, in their systems. These antibodies interfere with the normal function of the blood vessels and can bring on a stroke or heart attack. In pregnant women, they can cause a miscarriage*.

How Is Lupus Diagnosed? Medical professionals often have a difficult time diagnosing lupus, especially if the patient has only a few symptoms, because no one sign or symptom unquestionably means someone has lupus, and no single laboratory test is able to diagnose it either. For these reason, doctors must rely on a combination of a thorough medical history, observations, and tests to make a definite diagnosis of lupus.

To diagnose systemic lupus erythematosus, which is one type of lupus, doctors may order blood tests to check for certain antibodies that attack

the nucleus of cells, and for specific white blood cells, called LE (lupus erythematosus) cells, that destroy other blood cells and are an indication of lupus. They may also perform a skin biopsy* (removal of a small sample) to examine it for antibodies active in lupus.

These tests can help the doctor to make an early diagnosis, which is important so that treatment can begin as soon as possible.

How Is Lupus Treated?

Depending upon the particular needs and symptoms of a lupus patient, a doctor may select from numerous treatment options, including prescribing one or more drugs to counteract pain, inflammation, and related problems.

Nonsteroidal anti-inflammatory drugs (NSAIDs), such as aspirin, ibuprofen*, and naproxen, are common choices for lessening pain and inflammation in the joints and muscles. Another group of medications, called corticosteroids*, helps reduce inflammation and activity of the immune system. A third group, called anti-malarials because they also are used to treat malaria, can help with skin and joint symptoms. A doctor may also recommend ointments and creams that contain corticosteroids and sunscreens to treat skin eruptions.

In the early 2000s, doctors sometimes also prescribed transplant drugs, such as mycophenolate mofetil (MMF) and azathioprine (AZA), and chemotherapy* drugs, called cyclophosphamide, to treat lupus. These drugs help fight the kidney inflammation associated with lupus.

Some of the drugs prescribed to treat lupus can cause unwanted side effects. For this reason, and because symptoms may change, patients need ongoing medical advice and regular checkups to stay on top of the disease, its symptoms, and possible unwanted drug reactions.

Does a Cure Exist for Lupus?

As of 2009, no cure was available for lupus, but effective treatment could maintain normal body function and control symptoms in the great majority of patients. Nonetheless, SLE can be a life-threatening disease, particularly when the kidneys are involved. The most common causes of death are kidney failure, bacterial infection, and heart failure.

Living with Lupus No specific preventive measure, such as vaccination*, was available to help a person avoid getting lupus as of 2009. People who were diagnosed with lupus, however, were advised to take steps to reduce the likelihood of “flares,” or sudden worsening of symptoms. Patients who were sensitive to sunlight could help prevent rashes by avoiding excessive exposure to the sun, using sunscreens, or wearing broad-brimmed hats. Although no lupus vaccination existed, doctors recommended immunizations against other infections.

Lifestyle changes help patients with lupus avoid or control symptoms as well. Regular exercise can prevent some muscle weakness and fatigue. Quitting smoking or resisting excessive alcohol consumption can bring

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **ibuprofen** (eye-bew-PRO-fin) is a nonsteroidal anti-inflammatory drug (NSAID) used to reduce fever and relieve pain or inflammation.

* **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.

* **chemotherapy** (KEE-mo-THER-α-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.



▲ Magnified photograph of an adult male deer tick, *Ixodes dammini*, a common source of Lyme disease in the United States. Kent Wood/Photo Researchers, Inc.

How to Remove a Tick

Using thin-tipped tweezers, grasp the tick as close to the person's skin as possible.

Pull straight upward firmly and steadily until the tick lets go (do not squeeze or twist the tick body).

Clean the skin with soap and warm water, alcohol, or other antiseptic.

Save the tick for identification.

Petroleum jelly, lit matches, nail polish or other products do not help in tick removal and should not be used.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

about general health improvements. Joining support groups and talking with family, friends, and physicians can ease the effects of stress.

▶ See also **Arthritis • Kidney Disease • Raynaud's Disease • Scleroderma**

Resources

Books and Articles

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Organizations

Lupus Foundation of America. 2000 L Street NW, Suite 710, Washington, DC, 20036. Toll free: 800-558-0121. Web site: <http://www.lupus.org>.

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-226-4267. Web site: http://www.niams.nih.gov/Health_Info/Lupus/default.asp.

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web site: <http://www.4woman.gov/FAQ/lupus.htm>.

Lyme Disease

Lyme (LIME) disease is a tick-borne illness, the most common tick-borne illness in the United States. It is a bacterial disease that is spread to humans by the bite of an infected tick. It usually begins with a distinctive rash and/or flu-like symptoms and, in some cases, can progress to a more serious disease with complications that affect multiple body systems.

What Is Lyme Disease?

Lyme disease was first described in 1977 when a group of children living in and around Lyme, Connecticut, became ill with arthritis. In its early stage, Lyme disease produces flu-like symptoms; if untreated, the disease can progress to affect the joints, heart, and central nervous system*, especially in adults.

Lyme disease is caused by a corkscrew-shaped bacterium called *Borrelia burgdorferi* (buh-REEL-e-uh burg-DOR-fe-ree). It is most commonly carried by very small, immature ticks of the genus *Ixodes* (iks-O-deez) group called deer ticks or black-legged ticks. Deer ticks spread Lyme disease in the

Northeast, Midwest, and some other parts of the United States; another kind of *Ixodes* tick, the western black-legged tick, is the source of Lyme disease in the western United States. Lyme disease also occurs in other countries, such as China, Japan, and some countries in Europe.

Lyme disease is not spread from person to person. It is spread by ticks that become infected with *Borrelia burgdorferi* after feeding on an animal, usually a mouse. Ticks then pass the bacteria to humans while attached to the person's skin and feeding on the person's blood. To infect a human, the tick must be attached for at least 24 hours. A bite by a tick does not mean that the individual will get Lyme disease; most tick bites do not cause disease.

How Many People Get Lyme Disease?

In 2007, 27,444 cases of Lyme disease were reported in the United States, according to the Centers for Disease Control and Prevention (CDC). Although cases of Lyme disease have been reported in nearly every state, most cases are reported in New York State, Connecticut, Massachusetts, Maine, Rhode Island, New Hampshire, Pennsylvania, New Jersey, Delaware, and Maryland, and in Minnesota, Wisconsin, and California. These areas have natural habitats of *Ixodes* ticks.

People who live, play, or work in tick-infested wooded areas or areas of overgrown brush are most at risk of getting the disease. Lyme disease is most common during the late spring and summer months in the United States (May through September), when ticks are most active and people are frequently outdoors.

What Happens When a Person Has Lyme Disease?

Signs and symptoms Within a few days to weeks after being bitten by an infected tick, about 80 percent of people develop at the site of the bite a characteristic red circular rash the size of a quarter or larger known as erythema migrans (air-uh-THEE-muh MY-granz). The center of the rash may clear as it grows, giving the appearance of a bull's-eye pattern. The rash may be warm to the touch, but it is usually not painful or itchy. Other symptoms in the early stage of Lyme disease may include tiredness, fever, chills, joint pain, muscle aches, headache, stiff neck, and swollen lymph nodes* (glands). Not everyone who is infected with the bacterium gets ill. Some people have no noticeable symptoms, and some only have the non-specific, flu-like symptoms, such as fever and headache.

If untreated, Lyme disease can progress to the next stage, called the early disseminated stage, as the infection spreads and starts to affect a range of body functions. This more advanced stage appears a few weeks to as long as three months after a bite by an infected tick. Symptoms may include two or more areas of rash, severe headache, severe tiredness, stiffness in the joints and neck, one-sided facial paralysis* (Bell's palsy*), tingling or numbness in the legs and arms, irregular heartbeat, fever, and meningitis*.



▲ The telltale “bull’s eye” circular rash at the site of a tick bite on the human arm. ©CDC/Peter Arnold, Inc.

- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.
- * **Bell's palsy** (PAWL-zee) is a condition in which there is weakness or loss of function of muscles on one side of the face.
- * **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

Mothers Lead the Charge

In 1975 the mothers of a group of children who lived near each other in Lyme, Connecticut, contacted the Connecticut State Health Department and Yale Medical Center to report that children in their area were being diagnosed with rashes and pediatric arthritis. After a two-year investigation, Allen C. Steere of Yale University called the condition Lyme arthritis. In 1982 Willy Burgdorfer of the Rocky Mountain Laboratory in Hamilton, Montana, discovered the cause of the disease, a spirochete (a type of bacterium), which was subsequently named *Borrelia burgdorferi* in his honor.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

* **endemic** (en-DEH-mik) describes a disease or condition that is present in a population or geographic area at all times.

A late stage of Lyme disease may develop weeks to years later if the disease remains untreated. In this stage, symptoms can include chronic Lyme arthritis (episodes of pain and swelling in the joints, especially in the arms and legs), memory loss (which is rare in children and teens), and numbness in the hands, arms, legs, and feet.

Diagnosis Diagnosing Lyme disease can be difficult because the symptoms often look like those of other diseases. In addition, doctors may have difficulty in distinguishing it from conditions with similar symptoms, particularly in cases in which the characteristic rash is not present. A known recent tick bite or the erythema migrans rash is often key to the diagnosis of Lyme disease. Following a physical examination and the taking of a medical history that has included the doctor's asking about the patient's exposure to tick-infested areas, the doctor may order blood tests that look for the presence of antibodies* to *Borrelia burgdorferi*. If any joints are swollen or signs of meningitis are present, joint fluid or spinal fluid is sometimes evaluated for evidence of *Borrelia* infection.

Some blood tests for *Borrelia* infection can give false negative results, particularly if performed within the first month after infection. False positive test results can also occur. Because of this, doctors may have difficulty interpreting Lyme disease test results and confirming a diagnosis.

Treatment Lyme disease is usually treated with antibiotics*, which are taken for three to four weeks. Antibiotics used to treat Lyme disease are typically taken by mouth, but in severe or advanced cases of Lyme disease they may be given by injection. If treatment begins at the early stage of the disease, a complete cure is likely; it generally takes a few weeks or months for the symptoms to go away. Sometimes symptoms recur, making it necessary for a patient to take another course of antibiotics. If treatment is not started until later in the progression of the disease (at the early disseminated or late stage), antibiotics are still effective, but recovery may take longer; the patient's symptoms may last for months or even years. Children usually recover from Lyme disease faster and with fewer complications than do adults.

A person who is not ill may be treated preventively with a single dose of antibiotics if the following applies to the case: the tick has managed to remain attached to an individual's skin for several days and has become engorged with blood; the tick was acquired in a Lyme-endemic* area; and the individual is not showing symptoms of Lyme disease.

Is Lyme Disease Preventable?

The best way to prevent Lyme disease is to prevent tick bites. Experts recommend the avoidance of areas that are likely to be infested with ticks, particularly in the spring and summer when nymph (immature) ticks feed. For any activity in tick-infested areas, it is wise to take the following precautions:

- Wear light-colored clothing so that ticks can be spotted easily.
- Keep arms and legs covered.

- Wear high rubber boots, because ticks usually are found close to the ground.
- Tuck shirts into pants and pants into socks or boots to help keep ticks from reaching the skin.
- Wear a hat and keep long hair pulled back.
- Shower and wash clothing after being in tick-infested areas.
- Inspect pets for ticks after they have been in the woods.

Applying insect repellents containing 10 percent DEET*, which is safe to use on children and adults, on both clothes and exposed skin, and permethrin (per-ME-thrin) (which kills ticks on contact) on clothes, may also help reduce the risk of tick attachment. If ticks are found attached to skin, they should be carefully removed with tweezers or forceps.

As of 2009, vaccines to prevent Lyme disease were under development but not yet available for use.

▶ See also **Tick-borne Illnesses**

Resources

Books and Articles

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Lang, Denise, with Kenneth B. Liegner. *Coping with Lyme Disease: A Practical Guide to Dealing with Diagnosis and Treatment*, 3rd ed. New York: Holt, 2004.

Wall, Mary. *Lyme Disease Is No Fun: Let's Get Well!* Jackson, NJ: Lyme Disease Association, 2004.

Organizations

American Lyme Disease Foundation. P.O. Box 466, Lyme, CT, 06371. Web site: <http://www.aldf.com/majorTick.shtml>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dvbid/Lyme>.

Lyme Disease Foundation. P.O. Box 332, Tolland, CT, 06084-0332. Telephone: 860-870-0070. Web site: <http://www.lyme.org>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/lymeDisease>.

Did You Know?

Immature ticks of the genus *Ixodes* (called nymph ticks) are about the size of a poppy-seed. Adult ticks are only the size of a sesame seed.

* **DEET** (abbreviation for N,N-Diethyl-meta-toluamide) is the active ingredient in many insect repellants.



▲ A lymphedema (swelling) is an accumulation of lymph fluid caused by obstructed lymph vessels. The red areas on the skin of the leg are due to an infection. Lymphedemas make the area more susceptible to infection.
Dr P. Marazziti/Photo Researchers, Inc.

* **lymphatic** (lim-FAH-tik) means relating to the system of vessels and other structures that carry lymph, a colorless fluid, throughout the body's tissues; the lymphatic system plays an important role in protecting the body from infections.

* **lymphatic system** (lim-FAH-tik) is a system that contains lymph nodes and a network of channels that carry fluid and cells of the immune system through the body.

* **radiation therapy** is a treatment that uses high-energy radiation from x-rays and other sources to kill cancer cells and shrink cancerous growths.

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

Lymphedema

Lymphedema, also called lymphatic obstruction, is swelling, usually of an arm or leg, due to the accumulation of fluids and other substances in soft tissues of the body. Lymphedema is caused by a blockage or malfunction in the body's lymphatic system*. It is a common complication of surgery or radiation therapy* for treating cancer*.*

What is Lymphedema?

Primary lymphedemas are rare inherited disorders in which components of the lymphatic system are abnormal or absent. Most lymphedemas are secondary or acquired, usually as a result of surgery or trauma* resulting in a malfunction in the lymphatic system. Secondary lymphedema can be temporary or acute*, lasting less than six months, or chronic*, lasting six months or longer—perhaps for the remainder of one's life.

Lymphedema can occur anywhere in the body but usually affects an arm or leg. What area is affected is determined by the cause of the lymphedema. Lymph-node removal to treat breast cancer can result in lymphedema in the arm. Treatments for gynecological cancer may result in lower-limb lymphedema.

The lymphatic system The lymphatic system is a network of vessels and nodes located throughout the body that collects excess fluid and other substances from tissues and transports them to the circulatory system*. The walls of the lymphatic vessels take up water, proteins, fats, cell waste products, and foreign* substances, including bacteria* and viruses*. Valves in the vessels keep the clear lymphatic fluid flowing through progressively larger vessels in the direction of the heart. Lymph from the right arm and right side of the head and chest flows to the right lymphatic duct and is released into the large vein* under the right collarbone. The left lymphatic or thoracic duct collects fluid from both legs, the left arm, and left side of the head and chest and empties into the large vein under the left collarbone.

The lymphatic system is an integral part of the body's immune* defenses. Lymph carries lymphocytes* or white blood cells and other immune system* cells for fighting infection and disease. The fluid passes through lymph nodes*—small bean-shaped structures that filter out harmful substances, recognize infectious organisms, and initiate an immune response.

If the volume of the lymphatic fluid exceeds the capacity of the system, protein-rich fluid collects in the tissues of the affected region. The accumulating fluid increases the size and number of channels in the tissues, which swell and begin to harden. The accumulating fluid also reduces the availability of oxygen*, interferes with healing, and creates a suitable environment for bacterial infection.

WHAT IS A PRIMARY LYMPHEDEMA?

Primary lymphedema can affect any or all of the limbs, but most often a foot or calf. It may be associated with other vascular* abnormalities. The three most common types of primary lymphedema are:

- Milroy disease or congenital* lymphedema, a malformation* of the lymph nodes that becomes evident during infancy
- Meige disease or lymphedema praecox, which develops in childhood or at the onset of puberty*, is far more common in females than in males, and is characterized by lymph vessels without valves to prevent the fluid from flowing backwards
- Late-onset lymphedema or lymphedema tarda, a very rare condition that develops after about age 35

Acute versus chronic lymphedema There are four types of acute lymphedema:

- Brief mild lymphedema that develops a few days after the surgical removal of lymph nodes or injury to the lymphatic vessels or veins under the collarbone
- Lymphedema caused by inflammation* of the lymphatic vessels, occurring six to eight weeks after surgery or during radiation therapy
- Lymphedema occurring after an insect bite, minor injury, or burn that leads to infection of the skin and lymph vessels near the skin surface
- The most common type—gradual-onset lymphedema—which develops slowly, becoming noticeable many months or years after surgery or other cancer treatment

Failure to control lymphedema in its early stages can lead to a chronic condition. Chronic lymphedema occurs when the lymphatic system cannot meet the increased requirement for fluid drainage from body tissues. As the lymphatic vessels expand, the fluid flows back into the tissues, worsening the condition.

Causes of lymphedema Secondary lymphedema usually results from physical damage to the lymphatic system, most often the lymph nodes in the groin, pelvis, and/or armpits. Scar tissue resulting from surgery and/or radiation treatments for cancer, especially breast or testicular cancers, can disrupt the flow of lymphatic fluid and is the most common cause of lymphedema. The removal of a large number of lymph nodes or radiation to an area where lymph nodes have been removed increases the risk of lymphedema. Poor drainage of the lymphatic system following

* **trauma** refers to a wound or injury, whether psychological or physical. Psychological trauma refers to an emotional shock that leads to lasting psychological damage.

* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **circulatory system** (SIR-kyoo-luh-tor-e) is the system composed of the heart and blood vessels that moves blood throughout the body.

* **foreign** means coming from outside a person's body.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. A virus can only reproduce within the cells it infects.

* **vein** is a vessel that carries blood to the heart. Veins have greater capacity and thinner walls than arteries and contain valves that prevent blood from flowing backward and away from the heart.

* **immune** (ih-MYOON) means resistant to or not susceptible to a disease.

* **lymphocytes** (LIM-fo-sites) are white blood cells, which play a part in the body's immune system, particularly the production of antibodies and other substances to fight infection.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

What Is Filariasis?

Lymphedemas caused by parasites or other infections are common in tropical and sub-tropical regions and in developing countries. Some 200 million people—primarily in Southeast Asia, India, and Africa—suffer from a form of lymphedema called filariasis, sometimes referred to as elephantiasis. It is caused by filarial larvae—contracted from infected mosquitoes—that invade the lymphatic system and mature into worms in the peripheral lymphatic vessels.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **oxygen** (OK-si-jen) is an odorless, colorless gas essential for the human body. It is taken in through the lungs and delivered to the body by the bloodstream.

* **vascular** refers to veins and arteries (the blood vessels).

* **congenital** (kon-JEH-nih-tul) means present at birth.

* **malformation** (mal-for-MAY-shun) is an abnormal formation of a body part.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **prostate** (PRAH-state) is a male reproductive gland located near where the bladder joins the urethra. The prostate produces the fluid part of semen.

* **bladder** (BLAD-er) is the sac that stores urine produced by the kidneys prior to discharge from the body.

removal of lymph nodes or radiation therapy also can lead to infection and even minor infections can cause serious lymphedema.

In addition to surgeries for breast and testicular cancers, lymphedema is a possible complication of any surgery in which lymph nodes are removed, including surgeries for the following:

- Melanoma
- Gynecological cancers
- Head and neck cancers
- Prostate* cancer
- Bladder* or colon* cancer

Other causes of lymphedema include the following:

- Liposuction
- Surgery on blood vessels
- Leakage of protein into a surgical site through surgical drains
- Inflammation of a limb following surgery
- Cancer cells or tumors* that block lymphatic vessels or nodes
- Abdominal* or pelvic tumors that put pressure on lymphatic vessels and/or the large lymphatic ducts in the chest and block drainage of lymph
- Trauma or injury that affects the lymphatic system
- Burns
- Infection in the lymph vessels or nodes that restricts fluid flow
- Immobility of a limb for a period of time

How Common Is Lymphedema?

Lymphedema is both under-diagnosed and under-reported. However, it has been estimated that about 3 million Americans are affected by secondary lymphedema. It also has been estimated that 20 to 40 percent of cancer survivors—especially the elderly—develop lymphedema at some point.

Lymphedema of the arm occurs in about 10 to 15 percent of women who have full axillary lymph node surgery for breast cancer. It occurs in only about 1 percent of women who are treated with a sentinel lymph node biopsy*. Proper skin care and exercise can reduce the risk of lymphedema following a mastectomy*.

A study published in 2007 found that 10 percent of gynecological cancer survivors had been diagnosed with lymphedema and another 15 percent reported lower-limb swelling. Lymphedema had been diagnosed in 36 percent of vulvar cancer survivors.

What Are the Symptoms of Lymphedema?

The classic symptoms of lymphedema are discoloration and swelling of the affected region. The severity of the symptoms depends on the type of lymphedema:

- Acute lymphedema immediately following surgery or injury makes the affected limb warm and reddish. It is usually not painful.
- Acute lymphedema occurring weeks after surgery or during radiation therapy makes the affected limb tender, warm or hot, and red.
- Acute lymphedema from an infection or in a chronically swollen limb makes the affected area very tender, hot, and red.

Symptoms of gradual-onset acute lymphedema, the most common form, can include:

- Skin discomfort or tightness
- Hardening or thickening of the skin
- Weakness, heaviness, aching, or pain in an arm or leg
- Rings, bracelets, or shoes that suddenly become too tight
- Loss of flexibility in the hand, wrist, or ankle
- Reduced range of motion in an arm or leg
- Aching in the neck, shoulders, spine, or hips, caused by muscle overuse or stretching of soft tissues
- Changes in posture caused by the increased weight of the affected limb
- Recurring infections in the affected limb
- Loss of sensations of touch, temperature, or pain in the affected area

Chronic lymphedema is characterized by severe and painful swelling, heat, and redness. Chronic lymphedema can be distinguished from temporary lymphedema by the texture of the skin. With temporary lymphedema pressing on the skin of the affected area with the fingertips leaves an indentation. With chronic lymphedema the skin is hard and stiff and does not indent.

How Is Lymphedema Diagnosed and Treated?

Diagnosis Lymphedema is often first diagnosed by a swelling or feeling of heaviness in the arm or leg. In its early stages, diagnostics may include the following:

- A history of edema*, surgery, or radiation therapy
- Weight appropriateness, since obesity* can increase the risk of lymphedema
- Diameter measurements of the arms and/or legs to detect swelling
- Blood protein levels, which may be elevated with lymphedema
- Ability to perform daily activities
- Concurrent conditions such as diabetes*, hypertension*, kidney* disease, heart disease*, or phlebitis*

* **colon** (KO-lin), also called the large intestine, is a muscular tube through which food passes as it is digested, just before it moves into the rectum and out of the body through the anus

* **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **mastectomy** (mas-TEK-to-mee) is the surgical removal of the breast.

* **edema** (e-DEE-ma) means swelling in the body's tissues caused by excess fluids.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **hypertension** (HI-per-ten-chen) is abnormally high arterial blood pressure.

* **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **heart disease** is a broad term that covers many conditions that prevent the heart from working properly to pump blood throughout the body.

* **phlebitis** (fle-BY-tis) refers to inflammation of a vein.

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **blood clot** is a thickening of the blood into a jelly-like substance that helps stop bleeding. Clotting of the blood within a blood vessel can lead to blockage of blood flow.

Diagnostic imaging techniques may include the following:

- Lymphoscintigraphy, in which a radioactive material is injected to follow the flow of the lymphatic fluid
- MRI*
- CT scans*
- ultrasound* to visualize blood vessels and blood flow and to rule out the presence of a blood clot*

Staging Lymphedema is sometimes categorized as grades 1 through 4, with 4 being the most serious. It may also be classified in stages:

- Stage 1 or spontaneously reversible lymphedema is the pitting stage: the tissue holds an indentation. Upon awakening, the limb is of normal or near-normal size.
- Stage 2 or spontaneously irreversible lymphedema is characterized by spongy tissue that is non-pitting: It pops back without leaving an indentation. The affected limb may have begun to harden and increase in size.
- Stage 3—sometimes called lymphostatic elephantiasis—is present when the limb or limbs have become very large and the swelling is irreversible. The tissue is hard and unresponsive.

Treatment Appropriate treatment requires identifying the cause of the lymphedema. It is most often treated by physical means and/or medications. In its earliest stages, the swelling can be relieved by supporting the limb in a raised position, exercising it gently, and wearing elastic support garments. Acute lymphedema following surgery or injury can usually be relieved within a week by keeping the affected limb raised and contracting the muscles, such as repeatedly making a fist with the hand of an affected arm.

Other physical methods of treating lymphedema include the following:

- Compression wrapping, in which bandages, special compression garments such as sleeves or stockings, or specialized devices apply controlled pressure to the limb
- Therapeutic exercises
- Manual lymphatic drainage—a special light massage or mechanical manipulation that helps move fluid from the end of the limb toward the trunk
- Cleansing and care of the skin to prevent infection
- An appropriate protein-rich diet
- Sequential compression pumps or pneumatic compression devices attached to a cuff around the arm or leg that inflate and deflate to apply pressure for improving fluid flow and preventing fluid accumulation.

Complex physical therapy or complex decongestive therapy (CDT) use a combination of these methods. Some specialists believe that CDT

should not be used on patients with recurrent or metastatic cancers due to the risk of spreading the cancer through the lymphatic system. The presence of blood clots must be ruled out before using manual lymphatic drainage, which could move clots toward the heart or lung. Some physicians believe that compression pumps can actually worsen the lymphedema.

Drug treatments for lymphedema include the following:

- Antibiotics* to prevent or treat infections
- Anti-inflammatory drugs for lymphedema occurring some weeks after surgery or during radiation therapy
- Medications for pain
- Anticoagulants to treat blood clots

Repeated episodes of lymphedema, which stretch body tissues, increase the likelihood of recurrence. There exists no effective treatment for advanced chronic lymphedema. Physical treatments provide no relief. Although surgery can reduce severe swelling, it cannot cure lymphedema. Reconstructive or debulking surgery is sometimes used to remove excess tissue in stage 3 lymphedema. However, because lymphedema surgery usually results in complications, it is rarely used on cancer patients.

Complications Lymphedema can cause tissue damage by interfering with the uptake of nutrients* and by preventing limb mobility. Other complications of lymphedema include the following:

- Breakdown of the skin, especially in the hips, knees, or elbows
- Urine retention caused by lymphedema in the groin or pelvis
- Constipation* from opioid medications

Chronic lymphedema often leads to lymphangitis*—an inflammation of the lymphatic vessels that affects the connective tissue* under the skin. Repeated infections cause scarring that makes the tissue even more susceptible to swelling and infection. These lead to tissue hardening or fibrosis, which is characteristic of advanced chronic lymphedema. When the skin becomes so thick that it is difficult to move the limb, the limb may become permanently enlarged and deformed. The skin becomes so weak that ulcers* and infections become chronic. These complications are irreversible. In addition to these physical challenges, lymphedema can be so disfiguring, painful, and disabling that mental and sexual problems arise.

Can Lymphedema Be Prevented?

Risk factors for lymphedema include the following:

- Advanced age
- Inadequate diet
- Being overweight

What Is Lymphangiosarcoma?

Lymphangiosarcoma is a tumor of the lymph vessels. It is a rare, fatal complication of chronic lymphedema. The average time span between a mastectomy and the development of lymphangiosarcoma is about 10 years.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

* **nutrients** are the components of food (protein, carbohydrate, fat, vitamins, and minerals) needed for growth and maintenance of the body.

* **constipation** is the sluggish movement of the bowels, usually resulting in infrequent, hard stools.

* **lymphangitis** (lim-fan-JIE-tis) is inflammation of the lymphatic system, the system that carries lymph through the body. Lymph is a clear fluid that contains white blood cells.

* **connective tissue** helps hold the body together, is found in skin, joints and bones.

* **ulcers** are open sores on the skin or the lining of a hollow body organ, such as the stomach or intestine. They may or may not be painful

Methods for preventing or controlling lymphedema include the following:

- Early identification and careful monitoring of at-risk patients
- Keeping affected skin clean and moisturized with lotion
- Proper nutrition and weight control
- Keeping the arm or leg raised above heart level whenever possible
- Exercises for improving lymph drainage: hand and arm exercises following a mastectomy; leg or foot exercises following surgery that affects drainage of the pelvic lymph nodes
- Avoiding strenuous activity of the limb while recovering from radiation or surgery
- Avoiding rapid circling with the arm or leg, which collects blood in the lower portion of the limb
- Avoiding heat on the affected limb
- Avoiding pressure on the arm or leg
- Avoiding injections or blood pressure readings on an affected limb
- Avoiding tight clothing
- Precautions for preventing infection, such as wearing gloves and shoes
- Permanently protecting a treated limb from injury or infection, since lymphedema can develop 30 years or more after surgery

Resources

Books and Articles

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Tretbar, Lawrence L. *Lymphedema: Diagnosis and Treatment*. London: Springer, 2008.

Organizations

National Cancer Institute. NCI Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov>.

National Lymphedema Network. Latham Square, 1611 Telegraph Avenue, Suite 1111, Oakland, CA, 94612-2138. Toll free: 800-541-3259. Web site: <http://www.lymphnet.org>.

Lymphoma

Lymphoma (lim-FOH-mah) are cancers that are grouped together because they arise in the lymphocytes, a type of white blood cell located within lymph nodes of the immune system*. Generally, the lymphatic system is the network of vessels that carry the fluid lymph, which contains blood cells throughout the immune system. Within this system lymphoma first occurs. Hodgkin's lymphoma is one well-known example of lymphoma. Non-Hodgkin's lymphoma is sometimes used to refer to all lymphomas other than Hodgkin's lymphoma. However, the scientific classification of lymphoma includes a wide variety of forms: More than 30 types of lymphomas had been identified as of 2009.*

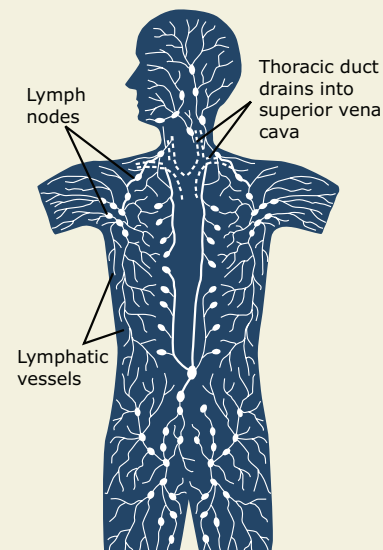
What Is Lymphoma?

Lymphoma is a general term for a group of cancers that begin in the lymphatic system, which is the part of the body system consisting of the tissues and organs used to make, store, and carry white blood cells for fighting infections and other diseases. This system includes the bone marrow*, spleen*, and hundreds of bean-sized lymph nodes* throughout the body. Lymphoma results when white blood cells, or lymphocytes (LIM-fo-sites), undergo changes and start to multiply out of control. Eventually, the cells crowd out healthy cells and create tumors*. Lymphoma can occur in a single lymph node, a group of lymph nodes, or in other parts of the lymphatic system. Eventually, it may spread to almost any part of the body.

The different types of lymphoma vary in severity, survivability, and frequency. Some types do not occur often. For instance, hairy cell leukemia (within chronic lymphoid leukemia) is diagnosed in only about 2,000 new cases each year in North America and Western Europe. Hodgkin's lymphoma is very survivable, being one of the most curable types of lymphoma, with a cure rate of more than 90 percent. By contrast, Mantel-cell lymphoma, an aggressive type of non-Hodgkin's lymphoma, is one of the deadliest lymphatic cancers.

Lymphoma has traditionally been divided into two main types: Hodgkin's disease, named after British physician Thomas Hodgkin (1798–1866), and non-Hodgkin's lymphoma. The division occurs, in part, because the cancer cells in Hodgkin's lymphoma look different under a microscope than do the cells in non-Hodgkin's lymphoma. However, both cancers make a person sick in the same way. Some types of lymphoma are among the most common childhood cancers. However, most cases of lymphoma occur in adults.

According to a plan of the World Health Organization, lymphoma is classified by the cell type associated with a particular tumor (neoplasm). The three major divisions are: B-cell tumors, T-cell and natural killer cell tumors, and Hodgkin's lymphoma. Previous classification systems, which



▲ The lymphatic system includes a network of tiny tubes that branch, like blood vessels, into tissues throughout the body. Lymph nodes are located along this network. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **bone marrow** is the soft tissue inside bones where blood cells are made.

* **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.

- * **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.
- * **biopsies** (BI-op-seez) are tests in which small samples of skin or other body tissue are removed and examined for signs of disease.

continued in use in the early 2000s, only contain two divisions: either Hodgkin's lymphoma or non-Hodgkin's lymphoma. Under such representation, B cell tumors and T cell/natural killer cell tumors would be considered non-Hodgkin's lymphoma.

Under B-cell tumors, B cells—also called B lymphocytes (in which the “B” stands for *bursa of Fabricius*, a bird gland where the tissue was first found)—are a component of the blood that makes antibodies*, which is essential in the body's defense against toxins, viruses, and bacteria.

T cells—also called T lymphocytes (in which “T” stands for *thymus*)—are a type of white blood cell found within the blood. They protect the body by attacking foreign substances. Damage to T cells can be caused by diseases. When damaged, T cells degrade (reduce) the body's ability to defend itself against infections. Natural killer cells, a specific type of T cell, have the ability to destroy microbes and tumor cells by releasing small granules.

Hodgkin's lymphoma—sometimes also called Hodgkin's disease—is the least severe form of lymphoma. One distinction of Hodgkin's lymphoma is the appearance of Reed-Sternberg cells in biopsies*. Derived from B cells, they are large, distinctive looking cells—sometimes described as looking like an owl's eye. Hodgkin's lymphoma spreads in an orderly fashion, from one lymph node group to another. As the disease advances, the symptoms increase in number.

There are numerous divisions within each major category. Within the B-cell tumor group, major types include small cell lymphoma (which is found mostly in the lymph nodes), chronic lymphocytic leukemia (bone marrow and blood), and B-cell prolymphocytic leukemia (a severe form of chronic lymphocytic leukemia). Two other B-cell lymphomas are follicular lymphoma (whose cells contain a vague clustering pattern) and Burkitt's lymphoma (which is associated with Epstein-Barr virus and causes mononucleosis).

Some of the major lymphomas within the T-cell and natural killer cell tumor group are: T-cell prolymphocytic leukemia (involving blood, bone marrow, liver, spleen, skin), T-cell large granular lymphocytic leukemia (peripheral blood, bone marrow, spleen, liver), and mycosis fungoides (also known as Alibert-Bazin syndrome, involving the skin).

The Hodgkin's lymphoma group contains such lymphomas as nodular lymphocyte-predominant Hodgkin's lymphoma and classical Hodgkin's lymphoma. Classical Hodgkin's lymphoma involves the steady distribution of cancer among the lymph nodes. It was one of the first types of cancer to be cured. In the early 2000s, it is cured in the vast majority of cases. Nodular lymphocyte-predominant Hodgkin's lymphoma was separated from classical Hodgkin's lymphoma because it progresses differently and contains cells shaped like popcorn.

What Causes Lymphoma?

No one knows exactly what causes lymphoma. It is not contagious, like a cold or chickenpox. Although as of 2009 scientists did not know what causes it, they did know when it occurs and that it causes genetic damage

to the body. White blood cells in the lymphatic system sometimes become cancerous and spread into the body, trying to replace healthy cells. Burkitt's lymphoma, for instance, contains cancerous B cells, which spread into the blood, bone marrow, and central nervous system*.

Oncogenes, which are involved in lymphoma, are the result of a normal gene* (called a protooncogene*) mutating through cell division. Such gene mutations are thought to increase the chances of healthy cells becoming tumorous, which can lead to cancers such as lymphoma. Oncogenes were first discovered in retroviruses* and, later, identified as a part in the development of cancer.

People with other kinds of cancer sometimes have what are known as risk factors. A risk factor is anything that increases a person's chances of getting a disease. Having AIDS* or an autoimmune disease* increases the risk for lymphoma. However, most people with lymphoma have no known risk factors.

DNA* may cause normal lymphocytes to become lymphomas. DNA is material that people inherit from their parents, which carries the instructions for everything the cells do. Just as people get bumps and scrapes during their lifetimes, the genes*, which are composed of DNA, also suffer different kinds of damage or malfunction. When that happens, a cell may receive wrong signals that cause it to grow out of control and form a tumor.

In addition, certain viruses appear to cause changes in genes that can lead to lymphoma. Epstein-Barr virus* can cause lymphoma in people with weakened immune systems. In people with healthy immune systems, the same virus has been linked to a form of the disease called Burkitt's lymphoma, which occurs in children and adults in Central Africa but is rare in the United States. A virus called HTLV-1* causes a kind of lymphoma seen almost exclusively in certain geographical areas, particularly Japan, the Caribbean, and the southeastern United States. In most cases, however, as of 2009 doctors had no idea why lymphoma develops.

What Are the Symptoms of Lymphoma?

Some people with lymphoma have early symptoms that cause them to go to the doctor. Others may have no symptoms at all, or they may mistake their symptoms for the flu (influenza) or another ordinary illness. This is because the body responds to lymphoma as though it were an infection. For example, Jacqueline Kennedy Onassis (1929–1994), the widow of President John F. Kennedy (1927–1963), was diagnosed with lymphoma after she went to the doctor thinking she had the flu. John Cullen (b. 1964), a former professional hockey player, experienced his first symptom as a pain in his chest after a game.

Lymphoma is generally characterized by enlarged lymph nodes in one or more parts of the body, such as painless swellings of the lymph nodes in the neck, armpit, chest, or groin. Other common symptoms include night sweats, weight loss, fever, malaise, tiredness, and reddening of the skin. Vomiting and nausea can sometimes occur. In addition, the

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **proto-oncogene** (pro-toe-AN-keh-gene) is a gene that is used to divide normal cells for specialized uses.

* **retrovirus** is a virus whose genetic information is found in ribonucleic acid (RNA), a nucleic acid that is found in all living cells.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **autoimmune disease** (aw-toh-ih-MYOON) is a disease in which the body's immune system attacks some of the body's own normal tissues and cells.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

- * **Epstein-Barr virus** (EP-stine-BAHR VI-rus) is a common virus that causes infectious mononucleosis.
- * **HTLV-1** short for human T-cell lymphotropic virus type 1, is a virus that is associated with certain kinds of adult leukemia and lymphoma.
- * **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.
- * **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.
- * **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

same physical reaction that causes itchiness in allergic reactions can cause widespread itching in lymphoma. Various other symptoms can eventually occur, depending on where the cancer has spread. For example, lymphoma that has spread into the lungs will cause a cough, whereas abdominal pain usually indicates the cancer has spread into the gastrointestinal tract.

How Is Lymphoma Diagnosed?

If lymphoma is suspected, the doctor can order various medical tests, including imaging studies to allow the doctor to see inside the body. Because many of the symptoms of lymphoma can be caused by non-cancerous problems such as infections, the only way to be sure that a person has lymphoma is to do a biopsy (BY-op-see). This procedure involves removing a sample of tissue from a lymph node, or sometimes even an entire node, for examination under a microscope. If cancerous cells appear from the microscopic examination, physicians make further investigations in order to learn what type of lymphoma is present.

Specifically, medical professionals determine the stage at which the lymphoma is present in the body by performing such tests as CT scans* and x-rays; ultrasound* tests, MRIs*, and positron emission tomography scans; bone marrow biopsies; lumbar puncture tests; and a comprehensive set of blood tests, including complete blood count.

Genetic and immunologic studies help to distinguish among the numerous types of lymphoma. A wide range of tests are important to properly assess the spread of lymphoma cells in the body and to accurately determine the cell type involved so that the most effective type of treatment can be identified and performed. The clinical analysis usually divides lymphomas into three grades: low, intermediate, and high. The low-grade form is the most survivable form.

How Is Lymphoma Treated?

Once the doctor knows for sure that a patient has lymphoma, the next step is to do something called staging. This activity involves determining what cell type is involved, whether the cancer has spread, and if so, how far. Staging is essential for deciding what kind of treatment a person with lymphoma should receive and what the outlook for survival is for the patient. The systems used to stage the different types of lymphoma are different, but the goal is always to decide the best treatment for the patient.

Early stage non-Hodgkin's lymphoma (involving B-cell tumors and T-cell/natural killer cell tumors) that has not spread is usually treated with radiation therapy, which uses high-energy waves to damage and destroy cancer cells. If the disease is widespread, it will probably require chemotherapy (kee-mo-THER-a-pee), which uses anticancer drugs that can reach throughout the body to fight cancer cells. Chemotherapy drugs are given either through a vein in the arm or as pills taken internally.

Sometimes chemotherapy is combined with radiation. Hodgkin's disease is also treated with radiation, chemotherapy, or both.

Both chemotherapy and radiation can have side effects, because treatments that kill cancer cells can affect healthy cells, too. The most common side effects of chemotherapy are nausea (feeling sick to the stomach), vomiting, hair loss, and tiredness. Nausea and vomiting can be prevented with medication, and, fortunately, most of these side effects go away after the treatment is completed.

Immunotherapy (also sometimes called biological therapy) uses artificially made substances that are modeled after substances naturally made by the immune system. Such therapies use various substances to kill or slow down the growth of lymphoma cells. They are also used to prepare a patient's immune system to better fight cancer cells brought on by lymphoma. One group of substances called monoclonal antibodies are designed to attack a specific target. One type of monoclonal antibody is rituximab (Rituxan), which seeks out special molecules on the surface of cancer cells.

Sometimes a bone marrow or stem cell* transplant is performed after the use of chemotherapy or radiation. Cancer cells are killed off in the chemotherapy or radiation process, and later, healthy bone marrow or stem cells are introduced back into the body with the use of such transplants.

Is It Possible to Prevent Lymphoma?

Unlike many other kinds of cancer, there are no known factors related to lifestyle, such as exposure to sunlight or specific eating habits, that a person could change in the hope of lowering the risk of getting lymphoma. However, preventing HIV* (AIDS virus) infection would prevent many cases of non-Hodgkin's lymphoma.

Will Treatment for Lymphoma Change in the Future?

As of 2009, researchers were studying how normal lymphocytes develop into cancer cells. This information may be used one day in gene therapy* to replace abnormal genes with normal ones and allow cells to grow normally again. This same knowledge was also being used to try to detect lymphoma earlier and to test how completely lymphoma was destroyed by treatment.

Lymphoma cells sometimes become resistant to chemotherapy: The cancer cells are able to change (mutate) so that the drugs are no longer effective. Various drugs were being studied that could interfere with this resistance, thus making chemotherapy more effective. Biological treatment, what is called immunotherapy, was being investigated to help patients' immune systems recognize and destroy the lymphoma cells.

Living with Lymphoma

Because treatment of both non-Hodgkin's lymphoma and Hodgkin's disease usually involves chemotherapy and radiation, one of the most difficult parts of living with lymphoma is coping with treatment. Many side

A Poison that Saves Lives

Near the end of World War II (1939–45), an Allied ship loaded with sulfur mustard, a poisonous gas used by the Germans during World War I (1914–18), blew up in an Italian port. Doctors treating the injured soldiers noticed that the gas had an effect on soldiers' immune systems. Because certain cancers form in the immune system, the doctors wondered whether a related gas called nitrogen mustard could be used to treat the cancers. They discovered that it could. In the 21st century, nitrogen mustard is one of about 30 anticancer drugs used to save or prolong the lives of people with lymphoma and other cancers.

* **stem cell** an unspecialized cell that gives rise to differentiated cells.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

* **gene therapy** is a treatment that works by altering genes.

effects of chemotherapy and radiation are short-term and go away when treatment stops. However, other side effects are long-term. For example, treatment may affect a person's ability to have children, or it may trigger the development of a different lymphoma many years later.

Follow-up care may continue for years or even decades. Aside from doctor's visits, though, once all signs of cancer are gone, people can go back to doing whatever they did before they got lymphoma. Most children with childhood lymphoma survive it, and they can expect to lead normal lives as adults.

▶ *See also* **Cancer: Overview • Leukemia • Radiation Exposure Conditions • Tumor**

Resources

Books and Articles

Canellos, George P., T. Andrew Lister, and Bryan D. Young, eds. *The lymphomas*. Philadelphia, PA: Saunders Elsevier, 2006.

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Organizations

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-227-2345. Web site: <http://www.cancer.org>.

Lymphoma Research Foundation of America (Los Angeles office). 8800 Venice Boulevard, Number 207, Los Angeles, CA, 90034. Toll free: 800-500-9976.

Lymphoma Research Foundation of America (New York office). 111 Broadway, 19th Floor, New York, NY, 10006. Toll free: 800-235-6848. Web site: <http://lymphoma.org>.

National Cancer Institute. 6116 Executive Boulevard, Room 3036, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov>.

M

Mad Cow Disease See *Creutzfeldt-Jakob Disease; Prion Diseases.*

Malabsorption Syndromes See *Maldigestion and Malabsorption Syndromes.*

Malaria

Malaria (mah-LAIR-e-uh) is a disease caused by a parasite that is spread to humans by the bite of an infected mosquito.

What Is Malaria?

Malaria, which literally means bad air, was once thought to be spread in the air around stagnant marshes. It was later discovered that mosquitoes, particularly female *Anopheles* (a-NOH-fel-eez) mosquitoes, spread the parasites that cause malaria. Four different species of a parasite in the genus *Plasmodium* (plaz-MO-dee-um) cause malaria. They are *falciparum* (fal-SIP-ar-um), *malariae* (ma-LAIR-e-eye), *ovale* (o-VAL-e), and *vivax* (VI-vax). Of the four, *P. falciparum* is the most common and the most deadly. *Plasmodium* requires time in both the mosquito vector* and human host* to complete its life cycle.

How Common Is Malaria?

Forty percent of the world's population is at risk for contracting malaria from infected mosquitoes, primarily in tropical and subtropical regions. Worldwide, there are 300 to 500 million cases of malaria and more than one million deaths from malaria each year. More than 90 percent of all malaria deaths occur in sub-Saharan Africa, a vast area south of the Sahara Desert, and 75 percent of deaths occur in children. *Plasmodium falciparum* causes malaria in this region, and poverty, poor nutrition, and poor access to health care all contribute to the high death rate. Malaria is increasingly common in Central and South America, Asia, the Middle East, and the Pacific Islands. About 1,200 cases of malaria are diagnosed in the United States each year, mostly in recent immigrants or travelers from countries where malaria is found.



Female *Anopheles gambiae* mosquito seen under an electron microscope. There are about 2,700 species of mosquitoes, including more than 90 species of *Anopheles* mosquitoes, many of which carry malaria. *Anopheles* mosquitoes typically bite between dusk and dawn. Only female mosquitoes suck blood and, thus, spread malaria. Dr. Tony Brain/Custom Medical Stock Photo, Inc. Reproduced by permission.

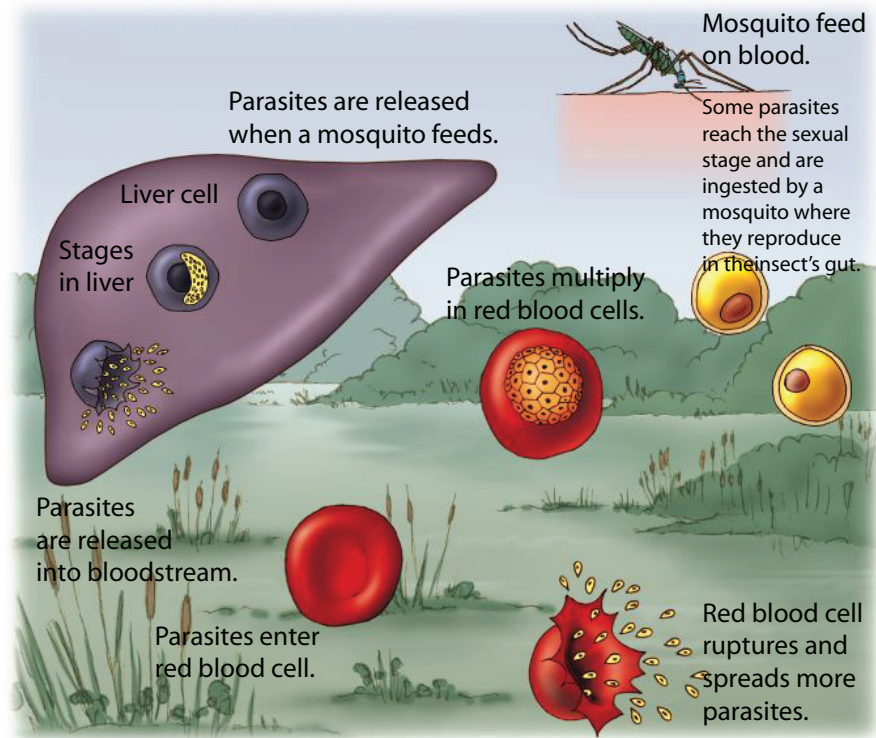
* **vector** (VEK-tor) is an animal or insect that carries a disease-causing organism and transfers it from one host to another.

* **host** is an organism that provides another organism (such as a parasite or virus) with a place to live and grow.

Malaria

Cycle of malaria infection. *Plasmodium* parasites can reproduce inside the *Anopheles* mosquito and be transmitted to people through mosquito bites. In people, the parasites can multiply in the liver and in the red blood cells.

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



* **incubation (ing-kyoo-BAY-shun) period** is the time between infection by a germ and when symptoms first appear. Depending on the germ, this period can be from hours to months.

* **toxins** are substances that cause harm to the body.

Mosquito control has virtually eliminated malaria in areas with temperate climates. However, the disease has made a comeback as mosquitoes have become resistant to insecticides and *Plasmodium* becomes resistant to medications used to treat malaria.

Is Malaria Contagious?

Malaria is not passed directly from one person to another. Mosquitoes spread the disease. When a mosquito bites an infected person, it ingests malaria parasites contained in that person's blood. The parasites need an incubation period* of about one week in the mosquito before the mosquito can spread the disease when it bites another person. Once in a person's body, the parasites travel to the liver where they can remain dormant, or inactive, for months or even years. In the liver, the parasites grow and multiply and are then ready to move into the body's red blood cells, where they continue to grow until the red blood cells burst, freeing more parasites to attack more blood cells. The parasite can be ingested by a mosquito and spread to another person only during the time that *Plasmodium* is in the blood.

What Are the Signs and Symptoms of Malaria?

Malaria causes fever and symptoms similar to those of the flu. In the early stages of the disease when the parasite is in the liver, the infected person does not feel sick. When the parasites invade the red blood cells and cause them to burst, toxins* are released into the blood, and the person experiences fever, chills, sweating, headache, muscle aches, and tiredness. Symptoms typically begin 9 to 16 days after infection with the parasite,

but the time may vary depending on the infecting species. Episodes of these symptoms reoccur every 48 to 72 hours. Other symptoms may include nausea*, vomiting, and diarrhea*.

How Is Malaria Diagnosed and Treated?

Under the microscope, a blood sample from a person who has malaria will show one of the four species of *Plasmodium* parasites within the red blood cells. Malaria is treated with antimalarial drugs, many of them derived from quinine, which is found naturally in the bark of the cinchona tree from Peru. Which drug is chosen to treat a patient depends on the parasite causing the infection, the severity of symptoms, the age of the patient, and whether the parasite is resistant to certain drugs. Some patients may need intensive hospital care.

Treatment can last several weeks or months. In some infections, the parasite can remain dormant in the liver for months or years, and the disease may return even after treatment. Destruction of red blood cells in cases of malaria can result in anemia* and jaundice*. Severe and untreated infection may cause liver and kidney* problems, seizures*, mental confusion, coma*, and death; malaria is fatal in 1 in 500 cases. Children and pregnant women are particularly vulnerable to complications. Infected pregnant women are at risk for miscarriage*, premature delivery*, and stillbirth*, and anemia in children can have long-term effects on growth and development.

Can Malaria Be Prevented?

In areas where malaria is endemic*, people can avoid being bitten by mosquitoes by wearing long-sleeved shirts and long pants, using insect repellent, and staying in a screened or air-conditioned room from dusk to dawn when mosquitoes are most active. Bed nets treated with certain insecticides repel mosquitoes for 6 to 12 months.

Anyone traveling to a malaria-endemic area should visit a doctor four to six weeks prior to travel to receive the appropriate vaccinations for certain tropical infections and proper prescriptions to prevent malaria. This precaution applies to people who grew up in a malaria endemic area and have lived elsewhere for a period of time.

In the early 2000s, scientists were working to develop a vaccine that would prevent malaria. However, the different species of *Plasmodium* and the complicated life cycle of these parasites have made developing a vaccine difficult.

▶ See also **Travel-related Infections**

Resources

Books and Articles

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Ollhof, Jim. *Malaria*. Edina, MN: ABDO, 2010.

- * **nausea** (NAW-zha) refers to a feeling of being sick to one's stomach or needing to vomit.
- * **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).
- * **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.
- * **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.
- * **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.
- * **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.
- * **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be woken up, and cannot move, see, speak, or hear.
- * **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.
- * **premature delivery** is when a baby is born before it has reached full term.
- * **stillbirth** is the birth of a dead fetus.
- * **endemic** (en-DEH-mik) describes a disease or condition that is present in a population or geographic area at all times.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **pancreas** (PAN-kree-us) is a gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/malaria>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/topics/malaria/en>.

Maldigestion and Malabsorption Syndromes

Maldigestion and malabsorption syndromes are conditions that result in abnormalities in the digestion of food or in the intestinal absorption of nutrients into the bloodstream. These conditions often occur together.

What Are Maldigestion and Malabsorption Syndromes?

In order for the body to use food, it must be chemically broken down into smaller compounds and then absorbed from the intestine into the bloodstream. If maldigestion occurs, the food a person eats is not broken down enough for the intestine to absorb it. If malabsorption occurs, the food is correctly digested, but abnormalities in the intestine prevent its absorption. As a result the body does not get all the nutrients it needs; undigested or unabsorbed nutrients are lost in feces*. Maldigestion and malabsorption can occur with proteins, fats, carbohydrates (sugars and starches), and any of the vitamins or minerals the body needs. Often more than one type of nutrient is affected.

What Causes Maldigestion and Malabsorption Syndromes?

Many different diseases can cause malabsorption of various nutrients. The most common disease causing malabsorption is celiac disease, also called celiac sprue or gluten-sensitive enteropathy. About 3 million people in the United States and another 3 million in Europe are affected. People with celiac disease cannot tolerate gluten, a protein found in wheat, rye, and barley. When people with celiac disease eat food containing gluten, their immune system* responds by causing the cells lining the wall of the small intestine to become inflamed. Over time, the inflammation* damages these cells so that they no longer can absorb a normal amount of nutrients.

The second most common cause of maldigestion and malabsorption is cystic fibrosis. This complex inherited disease involves the lungs, pancreas*,

liver, and intestines. One aspect of the disease is that the pancreas does not produce enough digestive enzymes* (a problem of maldigestion), and abnormal chemistry of the intestines prevents normal absorption of nutrients.

Lactose maldigestion is a condition in which the cells lining the small intestine do not produce the enzyme lactase needed to digest the sugar lactose found in cow's milk. According to the National Institute of Diabetes and Digestive and Kidney Diseases, between 30 and 50 million American adults are lactose intolerant; these people may produce some lactase and can consume small amounts of dairy products, but they do not produce enough of the enzyme to digest the quantity of dairy products found in the standard American diet.

Other conditions and diseases that cause malabsorption include short bowel syndrome, Crohn's disease, and some weight control surgeries (bariatric surgeries) that shorten the intestine. AIDS* can also cause malabsorption of nutrients as can diseases of the pancreas, including pancreatitis and pancreatic cancer. Infection with certain intestinal parasites* can interfere with the absorption of food. Certain drugs may also interfere with absorption of specific nutrients for as long as the drug is taken. Absorption normally improves after the drug is stopped.

What Are the Symptoms of Maldigestion and Malabsorption Syndromes?

Regardless of the cause, malabsorption and maldigestion syndromes produces somewhat similar symptoms. The most common symptoms are a bloated abdomen* (belly); chronic* diarrhea, passing a great deal of gas, bulky, bad-smelling stools, excessive fat in the stool (a condition called steatorrhea; stool often floats in the toilet because fat is lighter than water); weight loss; anemia*; general weakness; fatigue; and fluid retention. Infants and young children gain little weight and do not reach developmental milestones at the times expected, a condition called failure to thrive.

How Are Maldigestion and Malabsorption Syndromes Diagnosed and Treated?

Diagnosis begins with review of medical history, symptoms, and a physical examination. Blood tests are done to detect abnormalities in the level of iron, vitamin B-12, folate, cholesterol, triglycerides*, and various electrolytes. Imaging studies such as an endoscopy* may be performed to observe the appearance of the small intestine and to biopsy* the innermost surface called the mucosa. Specific diagnostic tests are performed for fat, protein, and carbohydrate malabsorption as well as for malabsorption of certain vitamins and minerals. Because many malabsorption syndromes are caused by other diseases, the issue is often not one of diagnosis, but rather of measuring the degree of nutrient deficiency and attempting to correct it.

* **enzymes** (EN-zimes) are proteins that help speed up a chemical reaction in a cell or organism.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **parasites** (PAIR-uh-sites) organisms such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

* **triglycerides** (try-GLISS-eh-rides) are a type of fatty substances found in the blood.

* **endoscopy** (en-DOS-ko-pee) is a type of diagnostic test in which a lighted tube-like instrument is inserted into a part of the body.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **cystic fibrosis** (SIS-tik fy-BRO-sis) is a disease that causes the body to produce thick mucus that clogs passages in many of the body's organs, including the lungs.

* **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.

* **cutaneous** (kyoo-TAY-nee-us) related to or affecting the skin.

Treatment depends on the cause of the syndrome. Eliminating gluten from the diet helps people with celiac disease. Limiting or eliminating dairy products helps people who are lactose intolerant. Some low-lactose and lactose-reduced products are available in the supermarket. Lactase, the enzyme that breaks down lactose so that it can be absorbed, can be eaten as a digestive aid. People with cystic fibrosis* are given supplemental pancreatic enzymes to aid digestion. Based on the specific nutrients deficiencies, people with malabsorption syndrome are given supplements of various vitamins and minerals, and amount of calories in their diet may be increased. Malabsorption syndromes usually require life-long dietary adjustments and monitoring. Complications frequently arise based on deficiencies in specific vitamins and minerals.

▶ See also **Cystic Fibrosis • Lactose Intolerance**

Resources

Organizations

Celiac Disease Foundation. 13251 Ventura Boulevard, Suite 1, Studio City, CA, 91604. Telephone: 818-999-2354. Web site: <http://celiac.org/lifestyle.php>.

Cystic Fibrosis Foundation. 6931 Arlington Road, Bethesda, MD, 20814. Toll free: 800-344-4823. Web site: <http://www.cff.org/LivingWithCF/StayingHealthy/#Diet>.

National Digestive Diseases Information Clearinghouse, National Institute of Diabetes and Digestive and Kidney Diseases. 2 Information Way, Bethesda, MD, 20892. Web site: <http://www.niddk.nih.gov>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/00299.htm>.

Malignant Melanoma

Malignant melanoma is a skin cancer that originates in the pigment-producing cells in the upper layer of the skin known as melanocytes (me-LAN-oh-sites). Malignant melanoma is one of the less common types of skin cancer, but it causes the highest number of deaths, accounting for 75 percent of all deaths resulting from skin cancer. Most melanomas begin in the skin, but some begin in the eye or even the intestines. Melanoma that starts in the skin is called cutaneous* melanoma. Melanoma that starts in the eye is called uveal (YOU-vee-ul) or ocular melanoma.*



Malignant melanoma. Highly malignant tumor of the melanin cells (skin pigment) which can be pigmented, as in this case, or without pigment. Malignant melanoma form on the skin, eyes, and mucous membranes then spread to the lymph nodes and elsewhere. *Custom Medical Stock Photo, Inc. Reproduced by permission.*



John's Story

John, a high-school senior, lives for baseball season, when he spends hours each day practicing with teammates as well as playing games against teams from other schools. His chief concerns with health matters are drinking enough water in hot weather and not overworking his pitching arm. He was surprised when the coach told him and his teammates before the start of spring training that they would have to be more careful about protecting their skin from the sun. The coach had read a bulletin from the American College of Sports Medicine about the dangers to young athletes from too much sun exposure, particularly the risk of melanoma.

John had never thought of sunlight as harmful to his skin. He has always enjoyed hiking in the mountains of the Southwest as well as sports and other outdoor activities. He is also three-fourths Native American and does not sunburn as easily as some of his lighter-skinned teammates. But the coach told John that people from any racial or ethnic group can get melanoma if they have a history of it in their family, live in hilly regions like northern New Mexico or Arizona, or have had occasional severe sunburns in childhood. The coach also said that as recently as the early 1990s, doctors rarely saw teenagers with melanoma, but that more and more cases were being found among young people John's age. John decided that he would ask his doctor to recommend an effective sunscreen for his skin type and that he would be careful to always wear a baseball cap and shirt during practice, because boys are more likely than girls to develop melanomas on the head, neck, and chest.

What Is Malignant Melanoma?

Malignant melanoma is a type of skin cancer that begins in certain cells in the epidermis (ep-ee-DER-miss), which is the outermost layer of the skin. These specialized cells are called melanocytes because they produce and

* **ultraviolet** light is a wavelength of radiation beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **mutations** (mu-TAY-shuns) are changes in a chromosome or a gene.

contain a brownish-black skin pigment called melanin (MELL-uh-nin). In humans, melanin provides the color in the skin, hair, and the colored part of the eye called the iris. There are between 1,000 and 2,000 melanocytes in each square millimeter of skin. The difference in skin color between fair-skinned and darker-skinned people does not depend on the number of melanocytes in the skin but on their level of activity. When skin is exposed to the sun, the melanocytes become more active, produce more melanin, and cause the skin to darken, that is, they cause a suntan.

The development of melanomas from normal skin was not completely understood as of 2009. Some researchers thought there may be several different pathways to melanoma, depending on whether they occur on skin that is exposed to the sun only occasionally (such as the chest or back area in women) or on skin that is frequently exposed to the sun (head, face, neck, and hands). In general, melanoma is caused by the interaction of ultraviolet* (UV) radiation from the sun and the melanin in melanocytes. UV radiation can damage the DNA* in skin cells both directly and indirectly. Researchers have found that 92 percent of melanomas are caused by indirect damage to DNA and 8 percent by direct damage.

When the DNA in a skin cell is damaged by UV radiation, the cell can undergo a series of mutations* that lead to abnormal multiplication of new cells. In some cases the changed DNA makes the cell more vulnerable to the damaging effects of UV radiation. About 40 percent of melanomas begin in moles, with the remaining 60 percent starting in normal-looking skin.

Melanomas grow in two stages or phases. The first is a phase of outward or radial growth. The second phase, which is much more dangerous, is a phase of vertical growth into deeper layers of tissue. It is during this second phase of growth that melanomas become harder to treat and able to spread to other parts of the body.

How Common Is Malignant Melanoma?

Malignant melanoma was considered a rare form of cancer until the 1970s, but its rate among Caucasians in the United States tripled between 1985 and the early 2000s. As of 2009 it was the sixth most common cancer in the United States. The current lifetime risk for developing invasive melanoma is one case for every 60 Americans, a 2000 percent increase since 1930. This risk rises to one case for every 32 Americans if early-stage melanoma (Stage 0 below) is included.

The highest annual rates of melanoma in the world, however, are not found in the United States but in Australia, New Zealand, and Israel. There are approximately 57 cases of melanoma annually per 100,000 people in Australia and 40 cases annually per 100,000 people each year in Israel.

One unusual finding in the United States is the rapid increase of deaths from melanoma in older males. Although the death rate among younger men (44 years or younger) dropped between the late 1990s and 2009, most likely as a result of public health education campaigns about

MELANOMA AND CLIMATE CHANGE

Melanoma was a rare form of cancer until the 20th century. The earliest known surgical removal of a melanoma was performed in 1787 by a British surgeon, but the disease was little studied until the 1840s and 1850s, when two other British doctors described the stages of melanoma and found that it runs in some families. The connection between melanoma and sun exposure was not made until 1956, when the Australian physician Henry Lancaster (1913–2001) found that high intensity of sunlight is a risk factor for melanoma. In the 1970s scientists began to notice that the ozone layer—a layer of oxygen molecules consisting of three atoms of oxygen in the upper atmosphere—was becoming thinner. The ozone layer helps to block a high-energy type of ultraviolet radiation known as UVB from reaching the earth's surface, so doctors began to wonder whether a thinner ozone layer could contribute to an increase in the rate of melanoma and other skin cancers.

As of 2009, however, doctors did not think that the rise in cases of melanoma since the 1980s was due primarily to changes in the ozone layer. One reason is that depletion of the ozone layer is most severe over

Antarctica, which is not a heavily populated continent. Another is that advances in genetics indicate that heredity plays a larger role in melanoma than was thought to be the case in the 1980s. Still another reason for skepticism about the role of the ozone layer in melanoma is that some studies indicated that a lower-energy form of ultraviolet radiation called UVA triggers the development of melanoma rather than the UVB blocked by the ozone layer. If this finding is accurate, then changes in the ozone layer are not related to melanoma. It is also likely that the increase in the number of reported cases of melanoma since the 1990s is due partly to better diagnostic instruments and earlier diagnosis.

Research into the rise in cases of melanoma was ongoing in the United States in the early 2000s. According to a report published by the Department of Health and Human Services, the Climate Change Science Program for 2009 will include studies on the effect of UVA and UVB radiation on the skin, research into the effectiveness of various sunscreen products, and the role of genes in triggering melanoma and other skin cancers.

the dangers of sun exposure, it rose 66 percent in men between the ages of 45 and 64, and 157 percent in men over 65.

Who Gets Malignant Melanoma?

Genetic* factors are involved in malignant melanoma, in part because skin color and sensitivity to the sun are inherited characteristics. In addition, melanoma is known to run in some families. Researchers have identified mutations in certain genes on chromosomes* 1, 9, and 12 in families with histories of malignant melanoma.

Although melanoma is more common in women than men up to age 40, in adults over 40 it is more common in men. The average age of Americans at the time of diagnosis of melanoma is 53 years; however, it is the most common cancer in women between the ages of 25 and 29 and is second only to breast cancer in women between the ages of 30 and 34. In terms of racial groups in the United States, melanoma affects Caucasians twenty times more often than African Americans, and six times more often than Hispanics.

The parts of the body where melanoma is most likely to start differ somewhat between men and women and between African Americans or Asians and members of other races. Men are more likely to develop melanoma on the head, neck, or chest; women, on the lower legs. African

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **chromosomes** (KRO-mo-somz) are threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.

Americans and Asians are more likely to get melanoma under the nails or on the palms of the hands and soles of the feet.

There are other factors that increase the risk of melanoma. These include the following:

- Having fair skin that freckles or burns easily
- Living in areas that get high levels of ultraviolet radiation, such as mountainous regions or countries closer to the equator
- Having a job that requires working outdoors during daylight hours
- Having a family history of melanoma, particularly in a parent or sibling
- Having a previous personal history of melanoma or another type of skin cancer
- Having atypical moles known as dysplastic nevi (diss-PLAS-tik NEE-vye). Dysplastic nevi are usually larger than ordinary moles and have irregular and indistinct borders. They are most likely to appear on the chest in men and on the legs in women.
- Having more than 50 ordinary moles
- Having a disorder that affects the immune system or a history of radiation therapy for cancer
- Scars or burns on the skin; fragile skin is more easily damaged by sun
- Exposure to certain chemicals in the environment, including arsenic and some types of weed killers
- Having a history of blistering sunburns before age 20
- Older age; people over 50 are at increased risk of developing melanoma and dying from it

How Is Malignant Melanoma Diagnosed?

About 80 percent of melanomas and other skin cancers are found by patients who notice suspicious changes in their skin and go to their doctor. The signs of melanoma are sometimes called the ABCDEs. A mole or patch of skin developing into melanoma may have the following features:

- **Asymmetry.** One side of the mole looks different from the other side in size, shape, or color.
- **Border irregularity.** The mole has a ragged or poorly defined border.
- **Color.** The color is not uniform; the mole has dashes of blue, red, or white mixed in with patches of brown or black.
- **Diameter.** The mole is larger than the end of a pencil eraser (about one-fourth inch in diameter).
- **Evolution.** The mole keeps changing in size, shape, or color.

Early-stage melanomas may itch or shed small flakes of skin, whereas more advanced melanomas may bleed or ooze fluid as well as itch. Advanced melanomas may also become hard or lumpy in texture. Melanomas do not, however, usually cause pain.

How Serious is Malignant Melanoma?

Malignant melanoma is the deadliest form of skin cancer. As was noted above, although melanoma accounts for only 4 percent of skin cancers in the United States, it is responsible for 75 percent of deaths from skin cancer. About 8,500 Americans die each year from melanoma, 5,500 men and 3,000 women. The World Health Organization reports that 160,000 cases of malignant melanoma are diagnosed worldwide each year, with 48,000 deaths.

Malignant melanoma is curable if caught early. When a melanoma is not removed in its early stages, however, cancer cells will start to grow downward from the skin surface and invade healthy tissue. The disease can then spread to other parts of the body, where it is difficult to control. Measuring a cancer's size, thickness, and likelihood of spreading is called staging. Melanomas are graded in five stages from 0 to 4. The chief factor in determining a patient's chances of recovery is the thickness of the melanoma. This is measured in millimeters and is called Breslow's depth, after the doctor who first connected it to the patient's chances of survival in 1970.

The five stages of melanoma and a person's chances of five-year survival at each stage are as follows:

- Stage 0: The cancerous cells are found only in the outer layer of skin and have not invaded deeper tissues. Survival rate is 99.9 percent.

OCULAR MELANOMA

Ocular melanoma, or melanoma of the eye, is a cancer that develops in the parts of the eye that contain melanocytes—the iris and other nearby structures that belong to the middle pigmented layer of the eye. It affects about 6 persons per million per year in the United States and is most likely to develop in people with blue eyes and fair skin. Ocular melanoma is more common in Denmark and other Scandinavian countries than in the United States. It is slightly more common in men than in women. The average age of a person diagnosed with this type of melanoma is 55.

Ocular melanomas can grow slowly for years without producing any symptoms, although they eventually cause blurred vision, gradual loss of sight, and sometimes pain in the eye. This type of melanoma often spreads from the eye to the liver, lungs, or even the central nervous system before it is diagnosed. Most patients die from the spread of the cancer to these vital organs rather than from the effects of the cancer on the eye itself. About half of all patients diagnosed with ocular melanoma die within 10 years after diagnosis and treatment. The standard forms of treatment for this type of cancer are radiation therapy and surgical removal of the affected eye.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **biopsy** (Bl-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **local anesthesia** (an-es-THEE-zha) means using medicine to block or numb pain in one part of the body while patients remain awake. General anesthesia blocks pain over the entire body while patients sleep.

- Stage 1: The melanoma is no more than one-twenty-fifth of an inch thick (1 millimeter) and has not spread to nearby lymph nodes*. Five-year survival rate is 85 to 95 percent.
- Stage 2: The tumor is between one and two millimeters thick but has not spread to nearby lymph nodes. Survival rate is between 40 and 85 percent.
- Stage 3: The melanoma has spread to nearby lymph nodes or to skin just outside the original tumor. Survival rate after five years is between 25 and 60 percent.
- Stage 4: The melanoma cells have spread to other organs, to lymph nodes, or to skin areas far away from the original tumor. The five-year survival rate is 7 to 10 percent, with an average life expectancy of 6 to 9 months.

Young children are an exception to the survival rates for adults. For reasons not fully understood as of 2009, survival in children is more closely related to age than to the thickness of the cancer, with younger children being less likely to survive than older children or teenagers.

How Is Malignant Melanoma Diagnosed and Treated?

Diagnosis A family doctor can often spot suspicious-looking changes in a patient's skin, but will usually refer the patient to a dermatologist (DER-muh-TAWL-oh-jist) for a definite diagnosis. Dermatologists are doctors with specialized training in diagnosing and treating skin disorders.

To diagnose cutaneous melanoma, a dermatologist first uses a dermatoscope, which is a special palm-sized instrument with a magnifying lens and built-in light. The use of dermatoscopes increased the accuracy of diagnosing malignant melanoma by 20 percent, because the doctor can make digital images of suspicious moles or skin areas and save them for comparison with images from later checkups.

If the dermatoscope images suggest that the patient may have melanoma, the next step is to take a sample of the abnormal mole or area of skin to be sent to a laboratory for analysis under a microscope. This procedure is called a biopsy*. In the case of melanoma, the doctor removes the entire mole, rather than just a portion of it, to obtain an accurate measurement of Breslow's depth. Biopsies are done under local anesthesia*.

To evaluate whether the melanoma may have spread beyond the skin, the doctor may perform a sentinel lymph node biopsy. A sentinel lymph node is the lymph node closest to the melanoma, the one to which the cancer is most likely to spread.

There was no blood test as of 2009 that could detect malignant melanoma.

Treatment The only definite cure for malignant melanoma is surgical removal of the cancerous mole or patch of skin before the melanoma reaches a Breslow depth of one millimeter. The surgeon removes a margin

of normal skin surrounding the melanoma as well as the tumor itself to make sure that no cancerous cells are left behind.

Patients with later-stage melanomas are treated with surgery to remove cancerous lymph nodes. Surgery by itself, however, is not effective in treating melanoma that has spread to other organs. In these cases a combination of chemotherapy*, radiation therapy*, or biological therapy is necessary. Biological therapy is a newer form of cancer therapy in which the patient is given vaccines or other agents to boost the response of the immune system to the cancer. It is also called immunotherapy.

Can Malignant Melanoma Be Prevented?

Limiting sun exposure People cannot change certain risk factors for melanoma, such as their genes or basic skin type, but they can lower their risk of melanoma by taking care of their skin. One way is to be careful about sun exposure. Some specific strategies are as follows:

- Avoiding the use of tanning booths and sun lamps. People who use tanning beds regularly increase their risk of developing melanoma by eight times.
- Considering the use of tanning extenders (also called sunless tanners) or bronzers if looking tanned is important. These products are considered cosmetics by the Food and Drug Administration (FDA) and do not protect the skin against ultraviolet radiation, but they are harmless when used properly.
- Staying out of the sun between 10 a.m. and 4 p.m. A handy rule is to stay out of the sun when one's shadow is shorter than one's height.
- Using a sunscreen with a sun protection factor (SPF) of 15 or higher every day. People with very fair skin should use a product with an SPF of 30 or higher.
- Applying sunscreen over the entire body 30 minutes before going outside and reapplying the product every two hours.
- Using a lip balm that contains sunscreen.
- Wearing clothing that covers as much of the body as possible, including a broad-brimmed hat and sunglasses to protect the eyes.
- Keeping infants under six months out of the sun altogether and using sunscreen on infants older than six months

Regular self-examination Another important way to lower one's risk of malignant melanoma is regular self-examination of one's skin. The American Academy of Dermatology outlines the steps to take:

- Individuals should first become familiar with all of their birthmarks, moles, freckles, and other skin blemishes in order to spot new growths or suspicious changes in existing moles or patches of skin.
- In a private room with plenty of light and a full-length mirror, individuals should use a handheld mirror in order to see their back, buttocks, and other parts of the body that require a second mirror.

* **chemotherapy** (KEE-mo-THER- α -pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **radiation therapy** is a treatment that uses high-energy radiation from x-rays and other sources to kill cancer cells and shrink cancerous growths.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

- It is important to check all parts of the body, not just those exposed to sunlight. People should begin with the upper body, front and back, then the arms. Women should look underneath their breasts.
- Next, while sitting in front of the mirror, individuals should examine their legs, genitals, soles of the feet, and the skin between the toes.
- They should examine the back of the neck and scalp using the hand-held mirror. They should part the hair at intervals to check the entire scalp. If necessary, they can ask another family member to help.

Other approaches Because slightly more than half of melanomas do not start in moles, doctors do not think that removing normal moles in teenagers or young adults is a useful way to prevent melanoma.

As of 2009, melanoma vaccines were undergoing clinical trials as biological therapies for patients with Stage 2 or Stage 3 melanoma, but the results were expected to take several years to evaluate. As of 2009, none of these vaccines was being tested as a possible way to prevent melanoma.

▶ See also **Cancer: Overview • Skin Cancer**

Resources

Books and Articles

Juettner, Bonnie. *Skin Cancer*. Detroit, MI: Lucent Books, 2008.

Kaufman, Howard L. *The Melanoma Book: A Complete Guide to Prevention and Treatment*. New York: Gotham Books, 2005.

Poole, Catherine M. *Melanoma: Prevention, Detection, and Treatment*, 2nd ed. New Haven, CT: Yale University Press, 2005.

Organizations

American Academy of Dermatology. P.O. Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: <http://www.aad.org>.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov>.

Malingering

Malingering (ma-LING-er-ing) means intentionally pretending to be sick or injured to avoid work or responsibility. The illnesses faked may be physical, such as the flu, or mental, such as depression. Similarly, a person may pretend to have severe back pain due to an injury. Sometimes a person may actually have a mild illness or injury and exaggerate the symptoms.*

Why Do Some People Malingering?

Although there are rare instances in which malingering may have a positive or useful purpose, such as faking illness as a prisoner of war, it is generally considered to be unacceptable behavior. Why then do people sometimes act this way?

People may fake a disorder for many reasons. They may wish to shirk military service or jury duty or avoid going on trial for some criminal act. Some people feign illness to get extra time off from school or their job. Others may fake or exaggerate an injury or disease to get undeserved money from an insurance company. Some people may malingering to get extra attention, sympathy, or help from family or coworkers.

Distinguishing Malingering from a Real Illness

As long as there have been malingerers, there have likely been others who understood what they were trying to do. The Greek physician Galen, who lived in the second century C.E., wrote, “People for many reasons may pretend to be ill; it is desirable, then, that the physician should be able to arrive at the truth in such cases.” Using their experience with actual diseases, he said, physicians need to distinguish tricks of the malingerer from the “true signs” of disease.

Physicians in modern times face many of the same basic problems with malingering that Galen did. To tell malingering from a real illness, doctors need to perform a thorough physical examination that may include tests to find out whether the symptoms a person claims to have are real and are in fact a sign of disease or injury. Doctors also need to be aware of circumstances in their patients’ lives, such as unwanted work or duties, that might cause them to fake a disorder.

Certain mental disorders could be confused with malingering. For example, in hypochondria*, conversion disorder*, and Munchausen syndrome*, the patients’ symptoms may not arise from actual physical conditions, yet these mental disorders are not the same as malingering. When people miss work or school due to physical symptoms that occur because of stressful changes or emotional upsets in their lives, they are not considered to be malingering. Individuals who are malingering know they are not sick and intentionally pretend to be ill for specific secondary gain.

▶ See also **Conversion Disorder • Hypochondria • Munchausen Syndrome • School Avoidance • Somatoform Disorders**

Resources

Books and Articles

Feldman, Marc D. *Playing Sick? Untangling the Web of Munchausen Syndrome, Munchausen by Proxy, Malingering and Factitious Disorder*. New York: Brunner-Routledge, 2004.

- * **hypochondria** (hy-po-KON-dree-ə) is a mental disorder in which people believe that they are sick, but their symptoms are not related to any physical illness.
- * **conversion disorder** is a mental disorder in which psychological symptoms are converted to physical symptoms, such as blindness, paralysis, or seizures. A person with conversion disorder does not intentionally produce symptoms.
- * **Munchausen syndrome** (MOON-chow-zen SIN-drome) is a mental disorder in which a person pretends to have symptoms or causes symptoms of a disease in order to be hospitalized or receive tests, medication, or surgery.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **aorta** (ay-OR-ta) is the major large artery that carries blood from the heart to the rest of the body.

Manic Depression See *Bipolar Disorder*.

Marfan Syndrome

Marfan syndrome involves the body's connective tissue and is characterized by abnormalities in the skeleton, heart, and eyes. It is caused by an abnormal gene that usually is inherited. People with Marfan syndrome are generally taller than average, have little body fat, and have long, thin fingers.*

What Is Marfan Syndrome?

Marfan syndrome was first described in 1896 by the French physician Antoine Marfan (1858–1942). Some famous people of the past, such as violinist Niccolò Paganini, who had very long fingers, and Egyptian King Tutankhamen, are believed by some to have had Marfan syndrome. In the early 2000s, the disorder received attention in the media as a result of health problems and deaths among celebrities such as Joey Ramone from the punk rock band The Ramones and Jonathan Larson, author and composer of the hit musical *Rent*. Still, the disorder is rare.

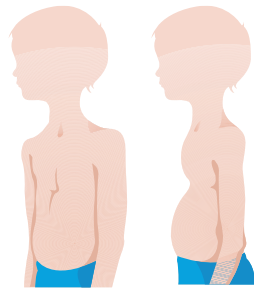
Marfan syndrome affects only about 1 to 2 people of every 10,000. In the United States, it has been estimated that between 60,000 and 200,000 people have the disorder. It affects men and women in equal numbers, as well as people of all racial and ethnic groups. Marfan syndrome can affect the heart and aorta*, the eyes, and the skeleton.

What Causes Marfan Syndrome?

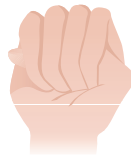
For many years, it was known that Marfan syndrome is inherited. It was observed that if someone had the disorder, each of his or her children would have about a 50 percent chance of developing it as well. However, it was not known what gene or genes were responsible for the disorder.

In the early 1990s, researchers found that the condition is caused by a single abnormal gene. This gene is involved in the production of a type of protein, called fibrillin, which gives connective tissue its strength. Connective tissue holds in place all the structures of the body. When the gene is defective, it causes critical changes in fibrillin that may weaken and loosen the connective tissue. This effect, in turn, causes the wide range of features, such as tall stature and loose joints, that are found in Marfan syndrome. It was not known as 2009 just how alterations in the genes produce these features.

Although anyone born to a parent with Marfan syndrome has a 50-50 chance of inheriting the disorder, an estimated 25 percent of people with Marfan syndrome do not have a parent who has it, which is because a



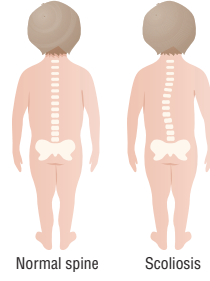
A. Pectus excavatum



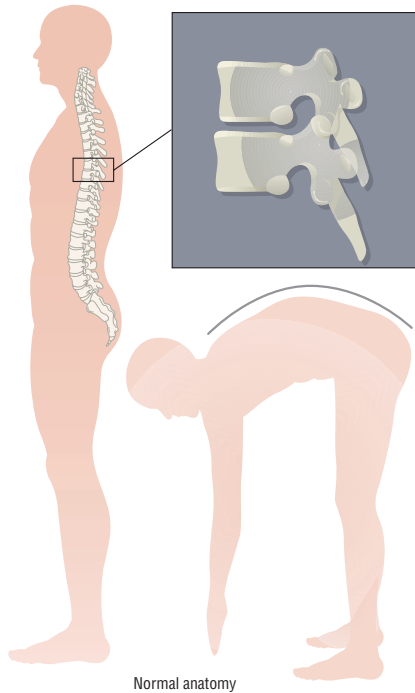
B. Positive thumb sign



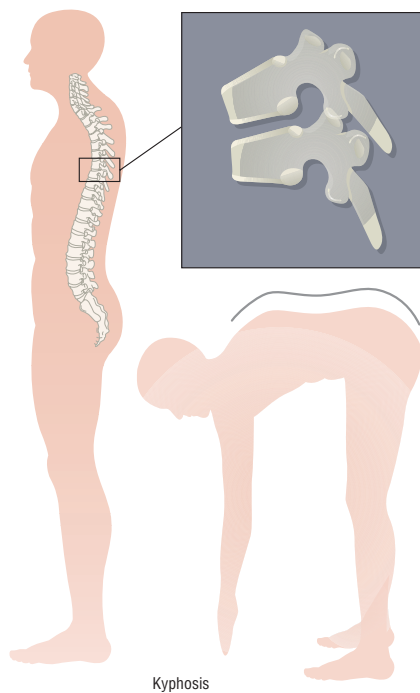
C. Positive elbow sign



D. Scoliosis of the vertebral



Normal anatomy



Kyphosis

Five clinical signs of Marfan syndrome, (left to right) pectus excavatum, positive thumb sign, positive elbow sign, normal spine compared with scoliosis, normal anatomy compared with kyphosis. *Illustrations by Argosy. Reproduced by permission of Gale, a part of Cengage Learning.*



person can have the defective gene owing to a spontaneous mutation, or change, in the normal gene.

What Are the Signs and Symptoms of Marfan Syndrome?

The characteristic signs and symptoms of Marfan syndrome usually do not begin to become apparent until a person is 10 years of age. When they do emerge, they may involve any or all of three parts of the body: the skeleton, the circulatory system (heart and blood vessels), and the eyes.

* **glaucoma** is a group of disorders that cause pressure to build in the eye, which may result in vision loss.

Skeleton A person who has Marfan syndrome usually (but not always) grows to be very tall and thin. The fingers also tend to be long and thin, or “spidery.” The head is sometimes elongated too, and the chest may have a caved-in look. The joints tend to be supple and loose and are prone to becoming dislocated. There may be scoliosis (sko-lee-O-sis), a side-to-side curvature of the spine.

Circulatory system The most serious features of Marfan syndrome involve the heart and aorta, the main artery that carries blood directly from the heart to the body. A characteristic defect in one of the valves of the heart (mitral valve) can cause irregular heart rhythm. Weakness in the aorta can allow it to widen, eventually leading to the development of an aneurysm (AN-yoo-riz-um), a bulge in the wall of a blood vessel. If untreated, the weak spot in the aorta can rupture, causing severe internal hemorrhage and death, without warning.

Eyes A common symptom of Marfan syndrome is myopia (my-O-pee-uh), or nearsightedness. In addition, detachment of the retina or early-onset glaucoma* have been described as complications of Marfan syndrome.

How Is Marfan Syndrome Diagnosed?

Marfan syndrome can be difficult to diagnose. As of 2009, no single laboratory test could identify it. Some people with the condition do not have all of its characteristic signs. Conversely, most people who are tall, lanky, and nearsighted do not have Marfan syndrome. (Again, the disorder is rare.)

Accurate diagnosis is made from a combination of one’s family history and a complete physical examination that focuses on the skeleton, heart and aorta, and the eyes. An echocardiogram (ek-o-KAR-de-o-gram), a picture of the heart produced by using sound waves, can detect abnormalities in the heart and aorta. Eye doctors can look for possible lens dislocations.

The identification of the gene that causes Marfan syndrome and of fibrillin as the component of connective tissue affected by the gene was expected as of 2009 to aid in future diagnosis.

How Is Marfan Syndrome Treated and Prevented?

Treatment and prevention of complications depend upon the individual symptoms of the person affected by the syndrome. Main aspects include annual echocardiograms to watch for enlargement of the aorta and to monitor heart function, and continuing eye examinations to detect lens dislocation. Medications called beta-blockers may be prescribed to lower blood pressure in an attempt to prevent aneurysms from developing in the aorta. If a significant size aneurysm is found on evaluation, or if the aneurysm leaks or ruptures, surgical repair becomes necessary and life-saving. The surgery performed is usually aortic grafting, with or without aortic valve repair. Although this procedure is complicated,

the prognosis is generally good if the surgery is performed on an elective basis before a rupture of the aorta. Braces can be used to correct spinal curvature.

In terms of lifestyle, strenuous sports may have to be avoided to reduce the risk of damage to the aorta. Genetic counseling is advisable for anyone thinking about having children because of the risk that children will inherit the condition. Although there is no cure for Marfan syndrome, working closely with one's doctor in an ongoing monitoring and treatment program can greatly improve the outlook for long life.

▶ See also **Cataracts** • **Genetic Diseases** • **Nearsightedness** • **Scoliosis**

Resources

Organizations

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-226-4267. Web site: http://www.niams.nih.gov/Health_Info/Marfan_Syndrome/default.asp.

National Marfan Foundation. 22 Manhasset Avenue, Port Washington, NY, 11050. Toll free: 800-862-7326. Web site: <http://www.marfan.org>.

Mastoiditis See *Otitis (Ear Infections)*.

Measles (Rubeola)

Measles (ME-zuls) is a viral respiratory system infection that is best known for the rash of large, flat, red blotches that appear on the arms, face, neck, and body.*

What Is Measles?

Measles, also known as rubeola (roo-be-O-luh), is a highly contagious* viral infection caused by the measles virus. Most people are familiar with its most recognized feature: a near full-body rash of red blotches. In fact, measles is primarily an infection of the respiratory system. The disease has been diagnosed throughout the world, and before a vaccine* was available it commonly appeared in the United States in springtime epidemics* every few years. In the United States, one to two deaths occur for every 1,000 cases of measles. In developing countries, the fatality rate can be as

* **respiratory system** or respiratory tract, includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

* **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

* **epidemics** (eh-pih-DEH-miks) are outbreaks of diseases, especially infectious diseases, in which the number of cases suddenly becomes far greater than usual. Usually, epidemics that involve worldwide outbreaks are called pandemics.



United Nations Children's Fund doctor Nicholas Alipui vaccinates a child against measles as part of the launch of a national vaccination campaign in the Philippines, February 3, 2004. *Jay Directo/AFP/Getty Images.*

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

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high as one in every four people who contract the disease. Most deaths from measles in the United States are caused by pneumonia*, either from the measles virus itself or from a bacterial infection that arises as a complication of measles.

How Common Is Measles?

Before the introduction of the measles vaccine* in 1963, approximately 500,000 reported cases of measles and 500 deaths occurred in the United States each year. After measles vaccination programs began, though, infection rates dropped by more than 98 percent, and epidemics* all but disappeared. According to the Centers for Disease Control and Prevention, between 1993 and 2001 there were fewer than 500 cases of measles diagnosed in the United States each year (in 2000 there was an all-time low of 86 cases). However, a previous resurgence of measles between 1989 and 1991 led to more than 55,000 diagnosed cases and 123 deaths. This epidemic arose because many children were not being vaccinated.

By contrast, measles in the developing world remained a serious problem in the 1990s and early 2000s. The disease accounted for about 873,000 deaths worldwide in 1991. Because of intensive vaccination efforts, which were begun in 2001 by the Measles Initiative, global deaths by 2005 had fallen 60 percent to 345,000. Limited access to the vaccine was the primary reason that developing countries continued to see large numbers of measles cases. Immigrants to the United States who had not received the vaccine in their native countries accounted for the majority of cases of the disease in the United States. However, the Measles Initiative set its worldwide goal on a 90-percent drop in mortality by 2010.

How Does Measles Spread?

Measles is highly contagious and can spread quickly among people who have not been immunized against it. The measles virus spreads by direct contact with an infected person or by breathing in tiny drops of fluid sent into the air when the person sneezes, coughs, or laughs. A cough or sneeze releases thousands of microscopic particles that contain the virus. These can stay in the air, able to infect people, for up to two hours. In some cases, people have caught measles after entering a room that an infected person had already left. A person with measles is contagious from one to two days before the symptoms begin until four or five days after the rash appears.

What Are the Signs and Symptoms?

After a person has been exposed to the virus, there is an incubation period that averages 10 to 12 days. The first symptoms include fever, runny nose, cough, and reddened eyes that are sensitive to light. Koplik spots, a unique sign of measles, break out one to two days before the rash begins and usually are gone by the time it appears; they are bluish-white dots found

THE SPREAD OF MEASLES

Historically, infectious diseases have affected huge populations. They have toppled kingdoms, swept through countries with devastating results, and altered world economies and religions. Measles traveled around the globe with European adventurers and explorers. The disease killed many inhabitants of the Pacific Islands and the Americas (North America, South America, and Central America). When the Spanish conquistadors Hernán Cortés (1485–1547) and Francisco Pizarro (ca. 1475–1541) arrived in the Americas, they unknowingly carried with them measles and smallpox, which resulted in the death of an estimated one-third of the native populations.

on the inside of the cheeks and other places on the mucous membranes (moist linings) in the mouth.

The measles rash typically begins on the forehead and extends across the face, neck, and body. It generally takes several days for the rash to travel from head to toes. The red blotches often spread out and join, completely covering the skin, especially on the face and shoulders. Once the rash appears, two to four days after the onset of illness, the fever rises and may peak at 104 to 105 degrees Fahrenheit. During this time, the patient looks and feels very ill. Symptoms improve soon after the rash has traveled down to the legs and feet, usually accompanied by a rapid drop in temperature. The rash fades along the same path that it appeared, beginning at the forehead and working its way down. As the rash disappears, the skin may temporarily look brown, dry, and flaky. Other symptoms of measles include loss of appetite, vomiting, and diarrhea (dye-uh-REE-uh), especially in young children. Hemorrhagic (heh-muh-RAH-jik) measles is a rare and serious form of the disease characterized by hemorrhaging (uncontrolled or abnormal bleeding), high fever, seizures* and delirium*.

How Do Doctors Make the Diagnosis?

Measles can be diagnosed by asking a patient about symptoms and performing a physical examination. If there is a question about the diagnosis or if it is necessary to confirm a suspected case of measles, blood tests can determine whether antibodies* to the virus have developed in the body.

What Is the Treatment for Measles?

Because measles is caused by a virus, treatment generally is aimed at keeping the patient comfortable until the infection runs its course. The high fever and sweating that accompany measles raise the risk of dehydration*, so patients should have plenty of rest and fluids. Taking vitamin A may aid recovery in some cases, especially among children with

Measles Redux

Cases of measles infection rose dramatically from 1989 to 1991 in the United States and other countries. Nearly half of the U.S. patients were unvaccinated preschool children living in urban areas. The epidemic began because of a lapse in measles vaccinations and public education. Many people were unaware that measles was still a threat. The general assumption was that years of public vaccinations had controlled the infection; moreover, some individuals were afraid of adverse reactions to the vaccine itself. Emergency vaccinations eventually contained the epidemic, but the outbreak revealed the persistence of a virus that many believed was no longer a cause for concern.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **delirium** (dih-LEER-e-um) is a condition in which a person is confused, is unable to think clearly, and has a reduced level of consciousness.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

- * **intravenous fluids** (in-tra-VEE-nus) are fluids injected directly into a vein.
- * **croup** (KROOP) is an infection involving the trachea (windpipe) and larynx (voice box) that typically occurs in childhood. It causes inflammation and narrowing of the upper airway, sometimes making it difficult to breathe. The characteristic symptom is a barking cough.
- * **subacute sclerosing panencephalitis** (sub-uh-KYOOT skluh-RO-sing pan-en-seh-fuh-LYE-tis), or SSPE, is a chronic brain disease of children and adolescents that occurs months or years after having had measles; it causes convulsions, movement problems, and mental retardation and is usually fatal.
- * **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.
- * **premature labor** is labor (the birth process) that begins too early, before the fetus has developed fully in the womb.
- * **immune globulin** (ih-MYOON GLAH-byoo-lin), also called gamma globulin, is the protein material that contains antibodies.

poor nutrition. Serious cases may require a hospital stay and intravenous fluids*. Antibiotics are given when bacterial infections (such as ear infections or pneumonia) develop as complications of the disease.

What to Expect

Measles generally lasts between 10 and 14 days from the onset of symptoms through the fading of the rash. Ear infections, croup*, and pneumonia sometimes accompany measles. Less commonly, inflammation of the brain (known as encephalitis, en-seh-fuh-LYE-tis) or inflammation of the heart muscle (known as myocarditis, my-oh-kar-DYE-tis) can occur. Subacute sclerosing panencephalitis* (SSPE), a type of encephalitis, is an extremely rare late complication of lasting measles virus infection that can cause gradual loss of brain function. SSPE may occur months, years, or even decades after measles infection, but it is almost never seen in the United States, as a result of widespread use of the measles vaccine. If a pregnant woman contracts measles, the infection can harm her developing baby, leading to miscarriage*, premature labor*, or low birth weight.

How Can Measles Be Prevented?

The best protection against measles is immunization. The vaccine usually is given as part of a combined measles-mumps-rubella (MMR) vaccine that children typically receive twice in their lives. The first round is given when an infant is 12 to 15 months old and the second when the child is ready to start school, at four to five years of age. Children also may receive the second vaccine when they are 11 or 12 years old, if they do not receive it earlier. Because about 5 percent of people do not develop protective antibodies after the first MMR vaccine, the second dose offers better protection against infection. If someone comes into contact with a person who has measles and then is vaccinated within three days of that exposure, the vaccine may prevent or lessen the severity of a case of measles. Immune globulin* can have the same result if it is given within six days of exposure to the virus.

▶ See also **Encephalitis • Mumps • Myocarditis/Pericarditis • Pneumonia • Rubella (German Measles) • Vaccination**

Resources

Books and Articles

Rosaler, Maxine. *Measles*. New York: Rosen, 2005.

Organization

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/measles.html>.

Medicines and Medications See *Psychopharmacology*.

Melanoma See *Malignant Melanoma; Skin Cancer*.

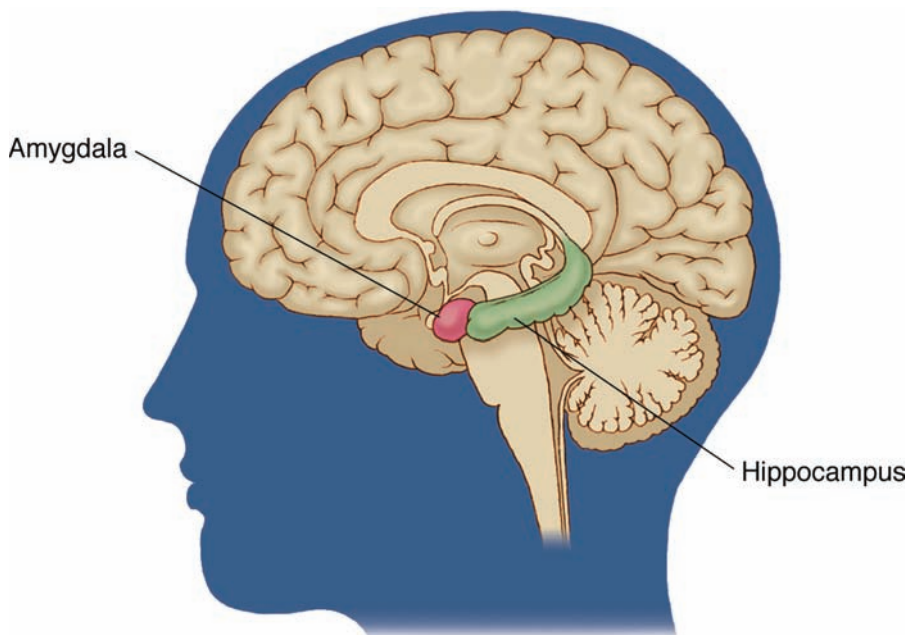
* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

Memory and Amnesia

Memory is the ability to remember and to recall previous sensations, ideas, experiences, or such information as has been consciously learned. Amnesia (am-NE-zhah) is the loss of memory about one or more past experiences that goes beyond normal forgetfulness in a person who has a normal level of consciousness (that is, the person is not asleep or in a coma). Amnesia can be caused by a variety of physical and mental illnesses.*

Brain Structures, Memory, and Amnesia

To understand human memory and how diseases, toxic substances, or physical injuries can interfere with it, it is necessary to have a basic understanding of the structures in the human brain that are involved in memory formation, storage, and retrieval. One important part of the brain is the temporal (TEM-puh-rul) lobes, located toward the lower front of



Research has linked memory to the amygdala and to the hippocampus, two structures deep inside the brain. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

- * **epilepsy** (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.
- * **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.
- * **Alzheimer's (ALTS-hy-merz) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.
- * **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.
- * **epilepsy** (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.
- * **thalamus** (THAL-uh-mus) refers to a pair of large egg-shaped areas located in the middle of the brain just under the cerebral cortex. The plural form is thalami.
- * **cortex** (KOR-tek-s) is the top outer layer of the brain. It controls the brain's higher functions, such as thinking, learning, and personality.

the brain over the ears. In the 1930s, while performing brain surgery on patients with epilepsy*, Canadian neurosurgeon Wilder Graves Penfield (1891–1976) used an electrical probe to stimulate different parts of the brain. Because the brain itself does not feel pain, the patients could remain awake during surgery. Penfield found that some patients reexperienced vivid events or scenes from their lives when he stimulated the temporal lobes. The temporal lobes, however, can be easily damaged by a concussion or more severe head trauma, or by a loss of blood supply to the brain caused by a stroke*.

Inside each temporal lobe is the hippocampus (HIP-po-KAM-pus) (plural, hippocampi), a seahorse-shaped structure that stores short-term memories. It is one of the first portions of the brain destroyed by Alzheimer's (ALTS-hy-merz) disease*; it can also be damaged by encephalitis*, oxygen deprivation, or temporal lobe epilepsy*. When surgeons removed the hippocampi from a patient known by the initials H.M., hoping to treat his epilepsy, they discovered that H.M.'s epilepsy improved, but his short-term memory disappeared. H.M. could remember events that happened many years before, but not events of the previous day or the previous hour. H.M.'s doctors had to reintroduce themselves to him every single day. On his death on December 2, 2008, H.M. was identified as Henry Gustav Molaison.

Another important brain structure is the thalamus*. The thalamus is a structure that lies between the cortex* of the brain and the brain stem*. It relays information from the senses to the cortex and also regulates a person's level of awareness. Damage to the thalamus impairs recent memory and the ability to form new memories.

The formation and recall of memory have an emotional as well as a cognitive* dimension. Experiences that make people feel happiness, sadness, intense fear, or some other strong emotion are more likely to be remembered. The structures in the brain that are most closely involved with processing emotion-laden memories are the hippocampus and the amygdala*, a small almond-shaped structure in the middle portion of the temporal lobe. The amygdala plays an important role in regulating the emotion of fear and of long-term memory consolidation. The amygdala's activity level increases when a person is highly aroused emotionally; memories formed at that time are more likely to be retained than those associated with less exciting situations. The amygdala is activated by traumatic events and by recalling memories of trauma. Certain studies using various brain imaging techniques indicated that high levels of activity in the amygdala are found in patients with psychogenic amnesia.

How Does Human Memory Work?

Human memory is generally divided into two broad categories: short-term and long-term.

Short-term memory Short-term memory is the form of memory that a person uses for such activities as remembering a new phone number after calling directory assistance. The person may repeat the number silently

before dialing it and then promptly forget it. If the person is distracted before dialing and did not write down the number, the person may have to call directory assistance again. That is because short-term memory is fairly easily disrupted. When students must learn new material, they must go over it several times, perhaps even write it out, rather than just see it one time. They are converting the information from unstable short-term memory into more stable long-term memory by paying close attention to it and rehearsing it.

People who experience a severe head injury demonstrate how easily the process of short-term memory can be interrupted. For example, a car accident victim may not recall what happened just before impact or even during the accident itself. Some athletes who are knocked unconscious during an especially rough play may not remember what happened minutes before they were hit. This type of amnesia occurs because there was not enough time for experiences to be converted from short-term to long-term memory.

Long-term memory Long-term memory, which is much more permanent and stable than short-term memory, can be further subdivided into two types: implicit and explicit. Implicit memory, or procedural memory, is the ability to repeat automatic tasks or procedures, such as riding a bike, driving a car, typing, or swinging a tennis racket. Explicit memory, by contrast, refers to recalling specific facts or events. This type of memory is what comes into play when a person takes a history test, for example, or remembers someone's name. Amnesia is more likely to affect explicit memory than procedural memory.

The Many Faces of Amnesia

He is a well-known Australian artist who was diagnosed in 1994 with Wernicke-Korsakoff (VER-ni-kee-KOR-sa-kof) syndrome, a disorder of memory most often caused by alcoholism. Once wealthy from the sales of his art, Charles Blackman (b. 1928) survives on money channeled into a trust fund. His memory comes and goes; when his amnesia returns, he resorts to confabulation* in order to carry on conversations with visitors. It is difficult for them to know how much of what he tells them really happened and how much is confabulated.

She was 16 years old when she collided with another player on the basketball court and hit her head sharply. The next day she felt nauseated, dizzy, and her vision was blurred. Then she had problems remembering what she was supposed to be learning in school; her memory was failing. Tracy had amnesia following a concussion*. She had three years of therapy in order to regain her memory well enough to complete high school.

He is a man in his 40s from Bellingham, Washington, who found himself in Denver, Colorado, in September 2006 with no idea of how he got there or who he is. He appeared on a Denver news show after three weeks in a local hospital asking the public for help in identifying him. His family had filed a missing person report; they were contacted by the Denver police. The man had been on his way to Canada to visit a dying

* **brain stem** is the part of the brain that connects to the spinal cord. The brain stem controls the basic functions of life, such as breathing and blood pressure.

* **cognitive** associated with thinking, learning, perception, awareness, and judgment.

* **amygdala** (a-MIG-da-la) is a small almond-shaped structure in the brain that plays a part in processing emotions.

* **confabulation** filling in gaps in memory by making up or fabricating facts. The gaps occur because the memory function is impaired.

* **concussion** (kon-KUH-shun) is an injury to the brain, produced by a blow to the head or violent shaking.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

friend when his emotional stress triggered a rare form of amnesia known as a fugue (FYOOG) state. According to the man's mother, he does not remember his entire past life, let alone the trip to Denver.

He had served as the thirty-third governor of California and the fortieth president of the United States. Starting about four years after Ronald Reagan left office, however, his family and friends started to notice that his memory was failing. In the fall 1992, Reagan asked one of his personal physicians what he should do next after making a speech. In February 1994 the former president made his last trip to Washington; he failed to recognize one of his long-term Secret Service agents and told his wife when they returned to their hotel room that he was not sure where he was. In November 1994 Reagan told the American public that he had been diagnosed with Alzheimer's disease, the disease that finally killed him in 2004.

He is a middle-aged Englishman living in a mobile home who was found by his friends in a confused and disoriented state in late 2007. He had no memory of what had happened. His doctors performed a range of diagnostic tests that included brain imaging, a muscle biopsy*, and a test of the patient's spinal fluid. The tests did not yield any useful results. Several weeks later, the patient's amnesia suddenly cleared up. His most recent memory was turning on his gas heater for the first time when the weather turned cold. A repairman went to the patient's home and found that the heater had been releasing carbon monoxide into the air. This colorless and odorless but toxic gas was the cause of the patient's amnesia as well as of his physical symptoms.

She is a survivor of the Cocomanut Grove nightclub fire of 1942, the second-worst single-building fire in U.S. history. She has no conscious memory of the disaster. Yet every year on November 28, the anniversary of the tragedy, she suddenly begins to ask those around her how many women they rescued from the fire. Her anniversary reaction is a symptom of dissociative amnesia.

What Is Amnesia?

As these case studies indicate, amnesia is a loss of memory in a person with a normal level of consciousness that can arise from a bewildering variety of conditions or accidents. It is not a disease or disorder in its own right but rather a symptom of an underlying physical or psychological condition. Amnesia may last from a few hours to a lifetime; it may be reversible or permanent; it may improve, stay the same, or get worse over time.

What Are the Different Types of Amnesia?

There are three distinct phases in human memory: registering the event in the brain, storing the information, and retrieving the information that has been stored. Disorders or injuries affecting any of these phases may cause amnesia. Amnesia can be classified in several different ways:

- **According to the time sequence of the events forgotten and the cause of the amnesia.** Anterograde amnesia is the inability to learn

new information. A person with this type of amnesia can accurately recall events in the past that happened before the trauma but has marked difficulty remembering any new information for more than a few minutes. In contrast, retrograde amnesia is the partial or complete loss of memory of events that occurred before the trauma. A person with retrograde amnesia can, however, process, store, and recall new information. It is possible for a person to have both anterograde and retrograde amnesia at the same time.

- **According to the length of time the amnesia lasts.** Amnesia that lasts only for a brief period of time is called transient or temporary amnesia. Amnesia that lasts for a long period of time is called non-transient or chronic amnesia.
- **According to whether the amnesia is total or partial.** Amnesia that includes all the person's memories of his or her past is known as global amnesia. Amnesia that affects only memories processed through a given sense, such as hearing or taste, is called sense-specific amnesia.
- **According to whether the amnesia stays at the same level of severity for long periods of time or gets worse.** Amnesia that gets worse with time, like the amnesia associated with Alzheimer's disease, is called progressive amnesia. Amnesia that does not worsen over time is called fixed amnesia.

What Causes Amnesia?

Amnesia can be caused by a range of physical injuries, drug reactions, toxic substances, seizure disorders, infectious diseases, or emotional traumas. Amnesias resulting from a physical disorder are classified as organic, or body-related, while those resulting from an emotional shock are called psychogenic* amnesias. As a rule, memory loss in organic amnesias is gradual and incomplete rather than sudden or total, which is more likely in psychogenic amnesia.

Organic causes of amnesia Specific organic causes of amnesia include the following:

- Head injuries. The most common causes of head injuries in children are sports and bicycle accidents; among adults, the most common causes are falls and auto accidents.
- Brain tumors.
- Seizures.
- Thiamine deficiency. Thiamine, or vitamin B₁, is necessary for the brain to use glucose (sugar) efficiently. Heavy drinking interferes with the body's ability to supply the brain with thiamine and causes direct damage to the thalamus.
- Infectious diseases. Infectious diseases that cause inflammation of the meninges* or the brain tissue itself can cause amnesia. Diseases

* **psychogenic** (SIGH-ko-JEN-ik) originating in the mind as a result of emotional conflict.

* **meninges** (meh-NIN-jeez) are the membranes that enclose and protect the brain and the spinal cord.

* **Epstein-Barr virus** (EP-stine-BAHR VI-rus) is a common virus that causes infectious mononucleosis.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **syphilis** (SIH-fih-lis) is a sexually transmitted disease that, if untreated, can lead to serious life-long problems throughout the body, including blindness and paralysis.

* **diuretics** (dye-yoor-EH-tiks) are medications that increase the body's output of urine.

* **transient ischemic attack** (TRAN-shent iss-KEE-mik) a temporary loss of blood supply to a particular area of the brain

known to cause amnesia include human herpesvirus-6 infection, dengue fever, Epstein-Barr virus*, AIDS*, late-stage syphilis*, Rocky Mountain spotted fever, and streptococcal toxic shock syndrome. Herpesvirus-6 infection destroys cells in the hippocampus and amygdala as well as causing inflammation.

- Drug abuse or intoxication. Alcoholics sometimes have blackouts, or episodes of amnesia caused by a rapid increase in blood-alcohol concentration. Alcohol specifically impairs the brain's ability to take short-term memories and experiences and transfer them to long-term memory. Illegal drugs that can cause amnesia include cocaine, LSD, PCP, and mescaline. Glue sniffing, or inhaling the solvents used in glue, nail polish, turpentine, spray paint, or similar products in order to get "high," can cause amnesia by direct destruction of brain tissue as well as cutting off the oxygen supply to the brain temporarily.
- Prescription medications. Several prescription drugs, including aminophylline, barbiturates, bromide, digoxin, diuretics*, isoniazid, methyl dopa, and tricyclic antidepressants, have been reported to cause transient amnesia.
- Carbon monoxide poisoning. Carbon monoxide damages the brain by interfering with its oxygen supply.
- Stroke. Stroke interferes with the blood supply to brain tissue. The parts of the brain involved in memory formation and retrieval can begin to suffer damage within minutes after the loss of blood supply.

Transient global amnesia, or TGA, is a form of memory loss that appears suddenly and causes confusion, disorientation, and forgetfulness for 30 minutes to 24 hours. This type of memory loss typically clears up on its own. The causes of TGA are not completely understood as of 2009; however, many doctors think that the disorder is an organic amnesia. Various explanations include an unusual form of migraine headache; a seizure in the temporal lobe of the brain; or a transient ischemic attack* or TIA, sometimes called a mini-stroke, that affects the thalamus or hippocampus.

Functional (psychogenic) amnesia Functional or psychogenic amnesia refers to amnesia triggered by psychological stress rather than a known physical cause. It may be localized (covering only specific events or a period of time in the person's life) or global. It may also be systematized; that is, the person may have amnesia only for certain types of information or for specific people and have normal memory for everything else. The basic mechanism of psychogenic amnesia is dissociation, a process in which the formation of memories is interrupted or altered by extreme fear in response to trauma. Memories of the frightening event or time period remain in the mind but are not accessible to explicit memory. There is evidence from brain imaging studies that the hippocampus is damaged by exposure to high levels of psychological stress and that the amygdala becomes more easily activated after a traumatic experience.

Traumatic memories may, however, reemerge in the form of nightmares or flashbacks* when a sound, sight, or even smell reminds the person of the traumatic event. A group of doctors in Boston caring for Cambodian refugees with post traumatic stress disorder (PTSD) reported in 2004 that 45 out of 100 patients reported flashbacks triggered by odors. Flashbacks and nightmares are generally thought to result from activation of the amygdala.

Specific disorders characterized by psychogenic amnesia include:

- Post-traumatic stress disorder. People diagnosed with PTSD may have amnesia related to the traumatic event, may suffer from flashbacks, and may find it difficult to learn new information.
- Dissociative amnesia. In dissociative amnesia, the patient cannot remember certain specific parts of the past (ranging from hours to years) but has an otherwise normal memory. The gaps in memory (almost always related to trauma) are usually clearly marked off from the portions of the past that the person does remember.
- Dissociative fugue. Dissociative fugue is marked by an amnesia in which individuals cannot recall some or all of their past and either lose their identity or form a new identity. They may travel far away from their home and take up a new occupation. Fugues are usually triggered by severe and long-standing emotional stress and a desire to escape from it.
- Dissociative identity disorder (DID),*. Dissociative identity disorder, or DID, used to be called multiple personality disorder. It is characterized by two or more identities called alters that alternate in directing the patient's outward behavior. The disorder includes inability to recall important personal information relating to some of the alters.

How Common Is Amnesia?

Amnesia is not an unusual symptom by itself, but the frequency of different types of amnesia in the United States varies considerably:

- Alzheimer's disease: 5 million adults.
- Brain tumors: about 44,000 new cases per year.
- Carbon monoxide poisoning: about 5,000 reported cases each year. The actual number may be higher.
- Concussion: 6 cases per 1,000 people per year. Some doctors think this estimate is too low, however.
- Dissociative amnesia: 2 to 7 percent of the general population. It is most likely to develop in survivors of wars or concentration camps; in patients with a history of child abuse or sexual abuse; in victims of torture; and in survivors of natural disasters.
- Dissociative fugue: about 2 adults in every 1,000 per year.
- Dissociative identity disorder: between 30,000 and 300,000 people.

* **flashbacks** are intensely vivid, recurring mental images of a past traumatic event. People may feel or act as if they were reliving the experience.

* **dissociative identity disorder (DID)**, formerly known as multiple personality disorder (MPD), is a severe psychiatric condition in which a person has two or more distinct sub-personalities that periodically take control of his or her behavior. The sub-personalities are thought to be caused by repeated episodes of an extreme form of dissociation.

* **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.

* **spinal tap** also called a lumbar puncture, is a medical procedure in which a needle is used to withdraw a sample of the fluid surrounding the spinal cord and brain. The fluid is then tested, usually to detect signs of infection, such as meningitis, or other diseases.

* **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

* **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.

* **electroencephalogram** an instrument that records the electrical activity of the brain.

- Infections of the brain: about 10,000 cases each year.
- Post-traumatic stress disorder: about 7.7 million adults.
- Seizure disorder: about 1 in every 100 persons.
- Stroke: 700,000 cases per year.
- Transient global amnesia: 5.2 cases in every 100,000 people in the general population; 23 cases per 100,000 people over the age of 50.
- Wernicke-Korsakoff syndrome: 1 to 3 percent of adults over 30.

How Do People Know They Have Amnesia?

People may or may not know that they have amnesia. As President Reagan's case indicates, those in the early stages of Alzheimer's disease are often aware that their memory is starting to fail. Many try to cope by writing notes to themselves or asking family members to remind them of appointments or such household chores as paying bills. Patients in the later stages of the disease, however, gradually lose their awareness of their memory loss.

People with dissociative identity disorder often become aware that something is wrong when they find items in their closet that they do not remember purchasing or when a person they do not recognize calls them by an unfamiliar name.

People in a fugue state may not realize that they are suffering from amnesia until they are asked for personal information, then they become aware that they do not know who they are. In some cases, the dissociative fugue clears up by itself with dramatic speed, and individuals are bewildered by finding themselves in an unfamiliar setting.

People with dissociative amnesia may or may not be aware that they have gaps in their memory. Some who are aware that they have periods of "lost time" in their past may recover their memories through psychotherapy*; however, others do not succeed.

People who have blackouts as a result of heavy drinking or glue sniffing usually recognize afterward that they had amnesia for the period of intoxication.

People with some forms of organic amnesia, such as late-stage syphilis or Wernicke-Korsakoff syndrome, are unaware that they have amnesia.

How Do Doctors Diagnose and Treat Amnesia?

Physical examination and laboratory tests The first step in diagnosing amnesia is to obtain a medical history and evaluate the patient for possible physical causes of the amnesia. A physical examination is particularly important if the patient appears to be disoriented, feverish, intoxicated, or severely injured. The doctor will typically order a complete blood count and brain imaging studies to rule out stroke, brain tumors, and a possible concussion. Urine tests may be done if the patient's condition seems to be drug-related. A spinal tap* may be ordered if the doctor suspects meningitis*, encephalitis*, or late-stage syphilis. An electroencephalogram (EEG)* may be done to rule out seizure disorder.

The physical examination of the patient includes neurological tests. These include tests of the patient's level of consciousness, sight, sense of touch, and hearing; and tests of the patient's reflexes, sense of balance, muscle strength, and ability to walk normally.

Interview and mental status examination Patients whose chief symptom is memory loss are interviewed by a psychiatrist so that possible emotional or progressive causes of the patient's amnesia can be evaluated. The psychiatrist gives these individuals a mental status examination, or MSE. The doctor asks questions to determine their level of alertness; ability to think, pay attention, and carry out simple instructions; their ability to speak and their tone of voice; and their emotional condition. Short-term memory is tested by asking the patients to repeat the names of three objects listed by the doctor after a one-minute delay. Long-term memory is tested by asking patients a question about their past, such as "Where were you born?" or "What kind of car did you use when learning to drive?" The MSE is useful in distinguishing between psychogenic amnesia and memory loss caused by Alzheimer's disease or a mood disorder* such as depression.

It is also important for the doctor to distinguish between a patient with genuine psychogenic amnesia and one who is malingering*, or faking their amnesia. There are cases of people faking amnesia caused by AIDS* or PTSD in order to qualify for disability benefits. There are several diagnostic interviews that psychiatrists can use to distinguish real psychogenic amnesia from faking.

Treatment Treatment of amnesia depends on the cause. Amnesia that has an organic cause is treated by identifying and treating or removing the underlying cause. Infectious diseases, Alzheimer's disease, stroke, seizure disorder, Wernicke-Korsakoff syndrome, and substance abuse can be treated, but the amnesia may or may not improve. If it does not, there were no specific treatments for the memory loss as of 2009.

Amnesia caused by prescription medications usually clears up when the drug is discontinued. Transient global amnesia and dissociative fugue often clear up on their own, sometimes within a few hours.

Amnesia related to PTSD, dissociative amnesia, or dissociative identity disorder usually requires psychotherapy, often combined with hypnosis*. Hypnosis can be helpful in healing the trauma that caused the dissociation as well as retrieving some of the patient's dissociated memories. In some cases the doctor may also prescribe tranquilizers or antidepressant medications* to help the patient cope with the emotions stirred up by traumatic memories.

Can Amnesia Be Prevented?

Some of the organic causes of amnesia are at least potentially preventable by attention to safety measures. People can lower their risk of head injuries by wearing protective equipment during sports competition; by

* **mood disorder** is a mental disorder that involves a disturbance in the person's internal emotional state. Depressive disorders, bipolar disorders, and mood disorders are associated with the use of drugs or medical illnesses.

* **malingering** (ma-LING-er-ing) means intentionally pretending to be sick or injured to avoid work or responsibility.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **hypnosis** refers to a trance-like state, usually induced by another person. The person under hypnosis may recall forgotten or suppressed memories and be unusually responsive to suggestions.

* **antidepressant medications** are used for the treatment and prevention of depression.

driving or riding a bicycle safely; and by checking their households for hazards that put the elderly at risk of falls. Installing and maintaining carbon monoxide detectors and having gas-powered appliances checked regularly can reduce the risk of carbon monoxide poisoning.

Other organic causes of amnesia are potentially preventable by lifestyle changes. Eating a healthful diet, keeping one's weight at the right level, exercising regularly, and quitting smoking can lower the risk of stroke. Practicing safe sex can reduce the risk of syphilis, AIDS, and other sexually transmitted diseases. Avoiding heavy drinking, illegal drugs, and glue sniffing lowers the risk of drug-related amnesia and Wernicke-Korsakoff syndrome.

Some organic amnesias could not be prevented as of 2009 because doctors did not yet fully understand the causes of the disorders associated with the memory loss. These disorders included Alzheimer's disease, some types of brain tumors, and seizure disorder.

Psychogenic amnesia was not preventable as of 2009 because doctors did not know why some people react to abuse or other traumatic experiences by dissociating and others do not. It was also not known why some people develop dissociative disorders without a history of trauma.

▶ See also **Alzheimer's Disease • Brain Injuries • Concussion • Dementia • Stroke • Substance Abuse**

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Organizations

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.psych.org>.

Brain Injury Association. 1608 Spring Hill Road, Suite 110, Vienna, VA, 20036. Toll free: 800-444-6443. Web site: <http://www.biausa.org>.

Center for Molecular & Behavioral Neuroscience–Rutgers University, Newark Campus. 197 University Avenue, Newark, NJ, 07102. Web site: <http://www.memory.rutgers.edu//memory>.

National Alliance on Mental Illness. Colonial Place Three, 2107 Wilson Boulevard, Suite 300, Arlington, VA, 22201-3042. Telephone: 703-524-7600. Web site: <http://www.nami.org>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov>.

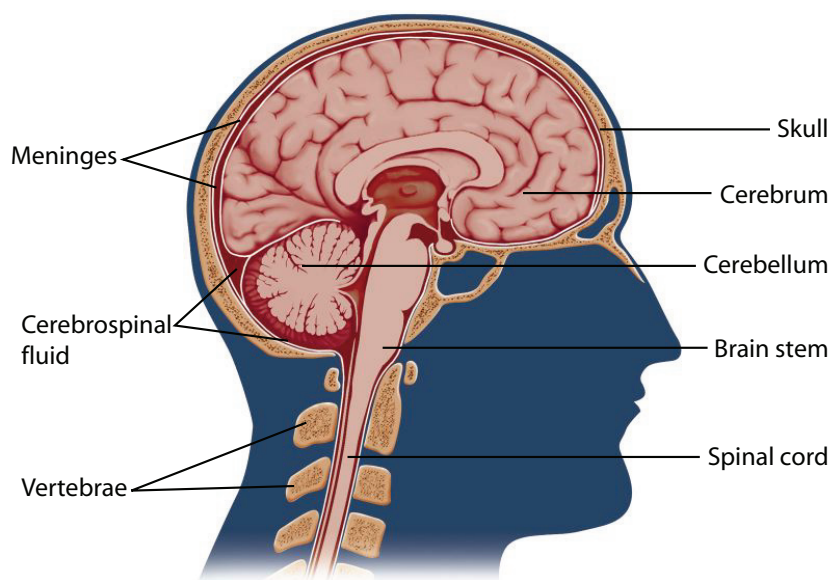
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Meningitis

Meningitis (meh-nin-JY-tis) is an inflammation of the membranes that surround the brain and the spinal cord (the meninges, meh-NIN-jeez). Meningitis is most often caused by infection with a virus or a bacterium.

What Is Meningitis?

Meningitis is an inflammation of the meninges, the membranes that enclose and protect the brain and the spinal cord. It is usually caused by infection, most often from viruses or bacteria. Meningitis caused by bacteria is known



◀ The meninges surround the brain and spinal cord. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

- * **echoviruses** a group of viruses found in the intestinal tract. The word echo in the name is acronym for enteric cytopathic human orphan viruses. When these viruses were named, they were not associated with any disease, hence the use of the word orphan. However, later these viruses were associated with various diseases, including meningitis and encephalitis.
- * **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.
- * **pathogens** (PAH-tho-jens) are microorganisms that can cause disease in another living organism.
- * **Lyme disease** (LIME) is a bacterial infection that is spread to humans by the bite of an infected tick. It begins with a distinctive rash and/or flu-like symptoms and, in some cases, can progress to a more serious disease with complications affecting other body organs.
- * **tuberculosis** (too-ber-kyoo-LO-sis) is a bacterial infection that primarily attacks the lungs but can spread to other parts of the body.
- * **syphilis** (SIH-fih-lis) is a sexually transmitted disease that, if untreated, can lead to serious life-long problems throughout the body, including blindness and paralysis.
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV)

as septic meningitis. Meningitis caused by other organisms, including viruses, fungi, and parasites, is called aseptic (a-SEP-tik) meningitis. Viral meningitis is the most common and mildest form of the disease, and most people fully recover from it without complications. Bacterial meningitis, if not diagnosed early, can cause serious and sometimes fatal complications.

Enteroviruses, a group of viruses that includes several strains of coxsackieviruses (kok-SAH-kee-vy-ruh-sez) and echoviruses*, cause about 90 percent of cases of aseptic meningitis. Two types of bacteria that are most likely to cause septic meningitis are *Streptococcus pneumoniae* (strep-tuh-KAH-kus nu-MO-nye) and *Neisseria meningitidis* (nye-SEER-e-uh meh-nin-JIH-tih-dis), also called meningococcus (meh-NIN-guh-kah-kus). Before the introduction of a vaccine* in the 1980s to prevent infection with *Haemophilus influenzae* type b (Hib), the bacterium was a common cause of septic meningitis in young children. Meningitis can be caused by other pathogens* as well, such as some species of parasites and fungi and the bacteria that cause Lyme disease*, tuberculosis*, and syphilis*. Meningitis from these organisms is usually a complication of widespread infection throughout the body and is more likely to be seen in people who have immune problems or other diseases, such as those with AIDS* or cancer. Sometimes, chemical irritations, severe drug allergies, or tumors can lead to inflammation in the central nervous system*, resulting in meningitis.

How Common Is Meningitis?

Bacterial meningitis, especially meningococcal meningitis, sometimes occurs in epidemics* in underdeveloped parts of the world, but epidemics are less common in the United States. Because of vaccinations (vak-sih-NAY-shunz) against some of the bacteria that can cause meningitis, the overall number of cases of septic meningitis steadily declined after 1990. Vaccinated infants and young children are much less likely to contract bacterial meningitis. However, after the late 1990s there was an increase in the number of cases of meningococcus infection seen in young adults, particularly in college students who live in dormitories.

How Does Meningitis Spread?

Some forms of bacterial meningitis are contagious, but these are not easily spread (compared to germs that cause colds and the flu). Bacterial meningitis almost never results from simply being in the same room or building with someone who has meningitis. Only a small fraction of people who come in contact with these bacteria and viruses actually develop meningitis.

Bacteria that can cause meningitis are sometimes found in the throats and noses of healthy people. They are spread through direct contact with respiratory secretions (drops of fluid from the mouth, nose, or lungs), which means they can be passed to someone who kisses an infected person or to someone who touches the secretions from someone who is sneezing or coughing and then touches his or her own nose or mouth. Meningococcus can spread in this way through households, daycare centers, and college dormitories.

Enteroviruses commonly are passed from person to person through contact with respiratory secretions, by breathing in drops from someone who is coughing or sneezing and from contact with an infected person's feces (FEE-seez, or bowel movements).

What Are the Signs and Symptoms of Meningitis?

Symptoms of meningitis often include fever, headache, stiff neck and back, photophobia (painful sensitivity of the eyes to light), abnormal sleepiness, and confusion. Vomiting may also be seen. Infants' symptoms are not as specific as those in older children and adults but usually include irritability, lethargy, poor feeding, crying when moved, and vomiting. Infants may not have neck or back stiffness while ill with meningitis. Meningococcus can cause a reddish-purple rash (from bleeding under the skin) that rapidly spreads over the body. Seizures* can occur in anyone with meningitis, regardless of age.

How Is Meningitis Diagnosed and Treated?

A doctor first asks questions about the illness, does a physical examination, and then performs some tests. The brain is sometimes viewed with a computerized tomography* (CT) scan to rule out other reasons for severe headache and illness, such as an abscess*, tumor, or other problems within the brain. A lumbar puncture (also called a spinal tap) is usually done to take a sample of the cerebrospinal (seh-ree-bro-SPY-nuhl) fluid (CSF), the fluid that surrounds the brain and spinal cord. The CSF is then examined under a microscope in order to identify bacteria or other infectious agents and to calculate increased numbers of white blood cells indicating inflammation.

Antibiotics are not used to treat viral meningitis because it is caused by a virus, not bacteria. Once a case of meningitis is known to be viral, rest and pain medication for body aches and headache can help the person feel better until the infection resolves on its own.

Bacterial meningitis requires prompt medical treatment, usually in the hospital. Antibiotics are given to fight the invading organism for at least two weeks. Treatment of complications may require intensive care and other medications.

Meningitis that results from other types of infection or other causes is treated with medications, such as antifungal* or antiparasitic drugs and may require hospitalization, especially during the early stages of medical care.

Most cases of viral meningitis last one to two weeks, and most people recover completely. Symptoms from bacterial meningitis can last weeks, and people may have severe complications from the disease, especially if it is not diagnosed and treated promptly.

What Complications Can Meningitis Cause?

Complications from viral meningitis are not as common as those from bacterial meningitis, but they can include inflammation and swelling of the brain. Sometimes, permanent learning disability and other brain damage can result.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **epidemics** (eh-pih-DEH-miks) are outbreaks of diseases, especially infectious diseases, in which the number of cases suddenly becomes far greater than usual. Usually, epidemics that involve worldwide outbreaks are called pandemics.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **abscess** (AB-ses) is a localized or walled off accumulation of pus caused by infection that can occur anywhere in the body.

* **antifungal drugs** (an-ty-FUNG-al drugs) are medications that kill fungi.

- * **sepsis** is a potentially serious spreading of infection, usually bacterial, through the bloodstream and body.
- * **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.
- * **kidneys** are the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.
- * **chronic** (KRAH-nik) lasting a long time or recurring frequently.
- * **prophylactic** (pro-fih-LAK-tik) refers to something that is used to prevent an illness or other condition, such as an infection or pregnancy.

Complications from bacterial meningitis can occur rapidly and be severe, even with quick diagnosis and treatment of the disease. Complications include sepsis*, brain swelling, seizures, shock*, organ failure (such as of the kidneys*), and death. Up to 15 percent of cases of meningitis caused by meningococcus are fatal. Long-term effects are seen in about 10 percent of those who survive bacterial meningitis and can include hearing loss, seizure disorder, learning disabilities, and other problems resulting from brain injury. Meningitis caused by the bacteria that cause tuberculosis is particularly likely to damage the nervous system.

Can Meningitis Be Prevented?

Vaccinations against *Haemophilus influenzae* type b and *Streptococcus pneumoniae* are given routinely to children in the United States before the age of two years. A vaccine against meningococcus is also available, although it is not regularly used in the United States and is not effective in young children. Young people going off to college, especially those who plan to live in a dormitory, should consider getting the vaccine, as recommended by the Centers for Disease Control and Prevention and the American Academy of Pediatrics. It also is recommended for people traveling outside the United States, people living in certain institutional settings, the elderly, and people with some chronic* medical conditions.

During outbreaks of bacterial meningitis, especially those caused by meningococcus, in schools, dormitories, or daycare, people may be given prophylactic* antibiotics to keep the disease from occurring in those who were in close contact with the infected person.

It is difficult to keep viruses such as enteroviruses from spreading from person to person. Risk of viral infection can be decreased by washing hands regularly, especially after using the toilet, and avoiding close contact with anyone who is ill, including not sharing food, eating or serving utensils, razors, or other personal items.

▶ See also **AIDS and HIV Infection • Coxsackievirus and Other Enteroviruses • Fungal Infections • Lyme Disease • Syphilis • Tuberculosis**

Resources

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Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/meningitis/index.htm>.

Meningitis Foundation of America. 212 W Tenth Street, Suite B-330, Indianapolis, IN, 46202. Toll free: 800-668-1129. Web site: <http://www.meningitisfoundationofamerica.org>.

Menopause

Menopause (MEN-o-pawz) is the time in a woman's life when menstruation (men-stroo-AY-shun or men-STRAY-shun) has permanently stopped and the woman is no longer fertile. Although it is a natural occurrence and is not an illness, menopause and the time surrounding it can cause a number of symptoms, which vary from one woman to the next.

What Is Menopause?

Women go through a number of natural stages in their lives, and menopause is one of them. A woman typically begins her menstrual cycle* by her early teens and continues to have periods for many years afterward. Eventually, when she gets older, her periods become less frequent, and she may begin to skip a month or several months at a time even though she is not pregnant. This time of irregular periods is called perimenopause (PARE-e-men-o-pawz). When a woman has not had a period for an entire year, she has reached menopause. Menopause, therefore, is the permanent end to a woman's menstruation. Once her periods have stopped, she can no longer become pregnant. Sometimes, perimenopause and menopause are together known as “the change of life” or “the change.” After the onset of menopause, the next stage of a woman's life is called postmenopause, which simply means “after menopause.”

Women go through perimenopause and reach menopause at different ages, and they also have different symptoms. Some women have very few symptoms, whereas others may struggle with a number of both physical and emotional issues that can be quite difficult. Treatments exist for many of these symptoms.

What Causes Perimenopause and Menopause?

Perimenopause and menopause are caused by changes in the levels of certain hormones*, known as progesterone (pro-JES-ter-one) and estrogen (ES-tro-jen), or collectively as female sex hormones.

* **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

- * **autoimmune disease** (aw-toh-ih-MYOON) is a disease in which the body's immune system attacks some of the body's own normal tissues and cells.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **chemotherapy** (KEE-mo-THER-ah-pee) is the treatment of cancer with powerful drugs that kill cancer cells.
- * **radiation therapy** is a treatment that uses high-energy radiation from x-rays and other sources to kill cancer cells and shrink cancerous growths.
- * **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.

WHEN DOES MENOPAUSE START?

The age at which women reach menopause varies widely. Usually women who live in developed countries reach menopause when they are between 45 and 55 years old, but some women are a little younger and some are a little older when it happens. Due to the dramatic increase in life expectancy in developed countries, most women can expect to be postmenopausal for half of their adult years. Menopause that occurs between the ages 40 and 45 is called early menopause. Menopause occurring prior to the age of 40 is called premature ovarian failure and is considered abnormal. The causes of premature ovarian failure include autoimmune disease*, thyroid disease, diabetes*, chemotherapy*, and radiation therapy*, but usually, the causes are unknown.

Estrogen is important in helping a girl to begin developing into a woman. As a girl approaches puberty*, her ovaries (O-va-reez), which are small, oval-shaped organs in the reproductive system, begin secreting estrogen. The estrogen causes a number of changes in the girl's body, including the growth of hair in her armpits and in her pubic area and also the gradual development of breasts. Estrogen's role continues once a girl begins menstruating, and its level increases and decreases during each menstrual cycle. In addition, estrogen prepares the woman's body for the fertilization of an egg, which is also produced by the ovaries.

The ovaries also make progesterone, which is important during a woman's child-bearing years. It helps prepare the uterus* so that it is a good environment in which a fertilized egg can develop into a fetus and eventually into a baby.

The ovaries continue to make estrogen and progesterone for many years after a girl first starts to menstruate. During this time, a woman begins to use up her supply of eggs. Once a woman reaches a certain age, and this age can vary from woman to woman, her egg supply becomes low, the ovaries start to shrink, the levels of hormones begin to fluctuate, and she enters perimenopause. The ups and downs of the hormone levels cause menstrual periods to become irregular. In some women, periods can become more frequent or even heavier, but in others, periods can come less often and may be lighter. Eventually, the ovaries start making less and less estrogen, until they make so little that a woman no longer has periods at all and cannot become pregnant anymore. Once a year has passed without a period, a woman has reached menopause and begins postmenopause. Within about a year, estrogen levels reach a certain low point and remain there, and progesterone levels drop to nearly zero.

Besides this natural progression during a woman's life, a female who has her ovaries surgically removed starts menopause immediately, even if she is very young.

What Are the Symptoms of Perimenopause and Menopause?

The symptoms of perimenopause and menopause vary among women. Some women may have almost no symptoms, whereas others may have severe symptoms. Symptoms may include none, one, or a combination of the following:

- Hot flashes, in which a woman suddenly feels flush for no reason, and night sweats, in which she begins sweating heavily
- Sudden irritability, changes in mood, or crying
- Loss or thinning of hair on the head and most of the body, but an increase in facial hair
- Extreme tiredness
- Either more headaches or fewer headaches than normal
- Rapid, irregular heartbeat, such as a fast flutter
- Difficulty staying focused and remembering
- Becoming confused
- Incontinence*, especially urinating when sneezing, coughing, or laughing
- Muscle tension
- Breast tenderness
- Drying and thinning of the skin
- Itchiness in different areas of the body
- Depression
- Lightheadedness, even dizziness
- Weight gain, particularly around the waist
- Dryness in the vagina
- Increased anxiety
- Indigestion, increased gas, and sometimes nausea
- Insomnia*
- Change in the desire for or interest in sex

Usually, a woman stops having most symptoms about a year after menopause. In some women, however, symptoms may continue, sometimes for many years. Medical professionals believe this may result from a woman having especially low estrogen levels.

All women should be alert to several health concerns that are associated with postmenopause and related to a lower estrogen level. These may include increased bone loss, which can lead to osteoporosis*, a serious health condition that can result in broken bones; osteopenia, low bone mineral density that is often considered a precursor to osteoporosis; heightened risk of tooth loss and gum disease*; and an increased risk for heart disease*. In addition, postmenopausal women may notice that they have more wrinkles, thinner and drier skin, and increased infections of the urinary tract and the vagina.

* **incontinence** (in-KON-ti-nens) is loss of control of urination or bowel movement.

* **insomnia** abnormal inability to get adequate sleep.

* **osteoporosis** os-te-o-por-O-sis) is the loss of material from the bone. This makes the bones weak and brittle.

* **gum disease** is an infection caused by bacteria that affect the tissues surrounding and supporting the teeth.

* **heart disease** is a broad term that covers many conditions that prevent the heart from working properly to pump blood throughout the body.

How Is Menopause Treated?

For most women, perimenopausal or menopausal symptoms eventually disappear on their own. Medical professionals encourage women to eat a healthy diet and exercise regularly to help them through their “change of life.” Women who want assistance in coping with their symptoms should see their physicians to select treatments that are right for them.

A common treatment in the late 20th century was hormone replacement therapy, which was usually a combination of estrogen and a synthetic (man-made) version of progesterone called progestin. Doctors sometimes prescribed hormone therapy to treat particularly troublesome hot flashes or vaginal dryness. Studies indicated that hormone therapy could prevent postmenopausal bone loss and, therefore, reduce hip fractures that occur due to osteoporosis; could lower the risk of colorectal cancer; and might also reduce the chance that a woman would experience heart disease. In addition, hormone therapy might help a woman sleep better and reduce her mood swings. However, hormone therapy was shown to have certain risks, according to a 2002 Women’s Health Initiative study. The study found a small but significant increased risk of breast cancer, heart attacks or stroke, blood clots, and gall bladder disease in women taking hormone replacement therapy. These findings led to a significant drop in usage of hormone replacement therapy in the early 2000s.

In addition, a study of women who took estrogen-progestin hormone therapy or took estrogen alone found that they had a higher incidence of abnormal mammograms (MAM-o-gramz), which are special types of x-rays used to look for possible evidence of breast cancer. The abnormal mammograms reported “false positives,” which means that they found signs of cancer although the women did not have the disease. The false positives may have resulted from estrogen in hormone therapy making the breast tissue more dense, which made it look like cancer even though none was present.

Hormone therapy may also cause a number of side effects, such as nausea, headaches, breast tenderness, and vaginal bleeding. A woman’s doctor will typically prescribe the lowest possible dose of hormone therapy to get the desired results and prescribe it only for a short time. The doctor will typically also schedule a follow-up appointment when that period of time is almost over to determine whether to continue hormone therapy. Hormone therapy comes in a number of different forms, including pills, skin patches, vaginal creams, and others.

For women who have reached menopause because they have had their ovaries removed in surgery, doctors sometimes prescribe hormone therapy with just estrogen. For other women, however, doctors typically recommend estrogen combined with progestin because estrogen alone can increase the risk of uterine cancer.

Many women try to treat their symptoms on their own. The following are home treatments for some menopausal symptoms:

- For hot flashes, some women find success by avoiding hot or spicy foods and alcoholic or caffeinated beverages; by engaging in regular exercise and by running a fan or by removing some layers of clothing.
- For insomnia, women may find that regular exercise sessions of 30 minutes everyday can help with certain symptoms. In addition, they may avoid daytime naps; drink a non-caffeinated, warm beverage before bed; and keep a regular sleep schedule by going to bed and getting up at the same time every day.
- For mood swings and memory problems, women often do well by getting enough sleep and remaining physically active.

Natural, or “alternative,” treatments for the symptoms of perimenopause and menopause are increasingly common. One of the most popular is soy, a plant that contains phytoestrogen, which is a plant chemical similar to estrogen. Soy comes in many forms, including soy beans (also called edamame), tofu, and soy milk (which is soy flour mixed with water). Soy is also available as a supplement in pill and powder form. Other commonly used alternative therapies for perimenopausal and menopausal symptoms are:

- Black cohosh (*Actaea racemosa* or *Cimicifuga racemosa*), an herb that is sometimes used to treat hot flashes. Studies of this herb have not conclusively shown that it has an effect on hot flashes.
- Ginseng (*Panax ginseng* or *Panax quinquefolius*), which may help with mood swings and sleeping problems.
- Dong quai (*Angelica sinensis*), which is used to treat hot flashes. Women who take the drug warfarin should not take dong quai, as this combination can lead to bleeding problems.

Medical professionals highly recommend that women who are considering alternative therapy consult with their doctors before trying them. Doctors can tell their patients whether the therapy will have any interaction with any other drugs they are taking and can also discuss possible safety issues.

▶ See also **Ageing • Breast Cancer • Colorectal Cancer • Depressive Disorders • Heart Disease • Osteoporosis • Uterine Cancer**

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Mayo Clinic. 200 First Street SW, Rochester, MN, 55905.
Web site: <http://www.mayoclinic.com/health/hormone-therapy/WO00046>.

National Center for Complementary and Alternative Medicine. 9000 Rockville Pike, Bethesda, MD, 20892. Toll free: 888-644-6226.
Web site: <http://www.nia.nih.gov/HealthInformation/Publications/Menopause>.

National Institute on Aging. 31 Center Drive, MSC 2292, Building 31, Room 5C27, Bethesda, MD, 20892. Telephone: 301-496-1752.
Web site: <http://www.nia.nih.gov/HealthInformation/Publications/Menopause>.

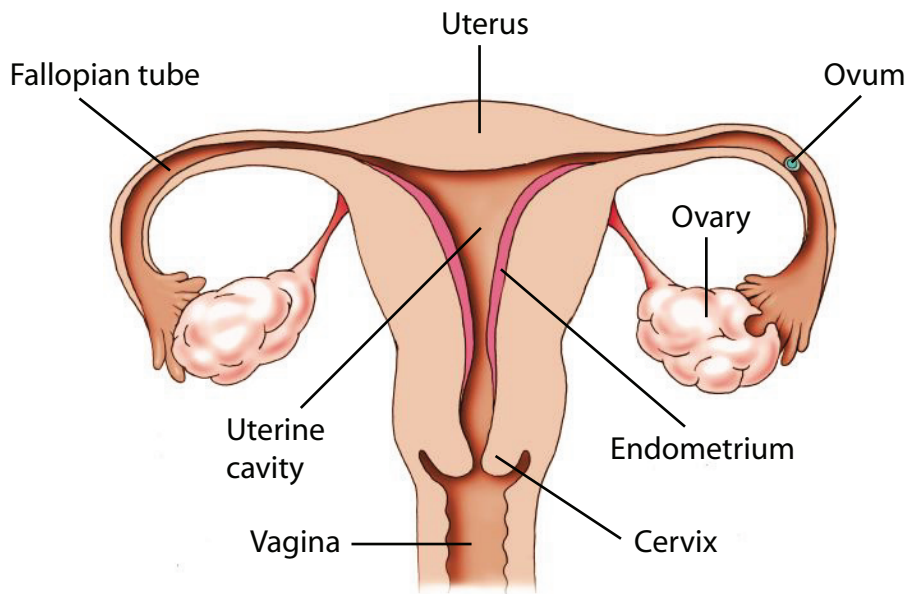
National Institutes of Health. 9000 Rockville Pike, Bethesda, MD, 20892. Telephone: 301-496-4000. Web site: <http://www.nih.gov/PHTindex.htm>.

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662.
Web site: <http://www.4woman.gov>.

North American Menopause Society. 5900 Landerbrook Drive, Suite 390, Mayfield Heights, OH, 44124. Telephone: 440-442-7550.
Web site: <http://www.menopause.org>.

Menstruation and Menstrual Disorders

Menstruation (men-stroo-AY-shun) is the discharge of the blood-enriched lining of the uterus. Menstruation normally occurs in females who are physically mature enough to bear children. Most girls have their first period between the age of 9 and 16. Menstruation ceases during pregnancy and with the onset of menopause. Because it usually occurs at about four-week intervals, it is often called the monthly period.



Anatomy of the female reproductive system, including an unfertilized egg (ovum) in one of the fallopian tubes. Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning



Menstrual (MEN-stroo-al) disorders result in abnormal menstrual periods. Usually, these disorders occur when the hormones* that control menstruation (men-stroo-AY-shun or men-STRAY-shun) are out of balance. In some cases, however, another medical problem is the cause. Menstrual disorders include pain during periods; changes in the length of the menstrual cycle; and heavy, prolonged, or too-frequent periods.

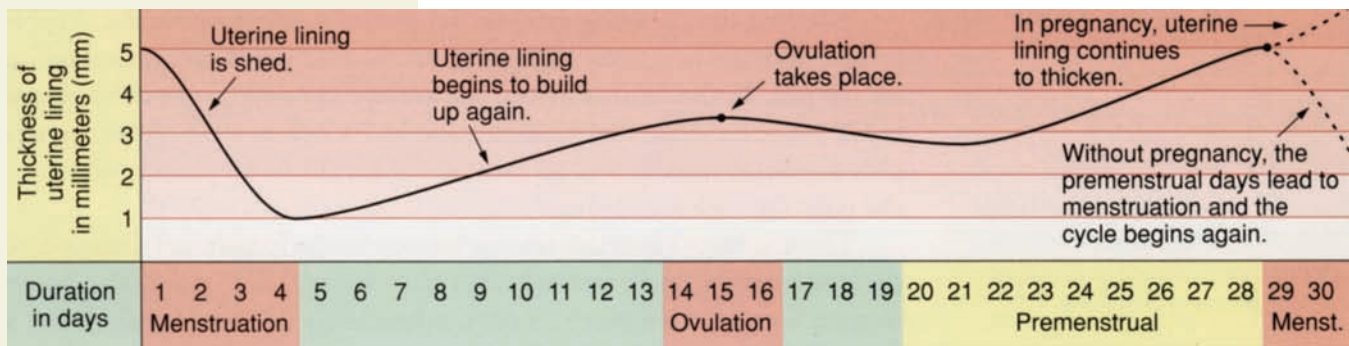
Kim's Story

Kim plays soccer in the fall, plays basketball in the winter, and does gymnastics in the spring and summer. Her friends call her the “lean, mean, fighting machine,” because she is almost all muscle and no fat. Kim is proud of her athletic ability, but she feels self-conscious because she has not developed as quickly as other girls her age. She has noticed some changes in her body, such as breast buds (puffing up of the nipples and the tissue surrounding them), pubic and armpit (axillary) hair, and a little bit of a rounding of her hips, but other girls have more noticeable curves. In addition, even though she just turned 16, she still has not gotten her period. All of her friends got theirs a few years ago. Kim is embarrassed and a little bit scared, because her mother made Kim an appointment with a gynecologist* to find out why Kim has not had her period.

The doctor examined Kim and asked her a number of family history and health questions, including questions about sports and how long she has been playing. The doctor told Kim that she probably had nothing to worry about; some girls just get their period later than others. Just to be sure, the doctor ordered some blood tests that would show if Kim had a medical condition affecting her menstrual cycle. The tests showed she was indeed fine, and three months later Kim got her first period.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **gynecologist** (gy-ne-KOL-o-jist) is a doctor who specializes in the reproductive system of women.



▲ The 28-day menstrual cycle, showing changes in the thickness of the endometrial lining. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

What Are the Menstrual Cycle and Menstruation?

The menstrual cycle is a normal part of being a healthy female of reproductive age. About once per month in this cycle, the female's reproductive system yields an egg that is ready to be fertilized, as well as the environment in which the fertilized egg can develop. This environment is the blood-rich lining of the uterus* (YOO-ter-us). If the egg is not fertilized, menstruation, also called menses (MEN-seez), occurs. During menstruation, the uterine lining sheds, resulting in blood and tissue being expelled from the body.

The female reproductive system, located in the abdomen*, consists of two ovaries (O-va-reez), two fallopian (fa-LO-pe-an) tubes, and the uterus, cervix (SER-viks), and vagina (va-JY-na). The almond-sized ovaries contain the female reproductive cells, or eggs. A girl is actually born with all the eggs she will need in her whole lifetime, but they are not mature (ready to be fertilized) until a few weeks before she has her first period. A delicate interaction of hormones controls the menstrual cycle. It starts when a gland in the brain, the hypothalamus, releases a hormone called gonadotropin-releasing hormone, which triggers another gland in the brain, the pituitary, to start releasing two other hormones: follicle-stimulating hormone and a small amount of luteinizing hormone. These stimulate the follicles, which are sacs around the eggs, to start to mature. The follicles then secrete the hormone, estrogen, that tells the uterine lining to thicken and soon also stimulates the pituitary to release even more luteinizing hormone. The flood of luteinizing hormone prompts a follicle to release an egg. The release of the egg is called ovulation (ov-yoo-LAY-shun).

Eggs move through the fallopian tubes to the uterus, which provides the environment in which a fertilized egg can grow and develop into a fetus. If the egg is not fertilized, the lining of the uterus sheds, and blood and tissue fragments exit the uterus through its opening, the cervix, and travel through the vagina to the outside of the body.

The hormonal interaction in a typical menstrual cycle The following are the major events in a typical menstrual cycle.

- Day 0 to 5: At the very beginning of the cycle, the levels of the hormones estrogen (ES-tro-jen) and progesterone (pro-JES-te-rone) in the body are low. Menstruation begins, and blood and tissue are

expelled from the uterus. The ovaries start making more estrogen, and the lining of uterus, called the endometrium (en-do-ME-tree-um), begins to thicken. Meanwhile, an egg in one of the ovaries begins to mature in a small sac of tissue.

- Day 14: The egg leaves the ovary (which is called ovulation [ov-yoo-LAY-shun]) and travels through the fallopian tube to the uterus. Three hormones control ovulation: gonadotropin (gon-a-do-TRO-pin)-releasing hormone (GnRH), follicle (FOL-i-kul)-stimulating hormone (FSH), and luteinizing (LOO-tee-in-eye-zing) hormone (LH). The empty sac in the ovary that once held the egg is now called the corpus luteum (KOR-pus LOO-te-um), and it makes the hormone progesterone. The combination of estrogen made by the ovaries and progesterone cause the endometrium to continue growing thicker. A woman can get pregnant just before, during, or right after ovulation. If the egg is fertilized, the thickened endometrium is ready to nourish the developing embryo*.
- Day 17 to 27: If the egg is not fertilized, hormone levels decrease.
- Day 28: The endometrium begins to break down, and menstruation begins. Cells in the uterine lining produce the hormone prostaglandin (pros-ta-GLAN-din), which causes blood vessels to narrow, slows the supply of oxygen to the uterus, and causes the muscles of the uterus to contract. This process helps to expel the blood and tissue of the uterine lining.

What Is Normal?

In a woman who is not pregnant, the menstrual cycle—calculated from the first day of one period to the first day of the next—occurs approximately every 28 days. However, the length of the cycle can vary from 21 to 35 days in normal, healthy girls and women. Usually, bleeding lasts for several days, which is the basis for the term menstrual “period.” A woman wears a pad in her panties or a tampon inserted into the vagina to absorb the blood, which typically amounts to two to eight tablespoons during an entire monthly period. Normally, menstrual blood does not clot. Women who experience clotting should mention it to their doctor.

The first time a young girl gets her period is called menarche (MEN-ar-kee). Some girls find menarche scary thing; others are eager to experience it. In the United States, the average age when menarche occurs is about 12-and-a-half years of age, but some girls start menstruating at 10 or younger and others at 16 or older. After menarche, a woman usually will get her period for 30 to 40 years, until she goes through menopause*.

A huge variation exists among women in the length and duration of the menstrual cycle and in whether they bleed a lot or a little. Some women have a period every 23 days, others every 35. Some periods last three days, whereas others last seven. And some women use three

* **embryo** (EM-bree-o), in humans, is the developing organism from the end of the second week after fertilization to the end of the eighth week.

* **menopause** (MEN-o-pawz) is the end of menstruation.

* **tumors** (TOO-morz) usually refer to abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **anorexia nervosa** (an-o-REK-se-a ner-VO-sa) is an emotional disorder characterized by dread of gaining weight, leading to self-starvation and dangerous loss of weight and malnutrition.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **eating disorder** is a condition in which a person's eating behaviors and food habits are so unbalanced that they cause physical and emotional problems..

tampons or pads per day, whereas others need several more. Because of this wide range, determining if a woman has a menstrual disorder can be difficult. It requires that a woman knows her own body and what is normal for her.

What Are Menstrual Disorders?

Menstrual disorders occur when something goes wrong with the normal monthly menstrual cycle. Disorders come in many types. Usually, they occur when the hormones controlling menstruation are out of balance for some reason. Underlying medical conditions, however, can cause menstrual disorders. A woman who experiences changes in her menstrual cycle—especially if these changes include heavy bleeding or cause problems with daily living—should see her doctor right away.

Disorders in menstrual cycle length Amenorrhea (a-men-o-REE-a) means “no menstrual periods.” Primary amenorrhea means not having a first period by the time a girl is 16 years old. Secondary amenorrhea occurs when a woman or girl stops getting her monthly period.

A related problem is oligomenorrhea (OL-i-go-men-o-REE-a), which occurs when menstrual periods are more than 35 days apart. Once doctors diagnose problems with menstrual cycle length, they then try to find out what is causing it.

Kim's story provides an example of primary amenorrhea. This condition may be caused by a hormonal imbalance or a developmental problem. Young female athletes often experience primary or secondary amenorrhea or both. Strenuous exercise seems to lower estrogen levels, thus causing periods to stop.

Shelly, a 25-year-old woman who usually gets her periods like clockwork, stopped having her period for three months. Her doctor first ordered a pregnancy test. It was a surprise to Shelly and her husband to learn she was pregnant. Pregnancy is the most common cause of amenorrhea in women in their reproductive years. A little while after the baby was born, Shelly resumed her regular menstrual cycle.

When Anne turned 48, the amount of time between her periods started getting longer and longer. When she did not get her period for four months, she went to see her doctor. The doctor examined Anne and did some tests. Anne learned that her amenorrhea was caused by approaching menopause, the natural time in a woman's life when she no longer has periods and cannot become pregnant anymore.

Medical problems, such as cysts (fluid-filled sacs) in the ovaries, abnormal growths or tumors* in the reproductive organs, anorexia nervosa*, and diabetes*, can also cause amenorrhea or oligomenorrhea.

Altered hormone levels can cause anovulation (an-ov-yoo-LAY-shun), which occurs ovulation does not take place, which in turn often causes amenorrhea. Hormones are affected when a woman exercises too much, loses or gains a lot of weight, is stressed, is breast-feeding a baby, or has an eating disorder*. All these situations can lead to amenorrhea.

Bleeding disorders Sometimes women have menstrual disorders in which they bleed too much, too often, or for too long. For example, Sally has menorrhagia (men-o-RA-jah), which means very heavy periods, and the bleeding goes on for almost 12 days. Sally will not even go to work on the first day of her period; she goes through a tampon and a pad every hour for the first five hours, and every month she ends up with bloodstains on her pants. Barb, by contrast, gets her period every 19 days, which is far too often for her liking; this condition is called polymenorrhea (pol-ee-men-o-REE-a). These conditions are classified as abnormal uterine bleeding, or AUB. AUB also includes bleeding, or spotting, between periods and bleeding after menopause.

In 80 percent of women with menorrhagia, the cause is either a hormone imbalance or the presence of fibroids (FY-broidz), which are abnormal growths in the uterus. Other causes of menorrhagia include the following:

- Endometrial (en-do-ME-tree-al) cancer
- Infections of the vagina or cervix
- Small growths on the cervix or uterine wall (polyps)
- Thyroid* conditions
- Diseases of the liver*, kidney*, or bloodstream.

Dysfunctional uterine bleeding (DUB) is another name for menorrhagia and other bleeding disorders that are caused by hormonal imbalances. Often, DUB occurs because of anovulation or when estrogen and progesterone are out of balance. Without proper hormonal cues, normal monthly shedding of the uterine lining does not occur, and the endometrium continues building up. The abnormally thick endometrium eventually starts to break down, and results in heavy and prolonged bleeding. DUB is common in teenagers, whose hormones have not yet been fine-tuned and who often do not ovulate regularly. Anovulation is also common in women about to go through menopause.

Painful periods Linda's school attendance was affected by her menstrual periods. Four months in a row, Linda went home sick from school each time she started her period. Linda was not faking it; she went home to bed with a backache and severe cramps, only getting up when she thought she might have to vomit.

Linda suffers from dysmenorrhea (dis-men-o-REE-a), or painful periods. Almost every woman has this condition at some time in her life. The symptoms of dysmenorrhea range from mild, uncomfortable cramps to abdominal pain, a sore back, nausea, and vomiting. Linda has primary dysmenorrhea, which means painful periods with no underlying medical disease. This type of dysmenorrhea is very common, especially among teenagers. The symptoms result from the hormone prostaglandin, which is released by the cells that are being shed from the uterus.

Secondary dysmenorrhea is caused by medical conditions such as polyps*, fibroids, and narrowing of the cervix. One common cause is endometriosis

* **thyroid gland** (THY-roid GLAND) is located in the lower part of the front of the neck. The thyroid produces hormones that regulate the body's metabolism (me-TAB-o-LIZ-um), the processes the body uses to produce energy, to grow, and to maintain body tissues

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **polyps** (PAH-lips) are bumps or growths usually on the lining or surface of a body part (such as the nose or intestine). Their size can range from tiny to large enough to cause pain or obstruction. They may be harmless, but they also may be cancerous.

Can a Girl or Woman Exercise Too Much?

How much estrogen a woman's body produces appears to be linked to her level of body fat. Gymnasts, ballerinas, and other athletes who regularly take part in strenuous exercise typically do not have much body fat and do not make much estrogen. If their hormone production is low enough, they might not get their first period until they are 16 or 17. Other young athletes who have normal periods for a while may develop amenorrhea when they resume strenuous exercise.

Because bone mass is linked to the level of estrogen in the body, some scientists suggest that even a few years of amenorrhea, especially during a girl's teens, can have lasting effects on bone formation or contribute to excessive bone loss. Young athletes should see their doctor if they experience a menstrual disorder. Diet and hormone therapy may fix the immediate problem and have a positive effect long into the future.

To ensure good bone health in general, doctors may recommend the following: exercising daily; maintaining a healthy, not-too-thin weight; getting enough calcium and vitamin D every day; managing stress, because stress can actually cause bone loss; staying away from cigarettes; and cutting back or eliminating caffeine from the diet. For girls with menstrual disorders, a doctor may also prescribe progesterone supplements. This hormone stimulates cells, called osteoblasts, to build new bone.

* **antidepressant medications** are used for the treatment and prevention of depression.

(en-do-me-tree-O-sis). Endometriosis is a condition in which uterine tissue grows outside the uterus, and it affects both young and older women. Even though fragments of endometrial tissue, also called implants, are not in the uterus, they still respond to hormones just as the normal endometrial tissue does. Therefore, in response to estrogen and progesterone, the implants grow, break down, and bleed. Because the blood has no opening that would allow it to leave the body, the blood causes irritation, which can be very painful. Sometimes, the implants keep growing and form scar tissue, or they act as an adhesive and stick organs together. Endometriosis can prevent a woman from getting pregnant, because implants may block the fallopian tubes or prevent the eggs from leaving the ovary. Endometriosis is found in 10 to 15 percent of 25- to 33-year-old women who are actively menstruating.

Infection of the endometrium causes another type of pain that accompanies menstrual periods. This pain, seen in pelvic inflammatory disease (PID), needs rapid diagnosis and medical treatment.

Premenstrual syndrome Every month, Stacy can tell her period is a week away by three signs: her skin breaks out, her lower back begins to ache, and her breasts feel sore. Her friend Sonya experiences a different set of symptoms: She feels bloated, is incredibly tired, has bad headaches, and feels depressed and grumpy.

Stacy and Sonya have premenstrual syndrome, or PMS, which is a set of symptoms that includes both physical and emotional symptoms. Most women with PMS have particular symptoms that occur each month at the same time. Fortunately, the symptoms disappear when the period begins.

No one knows for sure what causes PMS, but most scientists agree that it is linked to hormones. PMS symptoms appear during the second half of the menstrual cycle, after ovulation has taken place and when progesterone levels are highest. Health professionals may recommend one or more of the following to treat the symptoms of PMS:

- Regular exercise
- A daily supplement of calcium, vitamin B6, and or vitamin E
- The herbal supplement, evening primrose, for breast tenderness
- A reduction in the amount of symptom-related substances, such as caffeine, salt, and sugar in the diet
- Over-the-counter medications for cramps, headache, and other symptoms
- Prescribed medications, such as antidepressants*, or spironolactone, danazol, and bromocriptine for breast tenderness

At one time, doctors frequently prescribed birth-control pills to treat PMS. Studies showed, however, that they were not widely effective. In addition, the estrogen in birth-control pills can increase the risk of uterine cancer if it is not combined with another hormone, progestin, and studies have shown that progestin alone does not treat PMS symptoms.

Treatment for Menstrual Disorders

To determine if a woman has a menstrual disorder, doctors take a medical history and ask questions about her menstrual cycle. Doctors need to know what has changed from past normal periods. A pelvic exam may also be necessary. During this exam, doctors examine the reproductive organs by feeling and pushing on the uterus through the abdomen and by feeling the vagina, cervix, uterus, fallopian tubes, and ovaries through the vaginal opening. This procedure is slightly uncomfortable but not painful, and it takes only 5 to 10 minutes. The doctor may also order blood tests to measure the levels of hormones in the body. In rare cases, a doctor uses other techniques to find out what is happening in a woman's body. These include ultrasonography (ul-tra-so-NOG-ra-fee), a procedure in which sound waves produce images of organs inside the body, and hysteroscopy (his-ter-OS-ko-pee) or laparoscopy*, where instruments are inserted into the body through a small incision to take a direct look at the internal organs.

For all menstrual disorders, treatment depends on the underlying cause. Therefore, a woman should see a doctor if her menstrual cycle seems abnormal.

Hormonal imbalance When a hormonal imbalance is the cause of a menstrual disorder, hormone therapy often helps menstrual cycles return to normal. Hormone therapy includes taking birth control pills, mixtures of estrogen and progesterone, or just progesterone.

Dysmenorrhea and PMS Products such as ibuprofen* and naproxen (na-PROKS-en) suppress prostaglandin and are helpful in treating dysmenorrhea. Over-the-counter products to relieve menstrual cramps and bloating help some women with PMS. Birth-control pills also reduce painful periods in some women, as does exercise.

Endometriosis and other conditions For some women with endometriosis, the doctor may prescribe medicines to relieve symptoms. Women with severe endometriosis may need surgery to remove implants.

Methods of eliminating severe menstrual disorders include destroying the endometrial tissue in the uterus or removing the uterus (and sometimes also the ovaries) in a procedure known as hysterectomy (his-ter-EK-to-mee). This treatment is better for older women who are past childbearing years. This is not a treatment for younger women who want to have children.

For medical conditions, such as fibroids, polyps, or cancer, a woman may need surgery and other treatments to correct the problem.

▶ See also **Endometriosis • Infertility • Menopause • Pelvic Inflammatory Disease (PID) • Pregnancy**

Literal Meanings of Menstrual Terms

Many words used to describe menstruation and menstrual disorders come from Latin and Greek. The following are a few:

- Menses comes from the Latin word “mensis,” which means month. “Mensis” also derives from the Greek word “mene” for moon; the Moon travels around the Sun once every nearly 28 days, about the length of a month.
- Menarche, a girl's first period, comes from “mensis” and “archaios,” meaning “from the beginning.”
- Menopause, or the end of monthly periods, comes from “mensis” and “pauses,” meaning “to cease.”
- Menorrhagia means “heavy or prolonged bleeding” and is derived from “mensis” and “rhegynein,” meaning “to burst forth.”
- Menorrhea comes from “mensis” and “rhoia,” meaning “to flow” and refers to the “normal flow” of blood and tissue from the uterus during a menstrual period, also called menses and menstruation.
- The prefix “a-” means “not” and amenorrhea is the “cessation of menses.” The prefix “dys-” means “bad or painful,” and dysmenorrhea means “painful periods.” The prefix “oligo-” means “little or few,” and oligomenorrhea means having “infrequent periods.” The prefix “poly-” means “many,” and polymenorrhea means “periods that come too frequently.”

- * **laparoscopy** (lap-uh-ROS-kuh-pee) a type of surgery in which a small fiberoptic instrument is inserted through a very small incision to examine the inside of the abdomen or remove small amounts of tissue. It is also called minimally invasive surgery.
- * **ibuprofen** (eye-bew-PRO-fin) is a nonsteroidal anti-inflammatory drug (NISAD) used to reduce fever and relieve pain or inflammation
- * **nervous system** is a network of specialized tissue made of nerve cells, or neurons, that processes messages to and from different parts of the human body.
- * **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

Resources

Books and Articles

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- Weschler, Toni. *Cycle Savvy: The Smart Teen's Guide to the Mysteries of Her Body*. New York: Collins Living, 2006.

Organizations

- American Pregnancy Association.** 1431 Greenway Drive, Suite 800, Irving, TX, 75038. Telephone: 972-550-0140. Web site: <http://www.americanpregnancy.org/womenshealth/menstruation.html>.
- American Society for Reproductive Medicine.** 1209 Montgomery Highway, Birmingham, AL, 35216-2809. Telephone: 205-978-5000. Web site: <http://www.asrm.org>.
- Food and Drug Administration.** 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 888-INFO-FDA. Web site: <http://www.fda.gov/oc/opacom/kids/html/7teens.htm>; http://www.fda.gov/fdac/reprints/ots_endo.html.

Mental Retardation See *Intellectual Disability*.

Mercury Poisoning

Mercury poisoning damages the nervous system and is caused by exposure to mercury. Mercury is a metal in the form of a silvery liquid at room temperature, but it can also turn into a vapor. It forms chemical compounds known as salts that are used in industry and can form compounds in the ocean that can enter the human body through the consumption of saltwater fish.*

The Cat Dancing Disease

In the early 1950s, people living in the town of Minamata in southern Japan began to notice that the local cats were acting strangely. They would stand on their hind legs, run around aimlessly, go into convulsions*, and

die. The townspeople called this mysterious illness the “cat dancing disease.” They also noticed that there were dead fish floating on the sea and dead crows along the edge of the ocean. In April 1956 the illness spread to humans; eleven people in the town were treated by doctors for convulsions and difficulty in walking and talking. The doctors thought at first that the patients were suffering from a contagious disease that affected the central nervous system*. By October 1956, 40 people in Minamata had been diagnosed with the illness and 14 had died.

Researchers from a nearby university were called in to solve the puzzle. They found that the patients all came from fishermen’s families living along the bay and that all ate fish and shellfish on a daily basis. Their cats were fed the leftover fish. The researchers then suspected a kind of food poisoning caused by a heavy metal. In 1959 mercury was identified as the metal in question, and its source was identified as a chemical factory in Minamata that had been releasing mercury into the bay in its waste water. The fish and shellfish absorbed the mercury and concentrated it in their bodies. Larger and larger amounts of mercury built up in the local food chain*. When the mercury in the fish and shellfish increased to a high level, humans and their pets began to suffer from mercury poisoning.

By 2001, 2,265 patients had been identified as suffering from Minamata disease; 1,784 had already died. The chemical factory was forced to give the victims a financial compensation as well as change its manufacturing methods.

What Is Mercury Poisoning?

Mercury poisoning is a potentially fatal condition of the nervous system, lungs, kidneys, and other organs caused by exposure to liquid mercury, mercury vapor, mercury salts, or organic mercury (mercury combined with carbon). Some mercury enters the environment naturally from volcanoes and the breakdown of certain rocks in the earth’s crust; coal-burning power plants, explosives, and other human industrial processes also release mercury into the air. The mercury in the atmosphere enters the food chain when it falls back to earth and is absorbed by tiny organisms in the ocean that provide food for fish and shellfish.

People can be exposed to mercury by touching liquid mercury from a broken thermometer or fluorescent light bulb; breathing the vapors that liquid mercury releases at room temperature; accidentally swallowing small disk batteries or other substances that contain mercury compounds; or eating large amounts of fish with organic mercury in their tissues. Mercury can also affect the fetus* of pregnant women who ingest it; their fetus can die before birth or the baby can be born with serious birth defects.

How Common Is Mercury Poisoning?

Mercury poisoning was more common several centuries ago than it is in the early 2000s because it was used in making felt and some other industries. The phrase “mad as a hatter” came about because the people who made felt hats were exposed to mercury during the manufacturing process

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **food chain** the eating relationships between different organisms in a specific environment.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **syphilis** (SIH-fih-lis) is a sexually transmitted disease that, if untreated, can lead to serious life-long problems throughout the body, including blindness and paralysis.

* **latex** (LAY-tex) is a substance made from a rubber tree and is used in such things as medical equipment (especially gloves), toys, and other household products.

* **placenta** (pluh-SEN-ta) is an organ that provides nutrients and oxygen to a developing baby; it is located within the womb during pregnancy.

* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

* **mental retardation** is a condition in which people have below average intelligence that limits their ability to function normally.

and eventually suffered brain damage. Mercury was also used to make cosmetics and to treat syphilis*, a sexually transmitted disease. It was even used in laxatives. After mercury was found to cause brain damage and even death, people began to find replacements for it in manufacturing, cosmetics, and medical treatments.

Mercury poisoning is relatively uncommon in the United States in the early 21st century. The American Association of Poison Control Centers reported 3,362 cases of exposure to mercury in 2003; 569 were in children younger than six years of age. Of these patients, 44 had moderate effects, 6 had severe effects, but no one died. Fatal cases of mercury poisoning in the 1990s were accidents. In 1997 a professor of chemistry at Dartmouth College died seven months after spilling a mercury compound on her latex* glove. At that time it was not known that this particular form of mercury could seep through latex to reach the skin. In March 2008 a man in Oklahoma died of mercury poisoning after trying to use mercury to extract gold from computer parts.

Is Mercury Poisoning Contagious?

Mercury poisoning can be transmitted from a pregnant woman to her fetus because organic mercury from eating fish can cross the placenta and affect fetal growth. In many cases the woman has a miscarriage* or the baby is born with mental retardation*.

As the case of the Minamata tragedy indicates, mercury poisoning can affect groups of people as well as individuals, and it can be mistaken at first for an outbreak of a contagious disease. Mercury poisoning, however, is not spread from person to person in the way that bacterial or viral diseases are.

How Do People Know They Have Mercury Poisoning?

The symptoms of mercury poisoning vary somewhat depending on the form of mercury to which the person was exposed. Liquid mercury is not easily absorbed through the skin but can damage the lungs and travel to the central nervous system when a person breathes its vapors. The compounds of mercury that are found in batteries can be taken into the body through the skin or through accidental eating. They accumulate in and eventually damage the kidneys. Organic mercury is absorbed through the digestive tract and builds up in the brain, kidney, liver, hair, and skin. Some forms of organic mercury, such as the compound that killed the chemistry professor, can be absorbed directly through the skin.

The most noticeable symptoms of mercury poisoning are:

- Muscle weakness
- Skin rashes or a pinkish discoloration of the cheeks, fingertips, or toes
- Mental problems, including depression, mood swings, memory loss, and anxiety
- “Pins and needles” sensations in the hands, feet, and area around the mouth

- Problems with speech, hearing, and vision
- Loss of coordination, tremors, and difficulty speaking or writing
- Headaches
- Insomnia

People who have swallowed batteries containing mercury may have vomiting and other severe digestive problems caused by the mercury damaging the tissues of the intestines.

Long-term exposure to mercury vapor can cause loss of teeth, inflammation of the gums, a metallic taste in the mouth, chest pain, difficulty breathing, and heavy sweating.

How Do Doctors Diagnose and Treat Mercury Poisoning?

Diagnosis The diagnosis of mercury poisoning can be easily missed by doctors because the condition can take years to develop before symptoms appear; because several different organs may be affected; and because many of the symptoms can be mistaken for those of such other disorders as Alzheimer's or Parkinson's disease* (especially in the elderly), brain tumors, cerebral palsy, acute kidney failure, amyotrophic lateral sclerosis (Lou Gehrig'disease), and myasthenia gravis.

To diagnose mercury poisoning, the doctor needs to take a thorough patient history, including the person's occupation, hobbies, and the amount of seafood the person eats. There are many occupations and hobbies that increase a person's risk of exposure to mercury, including work in chemistry laboratories, the perfume industry, photography, embalming and taxidermy, electroplating, ink and dye production, paper pulp production, and gold and silver production. Pesticides and fungicides used in farming also contain mercury. In addition, some folk medicines that are made in Mexico and used by some Hispanics in the United States also contain high levels of mercury.

The doctor can also take samples of the patient's blood and urine* to see how much mercury is in the body. These tests do not always help in confirming the diagnosis, however. Urine tests are useful in evaluating whether the patient was exposed to liquid mercury or mercury salts.

Treatment Individuals who have breathed in large amounts of mercury vapor or have swallowed certain mercury compounds need emergency treatment in a hospital to keep their airway open. Contaminated clothing is removed and exposed skin is washed down with generous amounts of water. If the patients show signs of kidney failure, they are treated with hemodialysis*.

Doctors use chelation therapy* for patients with severe mercury poisoning. Chelation therapy involves the use of medications that combine with the mercury to prevent the body from absorbing it and make it easier for the body to excrete the mercury.

Most adults with mild exposure to mercury recover completely. Children, however, are more vulnerable to long-term damage from mercury poisoning than adults; babies born to mothers who have eaten

* **Parkinson's disease** is a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.

* **urine** is the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.

* **hemodialysis** (HEE-mo-dye-AL-is-is) is a method for removing waste products from the blood in patients with kidney failure.

* **chelation therapy** (chee-LAY-shun) therapy is a technique used to treat patients with lead or mercury poisoning by administering medications that combine with the metal to keep the body from absorbing it

fish containing high levels of mercury are at risk of lifelong muscle disorders, learning disorders, and problems with vision or hearing. There are six factors that influence the person's chances of recovery:

- Age. Fetuses are the most vulnerable to mercury poisoning.
- The chemical form of mercury involved. Organic mercury compounds are the most deadly.
- The length of time the person was exposed.
- The amount of mercury to which the person was exposed.
- The path of entry into the body (e.g., skin contact, eating, breathing vapors).
- The person's overall health.

Can Mercury Poisoning Be Prevented?

Mercury poisoning is preventable with proper precautions. In terms of mercury in the food chain, the Food and Drug Administration recommended in 2004 that pregnant women and young children should avoid eating fish with high levels of mercury, such as king mackerel, swordfish, and shark. They can safely eat 12 ounces per week (two average meals) of fish and shellfish that are low in mercury, such as shrimp, water-packed tuna, salmon, pollock, and catfish.

In terms of occupational exposure, many industries removed mercury in their manufacturing processes and products. Mercury was removed from indoor paints in the United States in 1990, for example. In 2006 the Environmental Protection Agency issued guidelines for phasing out the use of mercury in other industries and for finding better methods for safe disposal of used batteries and other products containing mercury.

In the home or workplace, people can lower their risk of mercury poisoning by using wood preservatives, insecticides, explosives, and other products containing mercury only in well-ventilated areas. People who work in chemistry laboratories should follow safety guidelines for working with mercury very precisely, remembering that mercury can penetrate latex gloves. Fluorescent bulbs or thermometers containing mercury should be handled very carefully if broken because of the danger of inhaling mercury vapor. The mercury from a broken thermometer or light bulb should be sponged up, sealed inside a plastic bag, and taken to a hazardous waste facility rather than removed with a vacuum cleaner, because vacuuming will spread mercury vapor.

▶ See also **Environmental Diseases • Lead Poisoning**

Resources

Books and Articles

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Organizations

American Association of Poison Control Centers. 515 King Street, Suite 510, Alexandria, VA, 22314. Telephone: 703-894-1858. Web site: <http://www.aapcc.org/DNN>.

Environmental Protection Agency. Ariel Rios Building, 1200 Pennsylvania Avenue NW, Washington, DC, 20460. Telephone: 202-272-0167. Web site: <http://www.epa.gov>.

National Institute of Environmental Health Sciences. P.O. Box 12233, Research Triangle Park, NC, 27709. Telephone: 919-541-3345. Web site: <http://www.niehs.nih.gov/index.cfm>.

Mesothelioma

Mesothelioma (me-zo-thee-le-O-muh), also called malignant mesothelioma, is a rare, deadly cancer* of the mesothelium*—the tissue that lines the lungs, stomach, heart, and other organs. Most mesotheliomas are caused by exposure to asbestos.*

What Is Mesothelioma?

Mesothelium is the two-layered membrane* that covers most of the organs of the body. It produces a lubricating fluid between the layers that cushions the organs and permits movement. Mesotheliomas can originate in four different types of mesothelium:

- About 75 percent originate in the pleura of the chest cavity and are called pleural mesotheliomas.
- About 10 to 20 percent originate in the peritoneum* of the abdomen* and are known as peritoneal mesotheliomas.
- Pericardial mesotheliomas are very rare, originating in the pericardium surrounding the heart.
- Mesothelioma of the tunica vaginalis—the lining of the testicles*—is extremely rare.

There are three types of mesothelioma:

- Epithelioid mesothelioma accounts for 50 to 70 percent of cases and has the best prognosis.
- Sarcomatoid mesothelioma accounts for 7 to 20 percent.
- Mixed/biphasic mesotheliomas account for 20 to 35 percent.

Although most people who develop mesothelioma have lived or worked where they may have inhaled or swallowed asbestos, the cancer

- * **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.
- * **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.
- * **mesothelium** (me-zo-THEE-le-um) is epithelium derived from embryonic mesoderm that lines the body cavities.
- * **membrane** (MEM-brain) is a thin layer of tissue that covers a surface, lines a cavity, or divides a space or organ.
- * **peritoneum** is the membrane that lines the abdominal cavity.
- * **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.
- * **testicles** (TES-tih-kulz) are the paired male reproductive glands that produce sperm.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **susceptibility** (su-sep-ti-BIL-i-tee) means having less resistance to and higher risk for infection or disease.

* **virus** (VY-rus) is a tiny infectious agent that can cause infectious diseases. A virus can only reproduce within the cells it infects.

can take 20 to 50 years to develop. Household members of people who worked with asbestos are also at risk for mesothelioma. However, many people with prolonged asbestos exposure never develop the disease, whereas some people with no known exposure do. There is some evidence that genetic* susceptibility* may play a role in mesothelioma. Some studies have suggested the possibility that exposure to simian virus* 40 (SV40) may increase one's risk for mesothelioma. Some injectable polio vaccines manufactured between 1955 and 1963 were contaminated with SV40, potentially affecting an estimated 10 to 30 million people.

WHAT IS ASBESTOS?

Asbestos is a group of naturally occurring fibrous silicate minerals. Small amounts of asbestos are present in the air, soil, and water. Curly chrysotile asbestos fibers are the predominant type used in commercial applications. Amphibole asbestos has straight needle-like fibers that may pose a greater risk for mesothelioma because they tend to remain in the lungs longer.

Starting in the late 1800s asbestos was mined for use in numerous industrial products, including cement, plastics, roofing, insulation, floor coverings, ceiling tiles, fireproofing, paints, coatings, adhesives, and textiles. It was used in the shipbuilding and automotive industries. However, there was a health risk in these uses. Tiny particles of asbestos that become airborne during manufacturing processes can be inhaled or swallowed, causing a range of serious health problems, including mesothelioma and other cancers.

In the early 1940s industrial use of asbestos increased sharply, and millions of Americans were exposed to asbestos dust. Because of the rise in mesothelioma and other diseases among asbestos workers, the Occupational Safety and Health Administration (OSHA) set limits on workplace exposure, and workers began wearing protective clothing and equipment. Workers were later usually required to shower and change clothing before leaving the workplace, to avoid bringing asbestos dust home on clothing, shoes, skin, and hair.

In the late 1970s the Consumer Product Safety Commission banned the use of asbestos in wallboard patching compounds and gas fireplaces. In 1979 electric hairdryer manufacturers voluntarily abandoned their use of asbestos. In 1989 the Environmental Protection Agency (EPA) banned all new uses of asbestos. The EPA also required schools to remove or encase damaged asbestos. The EPA estimates that as many as 733,000 schools and public buildings in the United States contain asbestos insulation. U.S. manufacturers voluntarily eliminated asbestos-containing talcs from crayons, and the EPA recommended caution when using vermiculite-containing garden products. Domestic use of asbestos dropped from 803,000 metric tons in 1973 to 2,400 metric tons in 2005.

How Common Is Mesothelioma?

Although it remains a relatively rare cancer, the incidence* of mesothelioma in American males increased between 1970 and 1990 and then stabilized at about 2,000 to 3,000 new cases annually. The incidence of mesothelioma in Europe continued to rise through the late 20th century and into the early 2000s. Mesothelioma is five times more common in men than in women, and 70 to 80 percent of patients have a history of workplace asbestos exposure. The risk for mesothelioma increases with age. Three-fourths of cases are in people over 65 years of age, and the cancer is rare in those under 55.

What Are the Symptoms of Mesothelioma?

Early symptoms of mesothelioma are nonspecific and often overlooked. More than half of people with pleural mesothelioma complain of pain in the lower back or side of the chest. Other symptoms of mesothelioma include:

- Shortness of breath or trouble breathing
- Problems swallowing
- Cough
- Sweating
- Fever
- Fatigue
- Weight loss
- Hoarseness
- Coughing up blood
- Swelling of the face and arms
- Muscle weakness
- Sensory loss

Symptoms of peritoneal mesothelioma include:

- Pain, swelling, or lumps in the abdomen
- Nausea* or vomiting
- Bowel obstruction

Mesothelioma can also cause blood-clotting* abnormalities or anemia*.

How Do Doctors Diagnose and Treat Mesothelioma?

Diagnosis Mesothelioma is rare and misdiagnosis is not unusual because the symptoms are similar to other diseases, including lung cancer. A history of asbestos exposure may suggest mesothelioma. A physical exam or imaging tests can detect fluid in the chest, abdominal cavity, or pericardium.

Who Has Been Exposed to Asbestos?

Workers at risk for asbestos exposure include:

- Asbestos miners and millers
- Manufacturers of asbestos textiles and other products
- Construction workers who handle insulation
- Drywall removers
- Demolition workers
- Firefighters
- Shipbuilders
- Automobile workers
- Railroad workers

Living near asbestos mines or deposits is also a risk. Libby, Montana, is believed to have the highest rate of mesothelioma in the United States because of the W. R. Grace vermiculite mine that operated near the town until 1990.

* **incidence** means rate of occurrence.

* **nausea** (NAW-zha) refers to a feeling of being sick to one's stomach or needing to vomit.

* **clotting** is a process in which blood changes into a jellylike mass that stops the flow of blood.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

Will 9/11 Result in Increased Mesotheliomas?

Rescue, recovery, and cleanup workers at the site of the September 11, 2001, terrorist attacks on the World Trade Center in New York City were considered to be at risk for mesothelioma and other asbestos-related health conditions. Asbestos was used in the construction of the North Tower and when the building collapsed hundreds of tons of asbestos were released. Firefighters, police, and volunteers working in the rubble at the site were believed to be at the highest risk. Residents and school children in the immediate vicinity were also thought to be put at risk.

* **bronchoscopy** (brong-KOS-ko-pee) is a procedure used to examine the bronchi, the major air passages in the lungs, with an instrument called a bronchoscope, which is a tool for looking inside the lungs that is made up of a lighted tube with viewing lenses. A bronchoscope has channels through which samples of material can be taken from the lungs for study in the laboratory.

* **trachea** (TRAY-kee-uh) is the windpipe—the firm, tubular structure that carries air from the throat to the lungs.

* **biopsies** (BI-op-seez) are tests in which small samples of skin or other body tissue are removed and examined for signs of disease.

* **aspiration** (as-puh-RAY-shun) is the sucking of fluid or other material out of the body, such as the removal of a sample of joint fluid through a needle inserted into the joint.

Other procedures for diagnosing mesothelioma include:

- Lung function tests
- A complete blood count
- Red-blood-cell sedimentation rates
- Bronchoscopy*, in which a viewing instrument called a bronchoscope is inserted through the nose or mouth into the trachea* and lungs to detect disease or remove tissue for examination
- Examination of cells from fluid around the lungs or abdomen

Because it is difficult to distinguish mesothelioma from other cancers by the appearance of the cells, laboratory tests look for markers present on mesothelioma cells.

Biopsies* used to diagnose mesothelioma include:

- Fine-needle aspiration* of the lung
- Thoracoscopy, in which a viewing instrument called a thoracoscope is inserted into the chest between two ribs
- Thoracotomy, in which an incision is made between two ribs to examine the inside of the chest
- Peritoneoscopy, in which a viewing instrument called a peritoneoscope is inserted through the abdominal wall
- Laparotomy, in which an incision is made in the abdominal wall

Staging Following a diagnosis of mesothelioma, additional imaging tests are performed to stage the cancer and determine if it has spread and if so, where. Stage I mesothelioma is localized in the lining of the chest wall and possibly the linings of the lungs, diaphragm*, or pericardium around the heart on the same side of the chest.

Advanced mesothelioma is staged as follows:

- Stage II: The same as stage I except that the cancer has spread to the lymph nodes* on the same side of the chest.
- Stage III: The cancer has spread to the chest wall, the area between the lungs, the heart, beyond the diaphragm, the peritoneum, and/or lymph nodes on the other side of the chest.
- Stage IV: The cancer has spread to distant organs or tissues.

Treatment Because mesothelioma is not a single tumor* mass, it is usually not possible to remove it completely by surgery and/or radiation therapy*. If the cancer is localized and the patient is otherwise in good health, curative surgery may be attempted. Extrapleural pneumonectomy removes one lung, the diaphragm, part of the chest lining, and the pericardium. The diaphragm and pericardium are reconstructed with prosthetic material. However, the cancer cells tend to spread and are difficult to detect. Thus, surgery may extend life but is unlikely to cure mesothelioma.

HOW DOES ASBESTOS CAUSE MESOTHELIOMA?

Asbestos is a known human carcinogen. When asbestos breaks up—as during mining or insulation removal—the airborne dust can be inhaled or swallowed. Tiny fibers travel to ends of small air passages, reaching the pleura. There the fibers cause scarring and inflammation* of mesothelial cells and stimulate their growth. The fibers may damage the cells' DNA* leading to uncontrolled growth. Peritoneal mesothelioma can result from coughing up and swallowing inhaled asbestos fibers.

Since asbestos fibers remain in the body, the mesothelioma risk does not drop with time. The risk does depend on the level and duration of exposure. People exposed to high levels for a long period at a young age are most at risk.

If the cancer has spread beyond the mesothelium or is difficult to remove completely or if the patient is too ill for extensive surgery, palliative* surgery may be performed to relieve symptoms and control pain:

- A needle or thin tube is used to drain fluid from the chest, abdomen, or pericardium.
- Pleurectomy/decortication removes the pleura to prevent fluid buildup and ease pain and breathing.
- Pleurodesis inserts scar-forming talc or drugs into the space between the mesothelial layers to prevent the buildup of fluid.

Radiation therapy is sometimes used as the primary treatment, as an adjuvant (a support) to surgery or as palliative treatment. Chemotherapy* for mesothelioma is palliative and is usually administered intravenously* or directly into the chest or abdominal cavity.

Prognosis Mesothelioma is usually not diagnosed until the cancer is quite advanced. The average survival time at diagnosis is one year. The five-year-survival rate is about 10 percent, although this rate was slowly increasing in the early 2000s. Most patients die of complications related to mesothelioma, such as lung failure, heart problems, or stroke*.

Can Mesothelioma Be Prevented?

Although not all mesotheliomas have been connected to asbestos, avoiding such exposure is clearly the best prevention. Precautionary measures should be taken in performing any work that may involve asbestos exposure, particularly demolition of old buildings. It is often more dangerous to remove asbestos-containing materials than to leave them in place. If they are removed, the work should be performed by a qualified contractor.

* **diaphragm** (DY-a-fram) is the muscle that separates the chest and abdominal cavities. It is the chief muscle used in breathing.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **tumor** (TOO-mor) is an abnormal growth of body tissue that has no known cause or physiologic purpose. A tumor may or may not be cancerous.

* **radiation therapy** is a treatment that uses high-energy radiation from x-rays and other sources to kill cancer cells and shrink cancerous growths.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **palliative** (PAL-ee-at-iv) means to ease or relieve without curing.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **intravenously** (in-tra-VEE-nus-lee) means given or injected directly through a vein.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

▶ See also **Environmental Diseases**

Resources

Books and Articles

Deraco, M., D. Bartlett, S. Kusamura, et al. "Consensus Statement on Peritoneal Mesothelioma." *Journal of Surgical Oncology* 98, no. 4 (September 15, 2008): 268–272.

Pass, Harvey I., Laura Roy, and Susan Vento. *100 Questions & Answers about Mesothelioma*. Sudbury, MA: Jones and Bartlett, 2005.

Organizations

American Cancer Society. P.O. Box 102454, Atlanta, GA 30368-2454. Toll free: 800-ACS-2345. Web site: <http://www.cancer.org>.

Mesothelioma Applied Research Foundation. P.O. Box 91840, Santa Barbara, CA 93190-1840. Telephone: 805-563-8400. Web site: <http://www.curemeso.org>.

Metabolic Disease

A metabolic (met-a-BOLL-ik) disease is a condition that interferes with the body's chemical processes involved in growth, maintenance of healthy tissues, disposal of waste products, and production of energy to fuel body functions. As a result, a person may have too much or too little of certain substances (such as protein, fat, or carbohydrate) in the body. This imbalance often interferes with the normal function of various body tissues and organs.

Archibald Garrod and Inborn Errors of Metabolism

In the late 1800s and early 1900s, British scientist Archibald Garrod (1857–1936) suggested that people could inherit genes that cause problems with the body's metabolism, a collection of chemical processes that are critical to the normal growth and working of the human body. A gene is the unit of heredity that carries physical characteristics from parent to child. Usually, the parents of an affected child do not have the particular metabolic problem themselves. This is possible because each parent carries a "hidden" mutant (changed or abnormal) gene. If the mutant gene comes from both parents, the child will get the disorder.

The inheritance of the mutant gene from both parents creates problems when the child's body needs to metabolize (me-TAB-o-lize),

or process, certain nutrients and other substances properly. Garrod's hypothesis was revolutionary at the time, because no one had yet suggested that the body's chemical processes might somehow be related to heredity. Moreover, the scientific and medical communities generally believed that only foreign agents from outside the body, such as germs and bacteria, could cause disease.

In lectures delivered in 1908, Garrod described several hereditary diseases caused by too little or a complete lack of certain enzymes*. An enzyme is a protein that speeds up or controls certain chemical reactions in the body. Garrod described three diseases—alkaptonuria (al-cap-to-NYOOR-ee-a), cystinuria (sis-ti-NYOOR-ee-a), and pentosuria (pen-tos-YOOR-ee-a)—in which the patients experienced abnormally high levels of certain forms of acids and sugar in the urine. This sign showed that the body had not processed these substances correctly, because if it had, the body would have used those substances rather than discarding them in the urine, a waste product. The finding also suggested that the enzymes needed for processing them were either absent or not functioning properly. Garrod called these diseases “inborn errors of metabolism,” a name that persists to this day. He published *Inborn Errors of Metabolism* in 1909, a second edition of which appeared in 1923.

In the decades after Garrod made his discovery, scientists identified hundreds of genetic mutations that cause different metabolic disorders. Some of these disorders are fatal mere hours after birth, but others are treatable, particularly when diagnosed early, and patients may go on to have long and productive lives.

How Does Metabolism Normally Work?

People eat and drink every day, but few think about what happens to that food once the stomach and intestines begin digesting it. Once digestion breaks down food and drink into substances that the body can use, the process called metabolism begins. Metabolism is a series of chemical processes used by the body to put to work the nutrients in food. This process allows the body to carry out a variety of functions, such as growing, maintaining healthy tissues, disposing of wastes, and producing the energy needed for all activities. As a whole, metabolism is quite complex with hundreds of different reactions happening one after the other to convert nutrients into materials that the body needs for the functions of life. One way of thinking of metabolism is to consider it a kind of domino effect, with each chemical reaction, or domino, falling into place in sequence to create the end result. Metabolism involves two main phases: building up and breaking down.

Anabolism (building up) Anabolism (a-NA-bo-liz-um) is the building-up phase. It includes all the processes that occur when the body makes use of nutrients for the purpose of growing and building new tissues, which involves converting simple substances into more complex substances. For example, during digestion, the food releases important

* **enzymes** (EN-zimes) are proteins that help speed up a chemical reaction in a cell or organism.

- * **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.
- * **mutation** (myoo-TAY-shun) is a change in an organism's gene or genes.

compounds called amino (a-MEE-no) acids, which are the building blocks of proteins. Through anabolism, the body converts amino acids into proteins that are essential to the body's growth, development, and health. Protein is the main building material for all living tissue, including muscles, skin, and internal organs. It also is necessary to form hormones*, antibodies*, and enzymes, which are proteins that the body's cells produce to speed up or regulate chemical reactions. Hormones, antibodies, and enzymes are essential to the body's normal function.

Catabolism (breaking down) Catabolism (ca-TA-bo-liz-um) is the breaking-down phase. It involves processes that move in the opposite direction from anabolism: that is, they break down more complex substances into simpler forms, releasing energy that the body uses for work, movement, or heat production. For instance, the body's tissues store a carbohydrate called glycogen (GLY-ko-jen) in the liver* and the muscles. When the body needs energy, it breaks down the glycogen into glucose, a form of sugar. Metabolism continues when the glucose breaks down in the body's cells to release energy for fueling body functions.

Enzymes None of the processes involved in metabolism would be possible without enzymes. Because enzymes are proteins, they are made up of a string of amino acids. Each type of enzyme has its own string with certain amino acids lining up in a specific order. A person's genes are responsible for making sure the string of amino acids is correct. People who are born with metabolic diseases inherit a genetic* mutation* in a specific gene, and that mutation affects the amino acid string so that the body either fails to produce an enzyme at all or produces an enzyme that is inactive. As a result, that enzyme's activity in the body decreases or is completely absent.

One way to think of enzymes and amino acids is to consider enzymes as words and amino acids as letters of the alphabet. When a word is misspelled, its letters are ordered incorrectly and some may even be missing. This may cause its meaning to become confusing or unclear. When an enzyme is "misspelled," the amino acids are out of order and some may be missing altogether. Consequently, it cannot function properly, and this defect affects the particular step or steps in metabolism that the enzyme would have otherwise controlled.

Hundreds of such "misspellings" are possible, and they can cause many different kinds of metabolic disorders. Some are more serious than others. Doctors can treat many, but not all of them. When no treatment exists, the body does not properly process particular substances, such as carbohydrates, sugars, fats, or proteins. Depending on the particular enzyme and its function, they may cause too much or too little of these substances to be produced. In either case, the consequence is an imbalance that causes problems with the function and growth of many body tissues and organs, including the brain.

What Are Metabolic Diseases?

Metabolic diseases come in a very wide assortment. Some of the more common ones are discussed below.

Phenylketonuria Labels on diet soda and other food products containing the artificial sweetener aspartame (ASS-per-tame) feature a special warning: “Phenylketonurics: Contains Phenylalanine.” This is a warning for people with the metabolic disorder phenylketonuria (FEN-il-ke-to-NYOOR-ee-a) that aspartame contains the amino acid called phenylalanine (fen-il-AL-a-neen). People who have phenylketonuria (PKU) lack the enzyme (called phenylalanine hydroxylase) that is needed to convert this amino acid into another substance called tyrosine (TY-ro-seen). In other words, the body cannot process phenylalanine correctly. This amino acid is necessary for normal growth in infants and children and for normal protein production throughout life. However, if too much of it builds up, which is a problem for people with PKU, it poisons the brain tissue and eventually causes mental retardation. It also can cause the skin and urine to give off an unusual musty odor and lead to skin rashes.

Fortunately, doctors can determine whether an infant has PKU almost immediately after birth. In the 1960s scientists developed a PKU test medical professionals habitually perform on all newborns born in the United States. It involves taking a small blood sample—usually from the heel—from a two- or three-day-old newborn. Because PKU prevents processing of phenylalanine, the amino acid would appear at a high level in the child’s blood. Some doctors repeat this test when the child is a week to 10 days old. If the test indicates that the child may have PKU, the doctor will typically take another blood sample from a vein and run the test again to make sure. Only 1 out of every 13,500 to 19,000 babies born in the United States tests positive for PKU, which makes it a rare condition, but this adds up to about 250 or more babies each year.

If a baby tests positive for PKU, the doctor will put the patient on a special diet right away. With such a diet, the patient can avoid the mental retardation that was the certain result of PKU in the past. This diet cuts out high-protein foods, which are also high in phenylalanine. High-protein foods include meat, poultry, and fish; milk, eggs, cheese, ice cream; nuts; and many products containing regular flour. The particular dietary restrictions vary from person to person, depending on the severity of the condition in each individual. Medical professionals often recommend that children with PKU take a special artificial formula as a nutritional substitute for the foods they cannot eat. Patients, with the help of their parents when they are young, must adhere to the diet—even when they find it difficult—so they can remain healthy and avoid retardation.

With early diagnosis and careful dietary restrictions, children with PKU are able to grow up normally. They achieve in school, attend college,

THE DISCOVERY OF PHENYLKETONURIA

In Norway in 1934, a mother with two severely mentally retarded children went to see Asbjørn Følling (1888–1973), seeking an explanation for her children's condition. She also wondered about an unusual smell that her children always seemed to have. After testing urine samples, Følling discovered that the children excreted a substance not found in normal urine. Although he did not have access to the advanced chemical tests that would become available later in the 20th century, eventually Følling was able to identify the substance as a compound called phenylpyruvic (fee-nul-PY-roo-vik) acid. He immediately wondered whether the buildup of acid had something to do with the children's retardation.

Følling collected urine samples from hundreds of other mentally retarded patients and found that eight of these individuals excreted the same acid. He then published a paper that drew a connection between the acid levels and retardation in these 10 people. He also made the hypothesis (hy-PAH-the-sis) that these people are unable to break down another compound called phenylalanine, which is an amino acid (a building block of proteins), and this excess phenylalanine converted into an elevated amount of phenylpyruvic acid. Eventually, he confirmed his hypothesis when he and his colleague figured out a way to use bacteria to test for high levels of phenylalanine in the blood.

Følling had discovered phenylketonuria (PKU), and in so doing, he changed the lives of future generations of children who would be born with this condition. He showed that mental retardation could be avoided if medical professionals diagnosed the condition right away and if phenylalanine levels were controlled through dietary changes.

In 1962, President John F. Kennedy awarded Følling the Joseph P. Kennedy International Award in Mental Retardation for his achievements. At about the same time, scientist Robert Guthrie was using Følling's discoveries to develop an effective newborn screening test for PKU. The test became available in the early 1960s, and Guthrie worked diligently to establish screening programs in the United States and many other countries. In the early 2000s, doctors routinely screen all babies in the United States for PKU.

and enter a wide range of challenging professions as adults. With the exception of the special diet they must follow, children with PKU can do anything that children without PKU can do.

Maple syrup urine disease PKU is just one of several metabolic disorders that occur when the body lacks an enzyme needed to process amino acids. Another is maple syrup urine disease (MSUD), also sometimes called ketoacidemia or branched chain alpha-ketoacid dehydrogenase (BCKD). In this disease, patients lack the enzyme needed to process three other amino acids: valine (VAYL-eeen), leucine

(LOO-seen), and isoleucine (i-so-LOO-seen). These amino acids are present in milk, meat, eggs, and many other foods, and are essential for normal growth and function. When the body fails to metabolize them properly, the amino acids can build up in the body, causing the urine to smell like maple syrup or sweet, burnt sugar. If left untreated, MSUD can cause mental retardation, physical disability, and even death.

MSUD is even rarer than PKU. Only about one in 185,000 infants worldwide are born with MSUD. In addition to urine that smells like maple syrup, individuals with MSUD usually have little appetite and are extremely irritable. Some states require that all newborns be tested for MSUD, but as of 2009 some states did not. Unless medical professionals diagnose and begin to treat MSUD right away, the disease can cause seizures*, unconsciousness, brain damage, and even death. Treatment takes the form of a carefully controlled diet that cuts out certain high-protein foods containing the three amino acids the body cannot process. As for children who have PKU, medical professionals often give young patients with MSUD an artificial formula that supplies the necessary nutrients they might otherwise miss because of their restrictive diet.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

KING GEORGE III AND MENTAL ILLNESS

George III (1738–1820) was the king of England against whom the American colonists rebelled during the War of Independence. History books note that George III experienced violent fits of madness that eventually made him incapable of ruling. He suffered through bouts of agonizing pain, overactivity, paralysis, and delirium. These so-called nervous spells occurred during the last three or four decades of his life, which ended in 1820 when he was 81.

Some historians believe that the king's problem was physiological. When psychiatrists studied the king's letters and examined the notes made by his doctors, they discovered that King George's symptoms included dark red urine, a tell-tale symptom of the metabolic disease porphyria. In 1967 two British psychiatrists published a scientific paper, "A Clinical Reassessment of the Insanity of George III and Some of Its Historical Implications," in which they asserted that the king had porphyria. Further historical investigation suggested that other members of the royal family may have had the condition, too.

While George III was alive, medical science could not explain what was wrong with him. The body's chemical processes and their effect on the mind was not understood. In the early 2000s, however, much is known about this relationship. Porphyria is actually a problem in the blood that, in some cases, interferes with normal brain function and causes numerous mental symptoms.

Galactosemia For most babies and young children, mother's milk (or a formula like breast milk) and then cow's milk supply nutrients essential to the body's function and growth. Babies born with the metabolic disease galactosemia (ga-lak-to-SEE-me-a), however, do not have enough of the enzyme that breaks down the sugar (called galactose) in milk. This enzyme is usually produced by the liver, but if the liver does not produce enough, galactose builds up in the blood and can cause serious health problems if the condition is not diagnosed and treated.

Symptoms usually appear in the first few days of life, as soon as the baby starts drinking breast milk or formula. The baby often starts vomiting, the liver swells up, and the skin and eyes take on a yellow color (a condition called jaundice). Other symptoms might include infections, irritability, failure to gain weight, and diarrhea. If medical professionals fail to diagnose it quickly, galactosemia can cause severe damage to the liver, eyes, kidney, and brain. For this reason, many states require that all newborns have a blood test that can detect it. About one in 30,000 to 60,000 babies are born with the condition. Treatment involves removing all milk and milk-containing products from the diet. Doing so reduces the risk of permanent damage, but the child may still have problems with growth, speech, and mental function as he or she gets older.

Fructose intolerance Besides galactosemia, many other metabolic diseases cause patients to be unable to process sugars properly. One of these is fructose (FROOK-tose) intolerance, in which a person cannot metabolize fructose, which is a certain form of sugar found in fruit, fruit juices, powdered and table sugar, honey, corn syrup, and other foods. Like the treatment for galactosemia, the treatment for fructose intolerance involves excluding certain foods from the diet. The patient must strictly limit fructose to avoid possible damage to the liver and kidneys, and possible mental retardation.

Glycogen storage disease In a healthy person, the body takes a simple sugar called glucose from foods, converts it into a carbohydrate called glycogen, and stores it in the liver and muscles. When the body needs energy to fuel its activities, specific enzymes then reverse the process and break down the glycogen into sugar. People with certain metabolic diseases have problems with one or more of these enzymes, resulting in a condition known as glycogen storage disease.

Glycogen storage disease actually comes in nine different types, each involving different enzymes. One example is glucose-6-phosphatase (G6PD) deficiency, in which the patient has too little of the enzyme called glucose-6-phosphatase. Normally found in the liver, glucose-6-phosphatase helps to release glucose from the liver into the bloodstream so that the body can process it to produce energy. Deficiency of the enzyme can cause the levels of sugar in the blood to fall dangerously low if the patient does not get glucose in his or her diet every few hours.

In G6PD deficiency and other glycogen storage diseases, various parts of the body store excessive amounts of glycogen, which causes problems with the liver, muscles, blood cells, heart, brain, and/or other organs. Treatment for these conditions usually involves changes in diet.

Porphyria The body uses a special chemical called porphyrin (POE-fir-in) to make heme, which is the substance in the blood that carries oxygen to the tissues. Eight different enzymes are in charge of the metabolic process that uses porphyrin to make heme. When any of these enzymes are missing or do not function properly, too much porphyrin builds up in the body, and this excess eventually leaves the body in the urine or stool. It also causes the individual's body to produce too little heme to keep the person healthy. This enzyme deficiency is called porphyria (poor-FEER-ee-a).

People who have porphyria can experience symptoms that involve the skin, the nervous system, and/or other internal organs. When porphyria affects the skin, the person may have blisters, itching, swelling, or extreme sensitivity to the sun. When it affects the brain, it can cause hallucinations*, delirium*, seizures, depression, anxiety, and paranoia*. Other physical symptoms may include chest or stomach pain, muscle cramps, weakness, or urine that is dark purple or red.

Doctors can test someone's blood, urine, or stool to diagnose porphyria. They may prescribe various drugs to treat the illness. In some cases, they may also recommend that the patient take glucose or beta-carotene. In one form of porphyria, in which the patient's body has an excess of iron, patients often benefit from systematic draining of the blood, in which medical professionals remove a pint of blood from the patient's body once or twice a week for several weeks, until iron levels drop to normal.

How Does an Inherited Metabolic Disease Develop?

Many metabolic diseases exist beyond those described here. These few examples, however, illustrate the chain of events that happen in many inherited metabolic diseases:

1. A person inherits a genetic mutation, or abnormality.
2. Because of this inherited genetic mutation, the body either does not produce a certain enzyme or else it produces an enzyme that does not work as it should.
3. Consequently, a certain necessary step in metabolism does not occur normally.
4. The substance that should have been metabolized (broken down or changed into another form) builds up in the body and/or other important substances needed by the body are not available in adequate amounts.

As a result, the normal processes of a person's system no longer work properly, which can cause damage if the problem is not corrected with

* **hallucinations** (ha-LOO-sin-AY-shuns) occur when a person sees or hears things that are not really there. Hallucinations can result from nervous system abnormalities, mental disorders, or the use of certain drugs.

* **delirium** (dih-LEER-e-um) is a condition in which a person is confused, is unable to think clearly, and has a reduced level of consciousness.

* **paranoia** (pair-a-NOY-a) refers to either an unreasonable fear of harm by others (delusions of persecution) or an unrealistic sense of self-importance (delusions of grandeur).

diet or medication. In some cases, medical professionals cannot correct the problem, and it may cause permanent damage or even death. Many people with metabolic diseases, however, can go on to live healthy, productive lives if they follow their doctors' instructions precisely.

▶ *See also* **Birth Defects and Brain Development • Diabetes • Genetic Diseases • Growth and Growth Disorders • Hypoglycemia • Intellectual Disability • Obesity • Phenylketonuria (PKU) • Porphyrin • Seizures • Thyroid Disease**

Resources

Books and Articles

Shannon, Joyce Brennfleck, ed. *Endocrine and Metabolic Disorders Sourcebook: Basic Consumer Health Information about Hormonal and Metabolic Disorders That Affect the Body's Growth, Development, and Functioning, Including Disorders of the Pancreas, Ovaries and Testes . . .*, 2nd ed. Detroit, MI: Omnigraphics, 2007.

Organizations

American Association of Clinical Endocrinologists. 245 Riverside Avenue, Suite 200, Jacksonville, FL, 32202. Telephone: 904-353-7878. Web site: <http://www.aace.com>.

American Porphyrin Foundation. 4900 Woodway, Suite 780, Houston, TX, 77056-1837. Toll free: 866-273-3635. Web site: <http://www.porphyrinfoundation.com>.

Endocrine Society. 8401 Connecticut Avenue, Suite 900, Chevy Chase, MD, 20815. Telephone: 301-941-0200. Web site: <http://www.endo-society.org>.

Maple Syrup Urine Disease Family Support Group. Telephone: 740-548-4475. Web site: <http://www.msud-support.org>.

National Endocrine and Metabolic Diseases Information Service. 6 Information Way, Bethesda, MD, 20892-3569. Toll free: 888-828-0904. Web site: <http://www.endocrine.niddk.nih.gov>.

National Organization for Rare Disorders. 55 Kenosia Avenue, P.O. Box 1968, Danbury, CT, 06813-1968. Toll free: 800-999-6673. Web site: <http://www.rarediseases.org>.

National PKU News. 6869 Woodlawn Avenue NE, Suite 116, Seattle, WA, 98115-5469. Web site: <http://www.pkunews.org>.

Parents of Galactosemic Children. P.O. Box 2401, Mandeville, LA, 70470-2401. Toll free: 866-900-PGC1. Web site: <http://www.galactosemia.org>.

Metabolic Syndrome

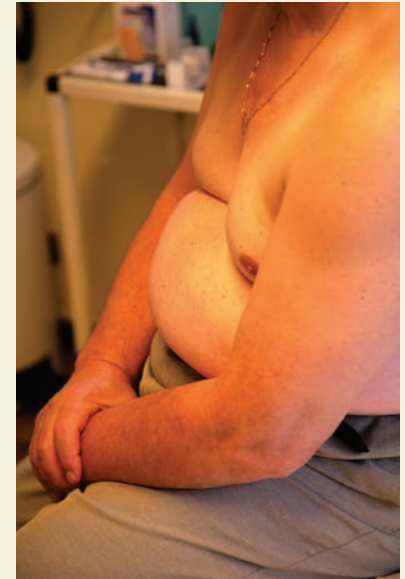
Metabolic syndrome is the name given to a group or cluster of conditions that occur together and increase a person's risk of diabetes*, heart disease, and stroke*. A short definition of the syndrome is that it is a group of metabolic* risk factors in one individual. Metabolic syndrome is also known as insulin resistance syndrome, syndrome X, and Reaven's syndrome, after the California diabetes researcher who first described it in 1992.*

Enrique's Story

Enrique is a sixth-grade student in a California school whose family has a history of type 2 diabetes. Type 2 diabetes is a form of the disease that usually develops in adults whose bodies do not use the insulin* produced by their bodies effectively. This condition is called insulin resistance. Between 90 and 95 percent of American adults with diabetes have type 2, which has been linked to the metabolic syndrome, obesity*, high blood pressure, and abnormal levels of cholesterol* in the blood. The risk of developing type 2 diabetes is also related to a person's race or ethnic group.

Enrique was asked to participate in a study of overweight Hispanic children to find out whether the high risk of type 2 diabetes in Hispanic adults affects younger Hispanics. Doctors have known for some years that Hispanic Americans, particularly those whose families came from Mexico, have a higher rate of diabetes than either African Americans or Caucasian Americans. Although researchers had studied overweight African American and Caucasian American children, they had not yet looked at Hispanic youth. They also wanted to find out whether the definition of metabolic syndrome that was worked out from studies of adults can also be applied to children and teenagers.

Enrique was interested in finding out more about his health and the health of his relatives. He went with his parents to a clinic in the medical school nearby, where the doctors measured his height, weight, waistline, and blood pressure, and took samples of blood to see how well his body used insulin. They found that Enrique belonged in the 30 percent of overweight children who fit the pattern of metabolic syndrome and that he had a higher than average risk of developing type 2 diabetes as he grew into adulthood. The doctors gave Enrique and his parents some advice about nutrition and exercise to help Enrique lose weight, and some information about medications that can be given to children with insulin resistance. Enrique was not happy to have to cut down on some of his favorite foods, but he was glad that he learned more about his body, and that he helped the doctors learn more about his age group and ethnic community.



▲ Abdomen of a man with metabolic syndrome. GARO/Photo Researchers, Inc.

- * **syndrome** is a group or pattern of symptoms or signs that occur together.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

- * **metabolic** (meh-tuh-BALL-ik) pertains to the process in the body (metabolism) that converts food into energy and waste products.
- * **insulin** is a kind of hormone, or chemical produced in the body, that is crucial in controlling the level of glucose (sugar) in the blood and in helping the body use glucose to produce energy. When the body cannot produce or use insulin properly, a person must take insulin or other medications.
- * **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.
- * **cholesterol** (ko-LES-ter-ol) is a fatlike substance found in the blood and body tissues.
- * **pancreas** (PAN-kree-us) is a gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.
- * **triglycerides** (try-GLISS-eh-rides) are a type of fatty substances found in the blood.

What Is Metabolic Syndrome?

Changing Names and Definitions As the many names given to metabolic syndrome indicate, it has been defined somewhat differently by various public health organizations and medical societies since it was first named syndrome X by Gerald Reaven in 1992. Reaven was first concerned with the relationship of the syndrome to insulin resistance, a condition in which a person's body cannot use effectively the insulin produced by the pancreas*. Although insulin resistance is not considered a disease by itself, it is known to increase a person's risk of developing type 2 diabetes and heart disease. Reaven later wrote a book for the general public about the connection between syndrome X and heart disease.

In 1999 the World Health Organization published a set of guidelines for identifying the metabolic syndrome that included being diagnosed with type 2 diabetes (which includes insulin resistance), high blood pressure, and obesity. Subsequent definitions of the metabolic syndrome, however, did not require that a person be diagnosed with diabetes itself; instead, these definitions emphasized that metabolic syndrome is a group of conditions that increase a person's risk of serious illness rather than a disease in its own right. As of 2009, the definition of metabolic syndrome that was most widely used is the description published by the National Cholesterol Education Program (NCEP) and modified by the American Heart Association (AHA) in 2005. The two organizations distinguished between the metabolic risk factors of the syndrome itself—abnormally high levels of blood cholesterol, high blood pressure, and high levels of sugar in the blood—and what the two groups called the underlying risk factors. These risk factors include obesity, insulin resistance, aging, not getting enough exercise, and hormonal imbalances.

To be diagnosed as having metabolic syndrome, an adult must have three or more of the following conditions:

- A waist measurement of 40 inches or more in men or 35 inches or more in women
- A high level of triglycerides* in the blood or being treated for high levels of triglycerides
- A low level of HDL cholesterol ("good" cholesterol) or being treated for low levels of this type of cholesterol
- High blood pressure or being treated for high blood pressure
- A high level of blood sugar when measured after fasting (going without food for about 8 hours before the blood test, usually overnight) or being treated for this condition

Although it is possible for a person to have only one of these health problems, having any of them increases a person's risk of developing the others.

Metabolic syndrome in children and teenagers As Enrique's story indicates, doctors have asked whether children and adolescents can

METABOLIC SYNDROME AND TYPE 2 DIABETES

There is a circular relationship between the metabolic syndrome and type 2 diabetes. On the one hand, an adult with metabolic syndrome is five times as likely to develop type 2 diabetes in the future as a person without the condition. On the other hand, being already diagnosed with diabetes or coming from a family with a history of diabetes are risk factors for developing the metabolic syndrome. High levels of blood sugar have been shown in animal studies to lead to insulin resistance, a condition that can lead to the metabolic syndrome as well as diabetes itself.

In one study done in Japan in 2004, scientists fed laboratory rats a diet that was one-third sugar. The rats first developed high levels of triglycerides in their blood after four weeks on their sugary diet but remained at the same weight as rats on a normal diet. Next, the rats on the experimental diet developed large pads of fat around their abdomens. At the end of 20 weeks on the high-sugar diet, the rats had become obese, had high blood sugar levels as well as high levels of triglycerides, and had become insulin-resistant. The researchers think that the metabolic syndrome may develop in humans in the same series of stages.

develop the metabolic syndrome as well as adults. In early 2004 a group of researchers studied nearly 2,000 California youngsters over the age of 12 and found that two-thirds of the children had at least one abnormal metabolic measurement, and 10 percent had the metabolic syndrome. The rate of metabolic syndrome climbed to 30 percent in children who were overweight or obese; this figure concerned researchers because the rate of overweight and obesity in American children tripled between the mid-1970s and the early 2000s. The doctors found that the rates of metabolic syndrome in children from different racial and ethnic groups follow the same pattern as those for adults: Hispanic children have the highest rates of metabolic syndrome, followed by Caucasian and African American children.

How Common Is Metabolic Syndrome?

Using the standards proposed by the NCEP and AHA in 2005, some doctors estimated that about one-fifth (20%) of adults in the United States have metabolic syndrome. But because the risk of developing the syndrome increases as people get older, some researchers suspected the true rate among American adults may be as high as 25 percent, or 47 million people. Among Hispanic adults, it was thought to be as high as 31 percent. Researchers expected the rate to increase as the rate of obesity among children as well as adults continued to rise.

* **metabolism** (meh-TAB-o-liz-um) is the process in the body that converts foods into the energy necessary for body functions.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **gestational** (jes-TAY-shun-al) means relating to pregnancy.

Who Gets Metabolic Syndrome?

Causes The causes of metabolic syndrome are not fully understood, although there was as of 2009 wide agreement that it is the end result of a complicated series of changes in the body's metabolism*. Some doctors suspected that obesity was the basic cause of metabolic syndrome, while others thought that insulin resistance is the basic cause. A third group of doctors theorized that both obesity and insulin resistance are the results of a more general metabolic disturbance in a person's body caused by a combination of genetic* and environmental factors. As of 2009, research continued to explore possible causes of metabolic syndrome in general and insulin resistance in particular.

Risk factors Some people are more likely than others to develop metabolic syndrome. These risk factors include:

- Having a parent or sibling with diabetes
- Having a family history of high blood pressure and heart disease
- Being over age 45
- Having a family background that is African American, Alaska Native, American Indian, Asian American, Hispanic/Latino, or Pacific Islander
- Being overweight or obese, particularly if the fat is concentrated on the upper body. A high proportion of body fat on the upper body—sometimes called an apple-shaped figure—is a greater risk factor for metabolic syndrome than a high proportion of fat on the lower body (a pear-shaped figure). Upper-body obesity is thought to lead to increased fat deposits in muscle tissue and the liver, which in turn leads to insulin resistance and higher levels of triglycerides in the blood.
- Being inactive. Getting enough exercise makes it easier to keep weight at a healthy level. In addition, regular physical exercise helps the body respond better to insulin.
- Taking medications that cause weight gain or changes in blood pressure, cholesterol, and blood sugar levels. These types of drugs are most often prescribed for inflammation, allergies, HIV infection, depression, and other kinds of mental illnesses
- Being a woman who was diagnosed with diabetes during pregnancy, a condition known as gestational* diabetes
- Being a woman with polycystic (POL-ee-SISS-tik) ovary syndrome, or PCOS. PCOS is a metabolic disorder that affects a woman's hormone levels and reproductive organs.

How Do People Know They Have Metabolic Syndrome?

It is possible for people to develop metabolic syndrome over a period of years without any noticeable symptoms; this slow development is one reason why regular medical checkups are important to good health. In addition, some people develop metabolic syndrome without being obese or having a large

METABOLIC SYNDROME AND HEART DISEASE

According to the National Institutes of Health, an adult with metabolic syndrome has twice the risk of dying from heart disease and three times the risk of developing it as a person without metabolic syndrome. In the early 2000s, it was projected that soon metabolic syndrome might overtake smoking as the major cause of heart disease in American adults.

There are two conditions that are commonly found in people with metabolic syndrome, although whether these conditions help to cause the syndrome or only make it worse was not known as of 2009. The two conditions are: a tendency to form blood clots and a low-grade inflammation throughout the body. Both of these conditions contribute to heart disease by encouraging the buildup of plaque* in the coronary arteries.

* **plaque** (PLAK) is a raised patch or swelling on a body surface. Arterial plaque occurs on the inner surface of an artery and is produced by fatty deposits.

waist measurement. Most people with metabolic syndrome are diagnosed in the course of a medical checkup that includes a blood test.

In some cases, people with diabetes that has not yet been diagnosed may notice increased thirst; increased urination, especially at night; unusual tiredness; and blurred vision. High blood pressure usually develops without any symptoms; however, a few people may notice dull headaches, dizzy spells, or more nosebleeds than usual.

Some people are diagnosed with insulin resistance, one of the risk factors for metabolic syndrome, because they develop a skin condition called acanthosis nigricans (ah-can-THO-sis NEE-grih-cans). A person with acanthosis nigricans develops dark patches on the skin of the neck or on the elbows, knees, knuckles, or armpits. This skin discoloration is more common in Hispanics or African Americans with insulin resistance.

How Is Metabolic Syndrome Diagnosed and Treated?

Screening and diagnosis Because metabolic syndrome usually does not have the kinds of symptoms that lead people to see a doctor and because it is more likely to affect older adults, doctors recommend that adults be screened for the syndrome starting at age 45. If the results of blood tests and other measurements are normal, screening should be repeated only every three years. If the person has any risk factors in addition to age, screening should occur more frequently, the frequency depending on the number of other risk factors and their severity.

Screening for metabolic syndrome consists first of measuring the patient's waist, at the top of the upper edge of the hipbone just after the person has exhaled (breathed out). The doctor also weighs the patient,

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein

notes the distribution of body fat, and measure the patient's blood pressure. A sample of blood is taken and sent to a laboratory to measure the levels of triglycerides and cholesterol.

The patient's blood sugar level and possible insulin resistance can be tested in two ways. The first is a fasting blood glucose test. The person does not eat or drink anything (except water) after midnight the evening before the test and has a sample of blood drawn in the morning. The second test is called a glucose tolerance test and measures how quickly the body uses sugar. In this test, the person has one sample of blood drawn after fasting overnight and the second sample taken two hours after drinking a sugary liquid in the doctor's office or diagnostic laboratory. Blood sugar levels higher than normal but not high enough to indicate type 2 diabetes are considered a sign of pre-diabetes.

A pre-diabetes score on the fasting blood glucose test and the glucose tolerance test is considered indirect evidence of insulin resistance. To measure insulin resistance directly, a complicated test called the euglycemic (yoo-gly-SEEM-ik) clamp, which is usually done only in research laboratories, can be performed. The euglycemic clamp test takes about two hours. The patient is given an intravenous* solution of insulin and a solution of glucose (sugar). The patient's blood sugar level is measured every 5 to 10 minutes. The amount of intravenous glucose that the patient needs during the last 30 minutes of the test to maintain a normal level of blood sugar measures the person's sensitivity to insulin. Individuals who need high levels of additional glucose are insulin-sensitive. Very low levels indicate insulin resistance.

Treatment The metabolic syndrome is treated first with a combination of lifestyle changes. The goal is to lower the patient's risk of heart disease and type 2 diabetes by bringing blood pressure, blood sugar, and blood cholesterol down to healthier levels. If the patient has already been diagnosed with type 2 diabetes, treatment is focused on lowering the risk of heart disease. Specific lifestyle changes include:

- Quitting smoking, if the patient smokes. The nicotine in tobacco increases a person's risk of heart disease because it raises blood pressure and speeds up the heart rate. Smoking also raises the level of triglycerides in the blood and lowers the level of "good" cholesterol.
- Losing weight. This lifestyle change alone can significantly lower a person's risk of diabetes and heart disease. Most adults with metabolic syndrome need to cut their food intake by 500 to 1,000 calories per day in order to lose 7 to 10 percent of their body weight (the recommended amount) over a period of six months to a year.
- Getting at least 30 minutes of moderate-intensity exercise (like brisk walking) on most or all days of the week. Exercise combined with calorie cutting speeds up weight loss.
- Eating a healthier diet, which means cutting back on foods that are high in fat and cholesterol and adding more fruits, vegetables, fish, and whole grains to the diet. The Dietary Approaches to Stop

Hypertension (DASH) diet is a specific diet plan that is often given to patients with metabolic syndrome.

Some patients need medications in addition to lifestyle changes to treat specific health risks associated with the metabolic syndrome. The specific drugs prescribed and their dosages depend on the individual patient's test results:

- Drugs to lower the level of “bad” cholesterol and triglycerides
- Drugs to raise the level of “good” cholesterol
- Diuretics and drugs called ACE inhibitors. These are given to control high blood pressure. Diuretics cause the body to excrete extra fluid through the urine, whereas ACE inhibitors work to lower blood pressure by increasing the volume of blood pumped by the heart and keeping the blood vessels from tightening or narrowing.
- Drugs to lower insulin resistance. Metformin (met-FORM-in) is the drug most commonly prescribed for this purpose. Metformin can also be given to people diagnosed with diabetes or PCOS. In addition to controlling blood sugar levels, metformin also lowers triglyceride levels.
- Insulin. Insulin is given to control blood sugar levels in patients already diagnosed with diabetes.
- Low doses of aspirin. Aspirin is recommended to lower the risk of blood clots in patients with a high risk of heart disease.

Can Metabolic Syndrome Be Prevented?

Some risk factors for metabolic syndrome, such as age, race, and family history, cannot be changed. People can, however, lower their risk of developing metabolic syndrome by following guidelines from the National Heart, Lung, and Blood Institute:

- Following a healthy diet plan
- Keeping weight at a healthy level for one's age, sex, and height
- Getting at least 30 minutes of exercise every day
- Quitting smoking, or not starting in the first place
- Getting regular medical checkups for measuring blood pressure, cholesterol, and blood sugar levels

Self-care at home for metabolic syndrome involves following the same recommendations as for preventive care.

▶ See also **Diabetes • Heart Disease • Stroke**

Resources

Books and Articles

Isaacs, Scott, and Fred Vagnini. *Overcoming Metabolic Syndrome*. Omaha, NE: Addicus Books, 2006.



▲
The back of the throat of a person with infectious mononucleosis also called glandular fever. ©Medical-on-LinelAlamy.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

* **cytomegalovirus** (sy-tuh-MEH-guh-lo-vy-rus), or CMV, infection is very common and usually causes no symptoms. It poses little risk for healthy people, but it can lead to serious illness in people with weak immune systems.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

Karst, Karlene. *The Metabolic Syndrome Program: How to Lose Weight, Beat Heart Disease, Stop Insulin Resistance and More*. Toronto: Wiley Canada, 2006.

Organizations

American Diabetes Association. 1701 North Beauregard Street, Alexandria, VA, 22311. Toll free: 800-342-2383. Web site: <http://www.diabetes.org/home.jsp>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: <http://www.nhlbi.nih.gov/index.htm>.

National Institute of Diabetes and Digestive and Kidney Diseases. NIDDK National Diabetes Information Clearinghouse, 1 Information Way, Bethesda, MD, 20892-3560. Toll free: 800-860-8747. Web site: <http://diabetes.niddk.nih.gov/index.htm>.

Migraine See *Headache*.

Mononucleosis, Infectious

Infectious mononucleosis (mah-no-nu-klee-O-sis), also known as mono, is an infectious illness usually caused by the Epstein-Barr (EP-steen BAR) virus (EBV). It often leads to fever, sore throat, swollen lymph nodes, and tiredness.*

What Is Mononucleosis?

By the time they are 40 years old, as many as 95 percent of all adults in the United States have evidence in their blood of a previous EBV infection. Many of these infections are never recognized, especially if they occur in early childhood, because the symptoms look like those of other childhood viral illnesses. Some people infected with EBV have no symptoms. This situation occurs in many parts of the world where most people are infected early in life. In the United States, EBV infection is most common during adolescence and early adulthood (ages 15–25). One-third to one-half of teens who come into contact with the virus for the first time develop symptoms of classic infectious mono: sore throat, swollen lymph nodes, fever, and extreme tiredness.

Mono most often is associated with acute* infection by EBV, but it is sometimes seen with acute cytomegalovirus* (CMV) infection, acute HIV* infection, and, rarely, other viruses.

Although the symptoms may be unpleasant, mono is generally a mild disease. After a person recovers, the virus remains dormant (inactive) in the body for life. It occasionally may reactivate, but it rarely causes symptoms again. When people have been infected with the virus, whether or not they had symptoms, they usually will be immune* to future EBV-related illness.

How Common Is Mononucleosis?

EBV is one of the most common human viruses in the world. In the United States, cases of mono with symptoms most often are found in teens between the ages of 15 and 17. The illness occurs in two out of every 1,000 adolescents and young adults and is less common in other age groups.

How Is Mononucleosis Spread?

Mono is contagious, although less so than the common cold. EBV passes from person to person primarily through contact with saliva. Kissing and sharing food, drinks, or utensils commonly spread the virus. Although EBV is present in the respiratory tract*, it usually is not transmitted by coughing or sneezing. Some people become sick and are able to spread the virus for weeks, especially those who are infected but do not feel sick and pass the virus to others without realizing it. The virus usually remains inactive after the first infection, but some people may spread it from time to time throughout their life.

How Do People Know They Have Mononucleosis?

Symptoms of mono develop between four and six weeks after infection and generally last two to four weeks. These include swollen lymph nodes, extreme tiredness, fever, sore muscles, and sore throat. Up to 50 percent of people with classic infectious mononucleosis have a swollen spleen, and some have an enlarged liver. Other symptoms may include loss of appetite, weakness, nausea (NAW-zee-uh), stiffness, headache, chest pain, and, rarely, jaundice*.

How Is Mononucleosis Diagnosed and Treated?

Symptoms of mono usually show up one to four weeks before the diagnosis is made. A physical exam, the patient's age, and sometimes a history of contact with an infected person help the doctor make the diagnosis. An adolescent patient with a lasting fever, sore throat, and swollen lymph nodes, with or without an enlarged spleen, is likely to have mono.

Blood tests can confirm the diagnosis. A blood count will show an increased number of lymphocytes*, and many of them will look unusual. A positive rapid screening test may confirm the diagnosis by revealing EBV in the blood, but this test can be negative, especially early in the illness. More accurate antibody* testing may be done to rule out other viruses that can cause mono-like illnesses. Antibody testing checks several antibodies to determine if there is a current infection or evidence of past infection.

There is no specific treatment for mono. Because it is a viral illness, antibiotics are not prescribed unless a secondary bacterial illness is present,

Kiss and Tell

Mono is often referred to as the “kissing disease” because the infection is spread primarily through direct contact with infected saliva.

* **immune** (ih-MYOON) means resistant to or not susceptible to a disease.

* **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

* **lymphocytes** (LIM-fo-sites) are white blood cells, which play a part in the body's immune system, particularly the production of antibodies and other substances to fight infection.

* **antibody** (AN-tih-bah-dee) is a protein molecule produced by the body's immune system to help fight a specific infection caused by a microorganism, such as a bacterium or virus.

EBV and Cancer

EBV has been linked to the development later in life of Burkitt's lymphoma (a rare blood disease of the lymph nodes seen mainly in Africa) and nasopharyngeal carcinoma (nay-zo-fair-in-JEE-ul kar-sih-NO-muh, a cancer in the throat area seen mainly in China). EBV is also linked to lymphoma in the United States, most notably in people with weakened immune systems, such as people who have HIV.

- * **strep throat** is a contagious sore throat caused by a strain of bacteria known as *Streptococcus*.
- * **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.
- * **ibuprofen** (eye-bew-PRO-fin) is a nonsteroidal anti-inflammatory drug (NISAD) used to reduce fever and relieve pain or inflammation.
- * **tonsils** are paired clusters of lymphatic tissue in the throat that help protect the body from bacteria and viruses that enter through a person's nose or mouth.
- * **hepatitis** (heh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.
- * **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

such as strep throat*. The best treatment for mono is rest. Over-the-counter medications such as acetaminophen* or ibuprofen* may be taken to relieve fever and pain.

Steroids, medications that reduce inflammation, may be given to decrease swelling in the tonsils* and lymph nodes in the neck if a patient is experiencing difficulty swallowing or breathing. Playing contact sports is prohibited for someone who has mono because when the spleen and liver enlarge, they are more vulnerable to injury. Patients with mono are advised not to play contact sports for at least one month and to be examined and get a doctor's permission before they start again.

Symptoms of mono usually clear up one to two months after they appear, but they can last as long as four months.

What Are Some Complications of Mononucleosis?

Recovery from mono is usually uneventful, but sometimes complications occur. An enlarged spleen may rupture, which is an emergency that needs surgery. Fifty percent of patients with infectious mononucleosis have some liver inflammation, but only a small number have significant inflammation, or hepatitis*. Blood problems that can result from the infection include anemia*, decreased white cells (cells that fight infection), and low numbers of platelets (cells that help the blood clot). Mononucleosis also can lead to encephalitis (en-seh-fuh-LYE-tis, inflammation of the brain), Guillain-Barré (GEE-yan bah-RAY) syndrome (an inflammation of the nerves, which causes muscle weakness and paralysis*), and Bell's palsy (PAWL-zee, a temporary weakness or paralysis of the muscles on one side of the face). Myocarditis (my-oh-kar-DYE-tis, an inflammation of the muscular walls of the heart) is a rare complication.

EBV has also been associated with cancers, such as lymphoma*, especially in patients with weak immune systems, such as people who have had organ transplants or who have HIV.

Can Mononucleosis Be Prevented?

There is nothing specific that a person can do to avoid contracting mono because EBV often is spread in the saliva of healthy people who have been infected in the past and who can still transmit the virus. Normal human behavior makes it practically impossible to prevent the spread of the disease.

▶ See also **AIDS and HIV Infection • Cytomegalovirus (CMV) Infection • Encephalitis • Hepatitis • Myocarditis/Pericarditis**

Resources

Books and Articles

Decker, Janet, and Alan Hecht. *Mononucleosis*. Philadelphia, PA: Chelsea House, 2009.

Marcovitz, Hal. *Infectious Mononucleosis*. Detroit, MI: Lucent Books, 2008.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/diseases/ebv.htm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/infectiousmononucleosis.html>.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **lymphoma** (lim-FO-muh) refers to a cancerous tumor of lymphocytes, cells that normally help the body fight infection.

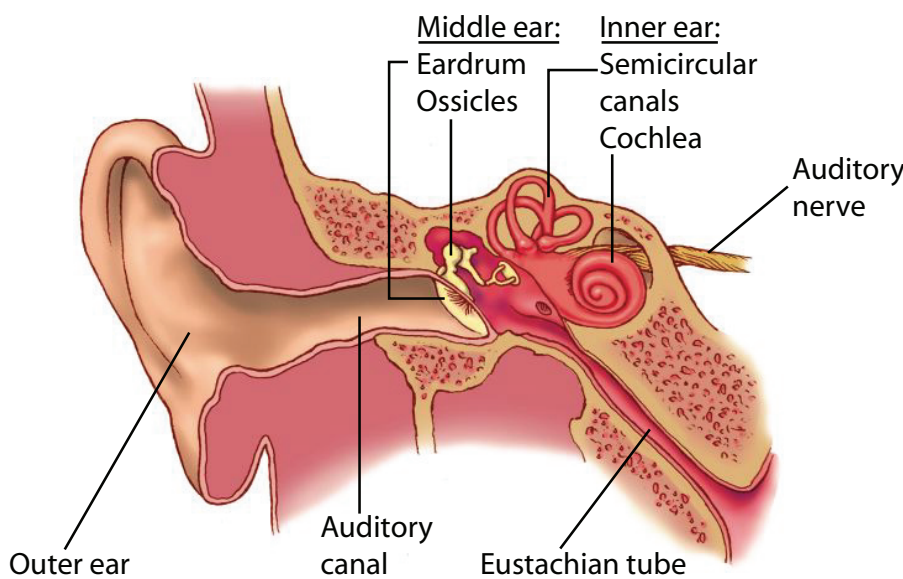
Mood Disorders See *Bipolar Disorder; Depressive Disorders.*

Motion Sickness

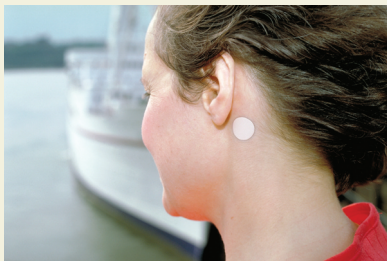
Motion sickness occurs when people feel dizzy or nauseated because the motion their body senses and the motion their eyes perceive are not synchronized. The conflicting messages sent to the brain make them feel ill.

The Ruined Fishing Trip

Jon and his dad were very excited about their upcoming deep-sea fishing trip off the Florida coast. His father’s friend Bob had a boat and knew the right spots to look for fish. The sun was bright, and the sea was choppy that day. Bob traveled out about four miles from shore. Suddenly, his motor quit, and the boat vigorously bobbed up and down on the waves.



◀ Anatomy of the inner and middle ear. Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



▲
A transdermal patch placed behind the ear can deliver medication to relieve motion sickness. *Van D. Bucher/Photo Researchers, Inc.*

The Patch

One of the most effective methods of preventing motion sickness is known as “the patch.” The patch is a small spot bandage that is usually worn behind the ear. The patch slowly releases scopolamine (sko-PALL-a-meen) through the skin. Scopolamine works by suppressing certain areas of the central nervous system, which decreases motion-induced nausea and vomiting. The patch provides lasting protection against motion sickness for about three days. The most common side effect of the patch is dryness of the mouth. Other less common side effects include drowsiness and dilation (widening) of the pupils of the eyes.

* **vertigo** (VER-ti-go) is the feeling that either the environment or one’s own body is revolving or spinning, even though they are not.

First Jon felt queasy in his stomach, and then he broke out in a cold sweat. He became nauseated and vomited over the side of the boat. When they got back to shore, Jon’s queasiness went away fairly rapidly. He felt frustrated that the pleasure of the fishing trip had been ruined by his bout of motion sickness.

What Causes Motion Sickness?

Dizziness, vertigo*, and motion sickness are all related to the sense of balance and equilibrium in the inner ear. Researchers in space and aeronautical medicine call this sense spatial orientation because it tells the brain where the body is in space.

The following sensors work together to maintain a sense of spatial orientation:

- The chamber of the inner ear known as the vestibular labyrinth (ves-TIB-u-lar LAB-e-rinth) consists of fluid-filled, interconnected tubes called semicircular canals that monitor the direction of motion.
- The eyes send signals to the brain about where the body is in space.
- Skin pressure receptors tell the brain what part of the body is touching the ground.
- Muscle and joint receptors tell the brain what parts of the body are moving.
- The brain processes all the information from these sensors and puts everything together. When information from the sensors appears to conflict, the brain is confused, and in many people motion sickness occurs. When the boat Jon was in was tossed about on the waves, information from Jon’s eyes did not match the information about the boat’s movement coming from other parts of his body. This confusion caused him to feel uncomfortable and to vomit. The sensitivity to mixed sensory messages about movement seems to be inherited; motion sickness tends to run in families.

What Are the Symptoms of Motion Sickness?

Almost everyone can get motion sickness at one time or another. Some people, especially children, become queasy when riding in a car or an airplane. Other people get seasick from the rocking motion of a boat on rough water. Some people feel sick from riding a roller coaster or a spinning carnival ride or even watching a jumpy, fast-moving scene in a movie. Poor ventilation, odors such as gas fumes or smoke, and drinking alcohol make a person more susceptible to motion sickness.

People who feel motion sick may do the following:

- become pale
- yawn
- act restless

- break out in a cold sweat
- feel queasy as if they will have to vomit
- vomit, sometimes repeatedly

How Can Motion Sickness Be Prevented?

Preventing motion sickness is easier than treating it once it has begun.

Travelers should sit wherever there is the least motion. In a car, sitting in the front seat and looking straight ahead may help. In an airplane, passengers feel the least motion in a seat over the wing. On a ship, remaining on the deck and looking at the far horizon rather than nearby objects may help. Eating only a light meal before traveling and avoiding alcohol also help a person avoid motion sickness.

Over-the-counter medications such as meclizine or dimenhydrinate (Dramamine) can be effective in preventing motion sickness. They work best if taken an hour or so before traveling. Although it is not a proven medical remedy, some people rely on ginger root, either sliced and chewed or brewed as tea, as a way to prevent motion sickness. In severe or prolonged cases of motion sickness, a doctor may prescribe a scopolamine patch.

Once the symptoms of motion sickness start, they are difficult to treat while the upsetting motion continues. For most people, the symptoms stop soon after the motion stops. If the symptoms persist, the person should consult a physician because another disorder may be causing the symptoms.

▶ See also **Vertigo**

Resources

Organizations

American Academy of Otolaryngology, Head and Neck Surgery.

1650 Diagonal Road, Alexandria, VA, 22314-2857. Telephone: 703-836-4444. Web site: <http://www.entnet.org/HealthInformation/dizzinessMotionSickness.cfm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD,

20894. Web site: <http://www.nlm.nih.gov/medlineplus/motionsickness.html>.

University of Maryland Medical Center. 22 S. Greene Street,

Baltimore, MD, 21201-1595. Telephone: 410-328-8667. Web site: <http://www.umm.edu/altmed/articles/motion-sickness-000110.htm>.

Mouth Cancer See *Oral Cancer*.



▲
Jacqueline Du Pré (1945–1987) circa 1967. *Erich Auerbach/Hutton Archive/Getty Images.*

* **autoimmune disease** (aw-toh-ih-MYOON) is a disease in which the body's immune system attacks some of the body's own normal tissues and cells.

MRSA See *Antibiotic Resistance; Skin and Soft Tissue Infections; Sports Injuries; Staphylococcal Infections.*

Multiple Personality Disorder See *Dissociative Identity Disorder.*

Multiple Sclerosis

Multiple sclerosis (MS) is an inflammatory autoimmune disease of the nervous system that disrupts communication between the brain and other parts of the body, resulting in episodes of weakness, paralysis, blindness, fatigue, and other symptoms.*

“She Played Like an Angel”

Jacqueline Du Pré (doo-PRAY) was born in England in 1945. On her fifth birthday, her parents gave her a cello, and she started lessons the next year. At 16, Jacqueline made her concert debut in London. In 1967 she married the pianist and conductor Daniel Barenboim, and together the young, talented couple charmed the musical world. Six years later, Jacqueline could no longer feel the strings of her cello. By the mid-1970s she was unable to dress herself or stand without help. In 1987, at the age of 42, she died of multiple sclerosis (MS). Many people with MS are mildly affected, but in the most severe cases, such as Jacqueline Du Pré's, a person may be unable to write, speak, or walk.

How Does the Body Communicate Information?

The nervous system allows the human body to receive information and react to the environment. The nervous system is divided into two parts: the central nervous system and the peripheral (pe-RIF-er-al) nervous system. The central nervous system consists of the brain and the bundle of nerves that is the spinal cord. The peripheral nervous system is made up of the nerves that branch out from the spinal cord and carry signals to and from the arms, legs, organs, and other parts of the body. The basic unit of the nervous system is the nerve cell, or neuron, and each human body has billions of them. Each neuron looks something like a kite. The top of the kite, or cell body, has many fingerlike extensions called dendrites. Dendrites send information in the form of electrical impulses toward the cell body. The tail of the kite, or axon, carries electrical messages away from the cell body. Axons, or nerve fibers, are sheathed (wrapped) in a protective substance called myelin (MY-a-lin). Myelin is made of fats

and proteins, and it acts to insulate nerve fibers and to keep the electrical impulses moving rapidly along the nerve fibers.

What Is Multiple Sclerosis?

MS is an inflammation* of the nerve fibers in the brain and spinal cord that results in the scarring of “white matter” (“sclerosis” means “scarring”). White matter (abundant in the brain and spinal cord) is made up of nerve fibers (axons) and their protective myelin sheaths. The scarred regions are called plaques. When the myelin covering the nerve fibers is damaged, signals passing through the neurons slow down or may stop completely. Some research has suggested that MS plaques represent not only damaged myelin, but also (in some cases) neurons that have been completely destroyed.

MS is not a common disease. Estimates of the number of people worldwide with MS vary, but in 2007 about 400,000 people in the United States were living with the disease and about 10,000 Americans were newly diagnosed with MS each year. The disease is most frequently diagnosed in people between 20 and 40 years of age, and it affects about twice as many women as men.

What Causes Multiple Sclerosis?

As of 2009, scientists did not know exactly what causes MS, but many thought that it is an autoimmune disease triggered by exposure to something in the environment in some individuals who have genes that make them susceptible to developing the MS plaques. In a healthy body, the immune system* is continually on guard to defend against foreign disease-causing invaders, such as bacteria, viruses, fungi, and parasites. Normally the body is able to distinguish its own cells from foreign cells and attack only foreign cells. Sometimes the mechanism for distinguishing self from non-self goes awry. Some scientists think that, with MS, the body no longer recognizes the myelin as “self”, and begins to attack it.

It is not clear what underlying changes occur that cause the body to attack the myelin in people with MS. Some scientists believe that a virus triggers a malfunction of the immune system. Because the incidence of MS is not spread evenly throughout the world, others believe that factors in the environment (colder temperatures, for instance) may trigger the disease. Both of these may play a role, as may other unknown environmental factors. Genes* appear to influence who gets MS. Generally, a person’s chances of getting MS are very low. If a member of a family has MS, then that member’s parents, children, and sisters and brothers still have a very low chance of getting the disease, but it is about 5 percent higher than in people who do not have family members with MS. It also seems likely that more than one gene is involved in a person’s susceptibility to MS. The understanding as of 2009 was that many different factors, both environmental and genetic, have to come together for a person to develop MS. Scientists continue to explore how genes interact with one another and with the environment, in relation to MS, in the hope of finding new ways to treat or cure it.

Word Origin

Sclerosis comes from the Greek word for “scarring” or “hardening.”

* **inflammation** (in-fla-MAY-shun) is the body’s reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person’s body structure and physical characteristics. Inherited from a person’s parents, genes are contained in the chromosomes found in the body’s cells.

* **incontinence** (in-KON-ti-nens)
is loss of control of urination or
bowel movement.

Are There Different Types of Multiple Sclerosis?

MS manifests differently in different cases, but usually the disease follows one of several patterns. The most common pattern is called relapsing-remitting MS, in which symptoms come and go, sometimes with periods of remission (when the affected person is fine). About three-fourths of all people diagnosed with MS have this type of the disease. In about half of all people with relapsing-remitting MS, the disease eventually returns permanently with no periods of relapse. When this happens, it is called secondary progressive MS. About 10 percent of people with MS have what is called primary progressive disease, which means that the disease does not go away after the first attack. Patients with primary progressive MS tend to be older (around 40 to 60 years old). A rare form of MS is called progressive-relapsing disease in which disease symptoms are always present, more or less at a constant level, however there are periods during which they worsen.

What Are the Signs and Symptoms of Multiple Sclerosis?

MS may begin abruptly, or the initial symptoms may be so mild and gradual that a person barely notices them. In the early stages of MS, people may find that simple motions such as opening a window or climbing a few stairs tire their arms and legs. Although everyone occasionally feels numbness or “pins and needles” in their hands and feet, these feelings are much more frequent in people with mild MS. Patients often experience blurring and double vision or they may lose vision in one eye or both eyes. Sometimes eye movement becomes painful. A person may become uncoordinated. In about 75 percent of patients with MS, many of these early symptoms disappear only to reappear months or years later.

Over time, as nerve damage increases, parts of the body may become stiff or paralyzed. Many patients with MS have difficulties related to urination and bowel movements, such as incontinence* and constipation. Walking or standing may become difficult or impossible. A person may become confused or forgetful owing to damage to the part of the brain that processes information. Some people with MS become depressed or have fits of laughing or crying uncontrollably, for no apparent reason. MS tends to vary in severity and the speed at which it progresses in different people; there is no single blueprint or timeline for how the disease develops.

How Is Multiple Sclerosis Diagnosed?

MS is often difficult to diagnose, because the symptoms are varied and not specific to the disease. Symptoms of MS can be confused with those that follow a viral infection or other disease. Diagnosis must be preceded by a complete neurological exam that tests functions of the nervous system such as reflexes, muscle tone, and perception of pain, heat, and touch. The accuracy of diagnosis improved with improvements in a diagnostic

THE FIRST DIAGNOSIS OF MULTIPLE SCLEROSIS

Jean-Martin Charcot (1825–1893) is known as the father of neurology, or the study of the nervous system. In 1868, a young woman came to his clinic with an unusual tremor and other neurological symptoms. She subsequently died, and in examining her brain, Charcot found the lesions* that people later recognized as brain and spinal cord plaques caused by MS.

Charcot was the discoverer of multiple sclerosis and the first person to describe the disease. He also gave the disease its name. His work established the foundation for the research that came later, and his definition of the disease remained in use in the early 2000s.

technique called magnetic resonance imaging*, or MRI, that is able to pinpoint locale(s) of damage that MS has caused in the brain. A spinal tap, also called a lumbar puncture, can also aid in diagnosis. This test removes a small amount of the fluid that surrounds the spinal cord so that it can be examined for certain abnormalities associated with MS. Also, an evoked potential test can be used to measure how strongly (or weakly) electrical impulses are transmitted from peripheral tissue, along nerve fibers, and to the brain. Abnormalities in this test also suggest MS.

What Is the Treatment for People with Multiple Sclerosis?

As of 2009, no cure existed for MS, and there was no way to prevent the disease. Treatment varies considerably because of the range and severity of MS symptoms. Some people do well for long periods with little or no treatment. Heat seems to make the symptoms of MS worse, but swimming or a cool bath may help to reduce symptoms. Several classes of drugs are used to treat MS and more were being developed and tested in the early 2000s. Some drugs are more effective for specific types of MS. However, many drugs used to treat MS have the potential to cause serious side effects.

Not all drugs are appropriate for all patients; however, several types of drugs are commonly used to treat MS. These include the following:

- Beta interferons. These are manmade versions of protein molecules produced naturally by cells of the immune system to fight infection. They are given by injection several times a week.
- Immune system blockers (or immunosuppressants). These drugs interfere with the immune system and slow its attack on myelin. They are given by injection.
- Corticosteroids* are used mainly in people with progressive MS. Long-term use of corticosteroids causes undesirable side effects.

The United States and the World

- In 2007 it was estimated that worldwide between 1.5 and 2.5 million people have MS.
- MS is more common in temperate regions north and south of the equator, such as the United States, Canada, northern Europe, and southern South America. MS is far less common in countries with tropical climates. No one knew why as of 2009.
- Caucasians, especially those of Northern European ancestry, get MS more often than Asians or Africans, and the disease is unknown among certain native peoples such as the Inuit (Native people of the Arctic) and Maori (Native people of New Zealand).
- Women get MS twice as often as men.

* **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

* **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.

- Muscle relaxants are used to treat muscle stiffening or muscle spasms that can be painful and interfere with daily activities.
- There are also drugs reduce fatigue, as exhaustion is a common symptom of MS.

In addition to drug treatment, people with MS often benefit from physical therapy and occupational therapy, which help them to better adapt to the difficulties they experience in performing daily tasks. Because MS takes a psychological toll as well as a physical one, counseling and support groups may also be helpful both to the patient and the patient's family.

Living with Multiple Sclerosis

About one-third of people with MS have very mild symptoms and are able to lead relatively normal lives. However, many people with MS gradually become seriously disabled, and their quality of life is severely diminished. The lifespan of people with MS is, on average, five to seven years shorter than that of persons without the disease. However, MS is rarely the cause of death in persons who have the disease; these individuals usually die of complications associated with the disease, such as paralysis, pneumonia, or some other infection, which are usually a consequence of their being bedridden.

The diagnosis of MS can be devastating because patients are often young adults. Suddenly plans for a career and family must take into account a disease whose course is uncertain. Yet many people with MS continue to lead productive lives. A woman who has MS may still become pregnant and bear a child safely, although she may be instructed to discontinue her MS medications during pregnancy, and the physical limitations of the disease may make it more difficult for her to care for her child.

More mature children who have a parent who has severe MS may find it hard to accept the changes they see happening in a person they remember as capable and independent and on whom they still depend. They may feel guilty about enjoying activities that the parent who has MS can no longer perform, or they may resent having to help with simple actions such as fetching a glass of water or turning on the radio or television for the parent. MS can take a tremendous emotional and financial toll on the entire family. Support groups and counseling can help MS patients and their families achieve the best possible quality of life given the limitations imposed by the disease.

▶ See also **Immune System and Other Body Defenses • Paralysis**

Resources

Books and Articles

Blackstone, Margaret. *The First Year: Multiple Sclerosis, An Essential Guide for the Newly Diagnosed*. New York: Marlowe, 2007.

Coyle, Patricia K., and June Halper. *Living with Progressive Multiple Sclerosis: Overcoming the Challenges*, 2nd ed. New York: Demos Medical, 2008.

Kalb, Rosalind C., ed. *Multiple Sclerosis: The Questions You Have—The Answers You Need*, 4th ed. New York: Demos Medical, 2008.

Rosner, Louis J., and Shelley Ross. *Multiple Sclerosis: New Hope and Practical Advice for People with MS and Their Families*, updated ed. New York: Fireside Book, 2008.

Organizations

Multiple Sclerosis Foundation. 6350 North Andrews Avenue, Fort Lauderdale, FL, 33309-2130. Toll free: 888-MSFOCUS. Web site: <http://www.msfacts.org>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Toll free: 800-352-9424. Web site: http://www.ninds.nih.gov/disorders/multiple_sclerosis/multiple_sclerosis.htm.

National Multiple Sclerosis Society. 733 Third Avenue, New York, NY, 10017. Web site: <http://www.nmss.org>.

Mumps

Mumps is a contagious viral infection that causes inflammation and swelling in the glands of the mouth that produce saliva.

What Is Mumps?

Mumps is an infection caused by a virus. The mumps virus can infect various parts of the human body, but typically it attacks the salivary glands. The mouth has three pairs of salivary glands: one pair under the mouth and lower jaw; a second pair under the tongue; and a third pair in the back of both cheeks between the ear and the jaw. In most cases, mumps affects the third pair, called the parotid glands*, causing them to swell painfully.

In some patients, the virus spreads to the central nervous system* and causes a condition called aseptic meningitis*. Up to 15 percent of patients who have mumps, most commonly adults, will develop cases of meningitis with symptoms (such as headache and stiff neck).

Before the introduction of the mumps vaccine in 1967, the infection was also a major cause of acquired (not present at birth) deafness in childhood. Deafness occurs in about one out of 20,000 cases of mumps, often in only one ear.



▲ Swelling of the neck and jaw is a sign of the mumps. *Andy Levin/Photo Researchers, Inc.*

* **parotid (puh-RAH-tid) gland** is the salivary gland located in the jaw just beneath and in front of each ear.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **aseptic meningitis** (a-SEP-tik meh-nin-JY-tis) is a milder, non-bacterial form of meningitis that is usually caused by a virus. Meningitis is an inflammation of the meninges, or the membranes that surround the brain and the spinal cord.

A Curious Outbreak

In 2006 an outbreak of more than 5,000 cases of mumps occurred in the United States. Most of the people affected were college students who had received one or more doses of the mumps vaccine. The illness was less severe than in non-vaccinated people. Analysis of this outbreak was expected to lead to new schedules of the vaccination.

* **epidemics** (eh-pih-DEH-miks) are outbreaks of diseases, especially infectious diseases, in which the number of cases suddenly becomes far greater than usual. Usually, epidemics that involve worldwide outbreaks are called pandemics.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

Is Mumps Common?

Mumps was a common childhood illness in the United States until 1967, when a vaccine was made available to the public. Before the vaccine, most mumps infections occurred in children under the age of 15, and 5- to 9-year-olds were the most frequently affected age group. In the early 2000s, many cases were diagnosed in young adults who had not been immunized.

After 1967, cases of mumps declined steadily. Statistics indicate the dramatic impact that the vaccine had. In 1964 approximately 212,000 cases of mumps were diagnosed in the United States. By 2001 that number had dropped to 231 cases, according to the Centers for Disease Control and Prevention.

Epidemics* of mumps are rare and usually break out among people who have not been vaccinated and who live in close quarters, such as army camps and college dormitories. For example, a small outbreak of the disease occurred between 1986 and 1987, mostly in older children and college-age students, because of insufficient immunization during a period from 1967 to 1977.

How Do People Contract Mumps?

Mumps is highly contagious. People infected with the mumps virus can spread it when they laugh, cough, or sneeze. Direct contact with saliva or fluid from an infected person's nose can also spread mumps. Patients are contagious from about one day before their glands become swollen to up to three days after the swelling has improved.

What Happens When People Have Mumps?

Signs and symptoms About one in five people who develop mumps have no symptoms. Many patients who do show signs of infection have only general symptoms such as a low fever, extreme tiredness, loss of appetite, muscle pain, and headache. Symptoms usually appear within 14 to 25 days after exposure to the virus.

Only 30 to 40 percent of people who become infected with the mumps virus have the swelling in the jaw area that most people associate with mumps. Earache and tenderness in the jaw are often the first signs of inflamed parotid glands. In two out of three cases of mumps, both parotid glands become swollen and painful, with one side swelling a few days before the other. Some patients also experience swelling in the other salivary glands. Talking, chewing, and swallowing can be painful, especially if the person eats or drinks acidic or sour food and beverages (such as lemonade and orange juice), which make the salivary glands squeeze out more saliva and increase discomfort.

Diagnosis and treatment A doctor typically diagnoses mumps by examining a person who has symptoms of the infection. Other infections can cause swelling in the salivary glands, too, so a doctor may take a sample of blood to look for antibodies* to the virus. Other tests that can

be used to diagnose mumps include culturing* samples of saliva or urine to find the mumps virus.

Most cases of mumps can be treated at home. Over-the-counter pain medication, such as acetaminophen*, can ease pain and fever, and warm or cold packs can soothe the pain of swollen, inflamed parotid glands. Resting and drinking plenty of non-acidic fluids help the body recover. The symptoms of mumps begin to clear up after one week and are usually gone within 10 days.

Complications Complications of mumps are rare but can be serious and may require additional treatment under a doctor's care or even hospitalization. The infection can lead to inflammation and swelling of the brain (encephalitis, en-seh-fuh-LYE-tis), as well as inflammation of the pancreas* (pancreatitis, pan-kree-uh-TIE-tis), other organs, or the membranes covering the brain and the spinal cord (meningitis). If symptoms of encephalitis or meningitis occur, it usually is within three to seven days after the swelling of the parotid glands begins. These symptoms include high fever, stiff neck, and headache. In some patients with mumps, an electrocardiogram* (EKG) will show signs of myocarditis*, but the condition rarely is severe enough to produce symptoms with mumps.

Up to half of all males who become infected with the mumps virus after puberty* experience painful swelling of the testicles* as a complication of the disease. Usually one testicle becomes swollen, but in some cases both do. High fever, chills, headache, nausea (NAW-zee-uh), and vomiting accompany the swelling, which generally goes away within a week after it appears, along with the fever and other symptoms. In rare cases, this swelling can permanently damage the testicle leading to infertility* due to the reduced ability to produce sperm cells. Only 5 percent of females who contract mumps after puberty develop inflammation of the ovaries*, which causes abdominal* pain and other symptoms similar to those of appendicitis*.

Can Mumps Be Prevented?

Immunization is the best way to prevent mumps, and the vaccine usually is administered during early childhood. The vaccine requires two doses and generally is given in the same shot with the vaccines for measles and rubella. This combination vaccine is known as the MMR (measles-mumps-rubella) vaccine. The first dose typically is given when an infant is between 12 and 15 months old and the second when the child is between four and five years old. Avoiding close contact with someone who has been diagnosed with mumps also reduces the risk of contracting the virus, particularly if the uninfected person has not been vaccinated.

▶ See also **Encephalitis • Measles (Rubeola) • Meningitis • Rubella (German Measles) • Vaccination**

* **culturing** (KUL-chur-ing) means being subjected to a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **pancreas** (PAN-kree-us) is a gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.

* **electrocardiogram** (e-lek-tro-KAR-dee-o-gram), also known as an EKG, is a test that records and displays the electrical activity of the heart.

* **myocarditis** (my-oh-kar-DYE-tis) is an inflammation of the muscular walls of the heart.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

* **testicles** (TES-tih-kulz) are the paired male reproductive glands that produce sperm.

* **infertility** (in-fer-TIH-lih-tee) is the inability of females to become pregnant or of males to cause pregnancy.

* **ovaries** (O-vuh-reez) are the sexual glands from which ova, or eggs, are released in women.

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

* **appendicitis** (ah-pen-dih-SY-tis) is an inflammation of the appendix, the narrow, finger-shaped organ that branches off the part of the large intestine in the lower right side of the abdomen.

* **factitious** means false. In this case it refers to an impression of illness produced falsely.

* **appendicitis** (ah-pen-dih-SY-tis) is an inflammation of the appendix, the narrow, finger-shaped organ that branches off the part of the large intestine in the lower right side of the abdomen.

* **dermatitis** is a skin condition characterized by a red, itchy rash. It may occur when the skin comes in contact with something to which it is sensitive.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

Resources

Books and Articles

Laskey, Elizabeth. *Mumps*. Chicago: Heinemann Library, 2003.

Organization

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/mumps.html>.

Munchausen Syndrome

Munchausen (MUNCH-how-zen) syndrome is a mental disorder in which a person pretends to be physically ill or produces the symptoms of illness in order to take on the role of a patient. The 1994 Diagnostic and Statistical Manual of Mental Disorders, known as the DSM-IV classified the condition as a “factitious disorder.” Factitious disorders include pretending to be mentally ill.*

How Did Munchausen Syndrome Get Its Name?

The disorder is named for Karl Friedrich Hieronymus, Baron von Münchhausen (1720–1797), a German nobleman, soldier, and huntsman who was known for making up exaggerated stories of his exploits and adventures. The disorder itself was not recognized and fully described until the twentieth century, however, the name “Munchausen,” was applied to it.

What Are the Signs of the Disorder?

There are a great many symptoms that may be faked or produced in Munchausen syndrome. For example, a person may complain of abdominal pain, fever, rashes, bleeding, irregular heartbeat, dizziness, fainting spells, or seizures. These symptoms may appear to be signs of such disorders as appendicitis*, dermatitis*, anemia*, a heart problem, or a brain tumor, even though the person never actually had the symptoms they complained of.

People with Munchausen syndrome often are knowledgeable about medicine and hospitals. They may pretend to have a disease by complaining of a symptom, such as pain, that they do not have. Sometimes they exaggerate or imitate a disorder, such as seizures, that they really do have. Some people may actually injure themselves to create a symptom. For example, they may make themselves bleed to produce anemia. They may also describe an elaborate but false medical history to their physicians and demand medical tests and treatment with drugs or even operations. If the faking of people with Munchausen syndrome is discovered and they are denied treatment, they may start all over again, attempting to fool another doctor at another hospital. In some cases, this process may be repeated throughout a person's life.

What Causes Munchausen Syndrome?

The basic cause for the behavior of people with Munchausen syndrome is believed to be an intense need for care and sympathy. Why people with the disorder have this driving need differs for each person. Often, the disorder begins in early adulthood, after hospitalization for a real medical condition. Other influencing factors may include an important past relationship with a physician, medical employment, or even ill will harbored toward the medical profession.

Diagnosis and Treatment

The two main tasks for a physician diagnosing Munchausen syndrome are to determine that the patient does not really have the illness that the described symptoms suggest and that he or she is not malingering. Malingering occurs when a person pretends to have an illness because of some life situation, such as wanting to avoid military duty, work, or school.

Munchausen syndrome is treated with psychotherapy. The therapist attempts to help patients understand why they have an excessive need for sympathy, care, and attention. Therapists also help patients find more honest and less destructive ways to satisfy their emotional needs. In the meantime, attempts are made to protect the patient from having unnecessary operations or other medical procedures.

Munchausen Syndrome by Proxy

A variation of Munchausen syndrome, called Munchausen syndrome by proxy, occurs when a caregiver (often the mother) falsely claims that a child is ill. (“By proxy” means acting as a substitute for another.) The caregiver may either pretend that the child is ill or do something to cause a symptom or illness. For example, the caregiver may give the child too much of a laxative, causing diarrhea. Sometimes, causing illness may seriously harm the child or even result in death.

It is believed that people with Munchausen syndrome by proxy seek to gain attention as devoted caregivers rather than for being sick patients, as in Munchausen syndrome. They often have troubled marriages or may have suffered some type of abuse as a child. Munchausen syndrome by proxy is considered a form of child abuse, and in most states suspicion of this disorder must be reported to a child protective agency.

▶ See also **Conversion Disorder • Factitious Disorder • Hypochondria • Malingering • Somatoform Disorders**

Resources

Books and Articles

Bools, Christopher. *Fabricated or Induced Illness in a Child by a Carer: A Reader*. Abingdon, Oxon, UK: Radcliffe, 2007.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

Feldman, Marc D. *Playing Sick? Untangling the Web of Munchausen Syndrome, Munchausen by Proxy, Malingering & Factitious Disorder*. New York: Brunner-Routledge, 2004.

Seligman, Linda, and Lourie W. Reichenberg. *Selecting Effective Treatments: A Comprehensive, Systematic Guide to Treating Mental Disorders*. San Francisco: Jossey-Bass, 2007.

Organizations

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905. Web site: <http://www.mayoclinic.com/health/munchausen-syndrome/DS00965>.

NHS Direct. Riverside House, 2a Southwark Bridge Road, London, UK, SE1 9HA. Web site: <http://www.nhsdirect.nhs.uk/articles/article.aspx?articleId=256>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/001555.htm>.

Muscular Dystrophy

Muscular dystrophy (DIS-tro-fee) is a group of inherited disorders in which there is a gradual deterioration and weakening of muscles in the body.

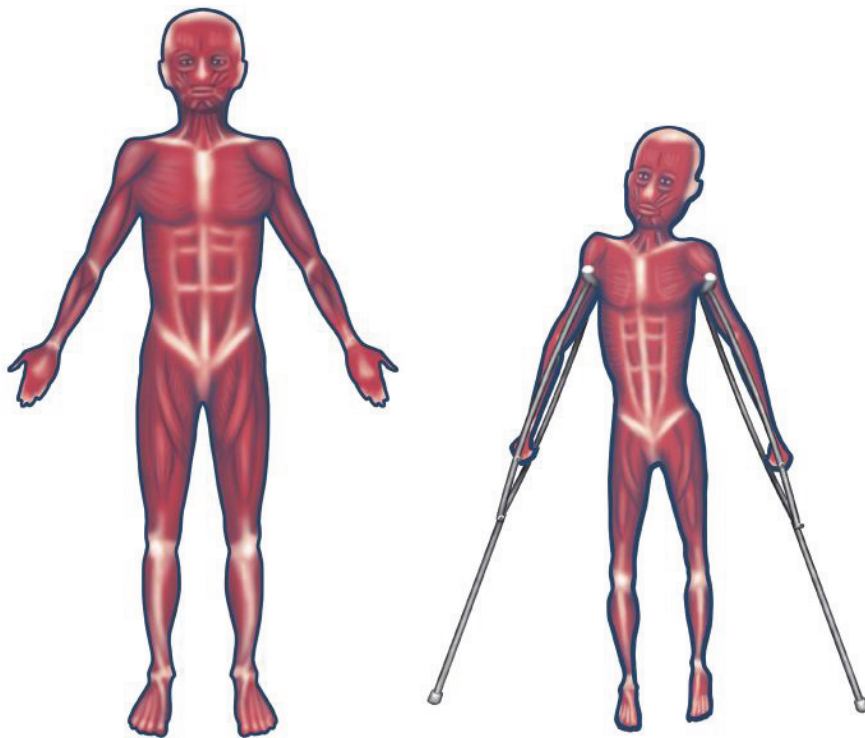
What Is Muscular Dystrophy?

The term “muscular dystrophy” actually refers to a group of disorders that affect different muscles in the body and that may range from mild to severe. Although all of the muscular dystrophies are known to be caused by genes*, the way in which the genes produce the disorder was as of 2009 only partly understood.

The muscles that become weakened in muscular dystrophy are mostly the voluntary muscles, those that people can control when they want to move different parts of their body. Another name for voluntary muscle is skeletal muscle. The weakness is usually symmetrical; that is, it occurs more or less equally on both sides of the body. Muscle deterioration is also progressive, or gradually increasing over time. There is no pain connected with the weakening condition, although there may be some cramps and stiffness. Mental retardation sometimes accompanies this condition.

Who Gets Muscular Dystrophy?

All types of muscular dystrophy are uncommon. Still, numbers of individuals affected range in the tens of thousands. Many people have come to know something about muscular dystrophy through the efforts of



Normal, healthy musculature

Muscular dystrophy

Healthy muscle tissue (left). Muscular dystrophy (right). *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



American comedian and actor Jerry Lewis, who appeared on television on behalf of the Muscular Dystrophy Association. Similar media appeals, such as the Téléthon in France, have raised public awareness about the disease in other countries.

The most common and severe form of the disorder, called Duchenne (du-SHEN) muscular dystrophy, affects only boys at a rate of about one in every 3,500 to 5,000 boys. (Although girls can carry the gene that causes this disease, they usually have no symptoms.) In the United States, it has been estimated that 40,000 boys and young men are afflicted with this form. In western Europe, an estimated 70,000 are affected. The incidence* is believed to be comparable throughout the world. Muscular dystrophy affects all races, ethnic groups, and social classes equally.

What Causes Muscular Dystrophy?

Whether individuals have a form of muscular dystrophy has already been determined through hereditary factors by the time they are born (even though its effects are not apparent at birth). Because it is an inherited disorder, the disease is not in any way contagious, and it is not caused by anything that might happen in everyday life.

The defective gene that causes Duchenne muscular dystrophy is located on the X chromosome*. The disorder is, therefore, said to be sex-linked. It also is recessive, which means that females who inherit the defective gene

* **incidence** means rate of occurrence.

* **chromosome** (KRO-mo-zom) is a unit or strand of DNA, the chemical substance that contains the genetic code to build and maintain a living being. Humans have 23 pairs of chromosomes, for a total of 46.

will not usually develop the disease (because they need to have the defective gene on both X chromosomes) but are carriers of it. They can pass it on to the next generation. Affected males always inherit the gene for Duchenne muscular dystrophy from their mothers, and each male born to a woman who is a carrier for the disease has a 50-50 chance of inheriting the gene.

Myotonic (mi-o-TON-ik) dystrophy, an adult form of the disorder, is inherited as an autosomal dominant gene. Autosomal means that the gene that causes the disorder is not located on a sex chromosome. Dominant means that just one defective gene in a pair is able to produce the disease. Males and females are equally affected by the faulty gene, and both can transmit the disease to their children.

Other types of muscular dystrophy follow various different patterns of inheritance, and they can affect both children and adults.

Muscles under a Microscope

The gene responsible for the Duchenne form of muscular dystrophy was discovered in 1986. That was an important breakthrough, but scientists still needed to know how the gene caused muscle weakness. The following year, a protein that was named dystrophin (DIS-tro-fin) was found to be absent in the muscles of Duchenne patients and present in normal tissue. Therefore, the defective Duchenne gene does not produce dystrophin, whereas the same gene in its normal form does produce this protein. To understand why dystrophin is important in muscle function, a powerful microscope is needed.

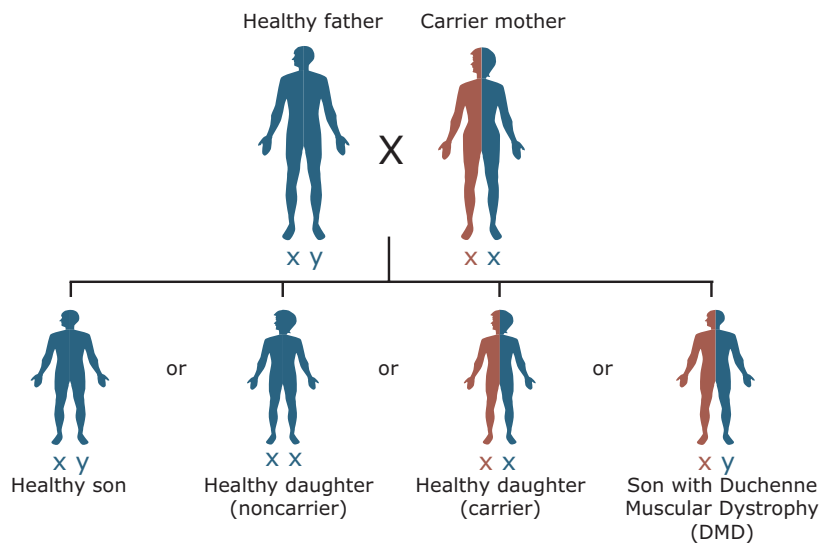
Seen under a microscope, muscles are made up of bundles of individual muscle fibers. Under greater magnification, each fiber is seen to have an outer membrane. Dystrophin is believed to be responsible for maintaining the structure of the muscle fiber membrane. Without it, the membrane tends to fall apart and become “leaky.” One of the substances that leaks out from inside the muscle fibers is creatine kinase (KREE-a-tin KI-naze), which is needed for the chemical reactions that produce energy for muscle contraction.

In other types of muscular dystrophy, the defect lies in an abnormality in another substance closely associated in function with dystrophin.

What Are the Symptoms of the Dystrophies?

There are several forms of muscular dystrophy. Some experts have listed as many as 20 types. Classification of types is based upon a person’s age at the start of the disease, the location of the muscles affected, the rate at which the disorder progresses, and the pattern of inheritance. The following are signs and symptoms of the more common and well-defined forms.

Duchenne muscular dystrophy The signs of Duchenne muscular dystrophy may not be noticed until ages three to seven, when the young boy is likely to start having difficulty walking. (Because of the way it is inherited, only boys usually have Duchenne muscular dystrophy.) Another characteristic sign is that the calf muscles, although becoming weaker, are enlarged partly because of accumulating deposits of fat in them.



Inheritance pattern of Duchenne muscular dystrophy (DMD). Sons have a 50-50 chance of inheriting the disorder from their mother if she carries the gene for it on one of her X chromosomes. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Muscle weakness steadily advances from the lower to the upper body, and the boy needs a wheelchair usually by the time he is 12. Complications such as scoliosis (side-to-side curving of the spine) and lung infections commonly occur in the teen years, and the person may not live past his late teens or early twenties.

Becker muscular dystrophy In this form, the signs and symptoms are the same as those of Duchenne muscular dystrophy, but they begin later in life and progress more slowly. The same gene that causes the Duchenne form is responsible, but its defects are less damaging to muscle. Most affected men must eventually use a wheelchair, but some do not, and many live past middle age.

Myotonic dystrophy Myotonic dystrophy usually develops in adulthood, but it may occur as early as infancy. Males and females are affected equally. The characteristic symptom is myotonia, a delayed relaxation of muscle after it has contracted. Weakness commonly occurs in the muscles of the hands, face, neck, forearms, and lower legs.

Unlike other dystrophies, myotonic dystrophy may involve parts of the body other than the voluntary muscles. For example, the heart rate may be abnormally slowed. Cataracts may develop in the eyes. As in other dystrophies, mental retardation sometimes accompanies the condition. Nonetheless, people with mild forms of myotonic dystrophy may have relatively normal lives and survive beyond middle age.

Facioscapulohumeral muscular dystrophy Facioscapulohumeral (fay-she-o-skap-yoo-lo-HU-me-ral) muscular dystrophy gets its long name from the fact that it weakens the muscles of the face, shoulders (the scapula is the shoulder blade), and upper arms (the humerus is the upper arm bone). Facial expression is altered, and the shoulders tend to droop. Both males and females are affected, and the progression of

WHAT'S IN A NAME?

The word “dystrophy” comes originally from the Greek “dys,” which means “difficult” or “faulty,” and “trophe,” meaning “nourishment.” This word was chosen many years ago because it was at first believed that poor nourishment of the muscles was in some way to blame for muscular dystrophy. People later understood that muscle wasting in the disorder is caused by defective genes rather than poor nutrition.

The “Duchenne” in Duchenne muscular dystrophy may have been an unsuitable name as well. The French neurologist Guillaume Benjamin Amand Duchenne (1806–1875) described the disorder in detail in 1868. However, later research showed that the English physician Edward Meryon (1809–1880) had independently described the condition several years before Duchenne.

symptoms is usually slow. Symptoms often begin to appear between the ages of 10 and 40.

Limb girdle muscular dystrophy Muscle weakness in this form occurs mostly around the hips and shoulders (limb girdles). Symptoms may eventually extend to other muscles. Often, however, worsening of the condition is slow. Both sexes are affected, and symptoms may begin in late childhood or early adult life.

How Is Muscular Dystrophy Diagnosed?

A doctor may suspect that someone has muscular dystrophy just by observing certain signs of muscle weakness. If someone in the patient’s immediate family is known to have the disorder, the diagnosis becomes clearer.

To confirm the diagnosis, a blood test may be performed to look for high levels of creatine kinase, mentioned previously as a sign of Duchenne muscular dystrophy. Blood samples may also be analyzed for defective genes and can help determine the specific type of the disorder. Other tests can measure muscle activity, and a muscle biopsy, in which a tiny sample of muscle tissue is removed to be examined under the microscope, can show specific abnormalities.

How Is Muscular Dystrophy Treated?

In the early 2000s there was no cure for muscular dystrophy. Sometimes treatment with steroids was able to slow progress of muscular weakness. Treatment was aimed at maintaining general good health and mobility for as long as possible. An important goal is preventing scoliosis and often fatal lung infection. Moderate exercise, physical therapy, the use of braces, and sometimes surgery can assist walking.

Genetic counselors, using medical tests and family history, can help prospective parents make informed decisions about having children. The disease can be diagnosed in a baby before it is born; this is called prenatal testing.

Meanwhile, medical scientists in the laboratory have been working on ways to attack the cause of muscular dystrophy directly, through a technique called gene therapy.

▶ See also **Genetic Diseases • Scoliosis**

Resources

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Organizations

Muscular Dystrophy Association—USA, National Headquarters.

3300 E. Sunrise Drive, Tucson, AZ, 85718. Toll free: 800-572-1717. Web site: <http://www.mda.org>.

Muscular Dystrophy Campaign.

61 Southwark Street, London, SE1 0HL, UK. Toll free: 0800 652 6352. Web site: <http://www.muscular-dystrophy.org>.

Muscular Dystrophy Canada.

2345 Yonge Street, Suite 900, Toronto, ON, M4P 2E5, Canada. Toll free: 866-MUSCLE-8. Web site: <http://www.muscle.ca>.

Mushroom Poisoning

Mushroom poisoning is a type of food poisoning caused by eating wild mushrooms that contain natural substances that are toxic (poisonous) to humans. Mushroom poisoning is considered an emergency needing immediate medical care.

What Is Mushroom Poisoning?

Mushroom poisonings occur for one of three reasons:

- A collector of wild mushrooms accidentally confuses a poisonous species with an edible species, which can happen even to experts if they are hunting mushrooms in an unfamiliar area.
- A person experimentally eats a mushroom found in the wild, which commonly occurs when a curious child finds a mushroom growing in a lawn or woods.

Three views of the Death Cap mushroom (*Amanita phalloides*) one of the most dangerous natural poisons.

*Custom Medical Stock Photo, Inc.
Reproduced by permission.*



- A person intentionally eats hallucinogenic mushrooms as part of a spiritual or recreational experience. This type of poisoning is not fatal.

Of the more than 5,000 species of mushrooms growing wild in the United States, only about 100 contain compounds that are poisonous to humans, and only about twelve species can cause death. The degree to which a mushroom causes illness depends on the type of mushroom eaten, the amount eaten, and the size of the person poisoned. Toddlers and young children, because of their small size and tendency to put objects in their mouths, are the group most likely to be poisoned, followed by amateur foragers of wild mushrooms. Some poisonous North American mushrooms look like edible European and Asian mushrooms. Consequently, immigrants from Europe and Asia are the most likely foragers to be poisoned in North America.

Each year the American Poison Control Centers report about 10,000 exposures to wild mushrooms. Most years these result in fewer than 10 deaths. In about 90 percent of poisonings, the species of mushroom is never identified. Members of the genus *Amanita* account for the majority of identified mushroom poisonings. Mushroom poisoning happens more frequently in Eastern Europe and Asia where wild mushroom hunting is much more common, with most poisonings occurring in the spring or fall.

What Are the Symptoms of Mushroom Poisoning?

Mushroom poisoning symptoms can range from mild to deadly. There are two general patterns of symptoms depending on whether the mushrooms contain long-acting or short-acting toxins.

FATAL MYTHS ABOUT POISONOUS MUSHROOMS

Many myths describe edible from poisonous mushrooms. These myths can be deadly. All of the following are folklore sayings that are **not true**.

- If you cook a poisonous mushroom, it will no longer be poisonous. **False:** heating, boiling, canning, drying, pickling, or any other processing does not destroy the toxins in most poisonous mushrooms.
- If you cook poisonous mushrooms with a silver spoon, the spoon will turn black. **False:** some toxins have no effect on silver.
- Poisonous mushrooms when boiled with rice turn the rice red. **False:** many poisonous mushrooms have no effect on the color of rice.
- Poisonous mushrooms smell and taste bad. **False:** some are quite delicious.
- If an insect eats a mushroom, it is safe for a human to eat. **False:** many toxins affect humans and insects differently.
- White mushrooms are safe, brightly colored mushrooms are poisonous. **False:** the deadly *Amanita phalloides* or death cap is white, whereas many colorful mushrooms are safe to eat.
- Puffballs are always safe to eat. **False:** Some are safe, and others are not, but more importantly, an immature *A. phalloides* can look like a puffball.

Mushrooms containing long-acting toxins are more likely to cause permanent organ damage or death. The best known and most deadly poisonous mushroom in the United States and Europe is *Amanita phalloides*, also called the Death Cap. Two other members of the genus, *Amanita*, *A. virosa* (the Destroying or Death Angel), and *A. verna* (the Fool's Mushroom), and *Galerina autumnalis* (*Autumn Skullcap*) are also quite deadly. These mushrooms all produce a family of toxins called amanitins, which act by inhibiting an enzyme that is necessary for cells to reproduce. This effect eventually causes cell death.

Other species that cause severe, sometimes fatal illness through long-acting toxins include *Gyromitra esculenta* and *G. gigas* (both called False Morel), *Verpa bohemica* (Early False Morel), and *Cortinarius orellanus* (Sorrel Webcap).

Symptoms of mushroom poisoning caused by long-acting toxins fall into the a three-stage pattern.

- Stage 1: No symptoms occur for anywhere from 6 to 24 hours (except for *C. orellanus* where symptoms are delayed for 3 to 14 days). This is followed by painful abdominal cramping, vomiting, and passing

National Poison Control Center

Any time someone is suspected of having eaten a poisonous or unidentified mushroom (or been exposed to any other potentially poisonous substance), assistance can be found at the National Poison Control Center. The center can be called tollfree from anywhere in the United States at (800) 222-1222. A list of local poison control centers also can be found at <http://www.aapcc.org/DNN>.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **schizophrenia** (skit-so-FREE-nee-ah) is a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors, which distort their view of reality.

of a huge volume of watery diarrhea. Fluid loss is great enough to cause severe, sometimes fatal, dehydration*, especially among children and the elderly. This stage usually lasts about 24 hours.

- Stage 2: Diarrhea stops or slows, and the patient appears to be improving. Nevertheless, laboratory blood tests show that liver and kidney damage is occurring. This stage lasts two to three days.
- Stage 3: Liver and kidney damage become obvious. Laboratory blood and urine tests become more abnormal. Jaundice* develops as the liver fails. The kidneys may shut down. Coma* followed by death can occur in three to seven days. Death rates of between 10 and 60 percent have been reported. If recovery occurs, it can take a month or more, and some liver and kidney damage is permanent.

Mushrooms that contain short-acting toxins follow a different pattern of symptoms. Typically vomiting begins anywhere from 15 minutes to 2 hours after the mushrooms are eaten. This is often accompanied by heavy sweating, confusion, chills, tremor, loss of coordination, and sometimes breathing abnormalities. Because the person usually vomits soon after eating, fewer toxins are absorbed into the bloodstream. Generally eating a mushroom containing a short-acting gastrointestinal irritant is extremely unpleasant, but results in fairly rapid recovery and no lasting harm.

Hallucinogenic mushrooms, many of which contain psilocybin, have been used for centuries as part of mystical or spiritual experiences or for recreational purposes. These mushrooms, sometimes called magic mushrooms or little brown mushrooms (after their rather ordinary appearance), do not cause fatal reactions. They do, however, cause visual and other hallucinations. Some people experience euphoria, but others experience fear, agitation, and schizophrenia*-like symptoms. Symptoms usually wear off after a few hours. Hallucinogenic mushrooms are usually ingested intentionally. However, if children accidentally eat them, frightening and schizophrenic-like symptoms may continue for up to 72 hours.

How Is Mushroom Poisoning Diagnosed and Treated?

Diagnosis of mushroom poisoning is made on the basis of the patient's history; any samples of the mushrooms or vomit containing mushrooms, if available; and symptoms. Diagnosis is difficult if two or more types of poisonous mushrooms have been eaten at the same time, especially if one contains a short-acting and the other a long-acting toxin.

Mushroom poisoning cases in which symptoms suggest a short-acting toxin are generally treated by inducing vomiting and stomach washing, followed by dosing with activated charcoal, a product that absorbs some toxins. Patients are usually kept under observation for 24 hours to make sure there are no complications.

Treatment of long-acting toxins is more complicated. During the vomiting and diarrhea stage, intravenous fluids and electrolytes are

WHAT TO DO IF MUSHROOM POISONING IS SUSPECTED

Anyone who has eaten an unknown wild mushroom or who becomes ill after eating a wild mushroom needs a prompt medical evaluation. If mushroom poisoning is suspected, the following steps ought to be taken:

- Call the National Poison Control Center Helpline, the local poison control center, or the local emergency room and follow the advice given.
- If any of the suspect mushrooms are available, put all of them in a paper bag (not plastic) or paper towel. Do not refrigerate them. Take them along with the patient to the emergency room.
- If the patient's vomit contains bits of mushroom, save it and take to the emergency room. Sometimes experts can identify the mushroom from spores in the vomit.
- If the wild mushrooms were collected intentionally, find out which mushrooms the foragers thought they had collected. Doing so helps the experts narrow the field to look-alike species.

given to prevent dehydration and help stabilize body chemistry. Large intravenous* doses of the antibiotic penicillin G are also given. In Europe, *Amanita* poisoning is treated with silibnin, a product of the milk thistle plant that appears to reduce liver damage by limiting binding of toxin to liver cells. Because of the small number of identified *Amanita* poisonings in the United States, not enough data are available to satisfy the safety and effectiveness requirements of this treatment for its approval by the Food and Drug Administration. Silibnin is, however, sold in the United States as a dietary supplement.

When substantial kidney damage occurs, kidney dialysis* (either temporary or permanent) may be required. Survival after major liver damage requires a liver transplant.

How Can Mushroom Poisoning Be Prevented?

Mushroom poisoning can be prevented by not harvesting and eating wild mushrooms. Commercially grown mushrooms are safe. If one chooses to eat wild mushrooms, they should come from a known, reliable source. Other ways of reducing the chance of mushroom poisoning are to supervise young children and to clear the lawn of any mushrooms as they appear.

It is important for people to remember that many mushrooms which are poisonous in North America look almost identical to safe-to-eat mushrooms found in Europe and Asia, so much so that even experts are fooled. People should collect wild mushrooms in an unfamiliar area only under the supervision of a local expert.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **dialysis** (dye-AL-uh-sis) is a process that removes waste, toxins (poisons), and extra fluid from the blood. Usually dialysis is done when a person's kidneys are unable to perform these functions normally



Exposure to *Mycobacterium marinum* can lead to a rare infection known as “swimming pool granuloma” or “aquarium granuloma.” About 3 weeks after the bacteria enters through a break in the skin, usually on the hands, reddish bumps appear. This infection can be prevented by avoiding contact with contaminated water and wearing gloves or washing thoroughly when cleaning aquariums. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **mycobacteria** (my-ko-bak-TEER-e-uh) belong to a family of bacteria called “fungus bacteria” because they are found in wet environments.

* **tuberculosis** (too-ber-kyoo-LO-sis) is a bacterial infection that primarily attacks the lungs but can spread to other parts of the body.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **opportunistic infections** are infections caused by infectious agents that usually do not produce disease in people with healthy immune systems but can cause widespread and severe illness in patients with weak or faulty immune systems.

▶ See also **Botulism • Food Poisoning**

Resources

Books and Articles

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Miller, Orson K., Jr., and Hope Miller. *North American Mushrooms: A Field Guide to Edible and Inedible Fungi*. Guilford, CT: Falcon Guide, 2006.

Organizations

American Association of Poison Control Centers. 515 King Street, Suite 510, Alexandria, VA, 22314. Toll free: 800-222-1222. Web site: <http://www.aapcc.org/DNN>.

Food and Drug Administration Center for Food Safety and Applied Nutrition. 5100 Paint Branch Parkway, HSF-555, College Park, MD, 20740-3835. Toll free: 888-SAFEFOOD. Web site: <http://www.cfsan.fda.gov/~mow/chap40.html>.

Mycobacterial Infections, Atypical

Atypical mycobacterial (my-ko-bak-TEER-e-ul) infections are infections caused by mycobacteria other than those that cause tuberculosis*.*

What Are Atypical Mycobacterial Infections?

Atypical mycobacteria are commonly found in the environment, such as in soil and water, and in food. Most of the time they do not cause infection or illness in healthy people. When a person’s immune system is weakened, however, as occurs in people who have HIV* or AIDS*, several strains of mycobacteria can cause opportunistic infections*. Atypical mycobacteria are related to the bacterium that causes tuberculosis (TB), but they often are resistant to the drugs used to treat TB. These strains are called “mycobacteria other than tuberculosis,” or MOTT. Sometimes, they also called “nontuberculous mycobacteria,” or NTM.

Although some mycobacteria can live on human skin or in the nose, atypical mycobacterial infections are not known to spread from person to person. Rather, infection comes from direct contact with the bacteria in the environment.

Are Atypical Mycobacterial Infections Common?

Mycobacterial infections other than tuberculosis are uncommon. Most frequently they affect people with HIV or AIDS. As cases of HIV and AIDS increased from the 1980s into the early 2000s, so did instances of mycobacterium infections, and in the United States, these infections were more common than tuberculosis. People with seriously weakened immune systems or chronic lung disease are at greatest risk.

How Do People Know They Have an Atypical Mycobacterial Infection?

Signs and symptoms of atypical mycobacterial infections include fever, swollen lymph nodes, extreme tiredness, night sweats, weight loss, diarrhea (dye-uh-REE-uh), joint and bone pain, cough, shortness of breath, skin lesions*, general discomfort, and paleness. Many of these symptoms can be signs of less serious conditions, but in a person with a weakened immune system a combination of such symptoms suggests a MOTT infection. In children, lymphadenitis* is the most common type of MOTT infection, whereas lung infections, which occur less often in children, are the most common in adults.

What Are Some Specific Infections?

Mycobacterium avium complex (MAC) MAC includes the species *Mycobacterium avium* (A-vee-um) and *Mycobacterium intracellulare* (in-truh-sel-yoo-LAR-e). MAC most commonly causes lymphadenitis and lung disease in otherwise healthy people. Patients who have AIDS are particularly susceptible to MAC, and the infection often spreads to the blood, lungs, spleen, liver, bone marrow*, and intestines in people with HIV. MAC infection in an HIV-positive person can signal the start of full-blown AIDS. Such a so-called disseminated disease* rarely occurs in people with healthy immune systems.

Mycobacterium marinum This infection causes skin lesions, sometimes known as swimming pool granuloma* or fish tank granuloma. Infection with *M. marinum* (MAR-ih-num) is very rare, occurring in less than 1 in 100,000 people. Most at risk are people with weakened immune systems and people who handle fish, are exposed to contaminated water in aquariums, or swim in fresh or salt water that contains the mycobacterium. Several weeks after a person has contact with contaminated water, a bump appears on a hand, arm, or foot where there was a break in the skin. The lesion grows and drains over several weeks, leaving an ulcer*. Occasionally, a deep infection will cause tenderness and swelling in the nearby bone or joints.

Mycobacterium ulcerans Infection with *Mycobacterium ulcerans* (UL-sir-ans) occurs in tropical and subtropical regions in Asia, the Western Pacific, and Latin America, but it is most common in West Africa. The infection causes skin lesions known as Buruli (boo-REH-lee) ulcers, named for a region in Uganda in Africa. The ulcers develop mainly on the limbs, grow

* **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.

* **lymphadenitis** (lim-fah-den-EYE-tis) is inflammation of the lymph nodes and channels of the lymphatic system.

* **bone marrow** is the soft tissue inside bones where blood cells are made.

* **disseminated disease** describes a disease that has spread widely in the body.

* **granuloma** (gran-yoo-LO-muh) is chronically inflamed and swollen tissue that often develops as the result of an infection.

* **ulcer** is an open sore on the skin or the lining of a hollow body organ, such as the stomach or intestine. It may or may not be painful.

Lady Windermere Syndrome

Lady Windermere Syndrome is a particular kind of atypical mycobacterial condition that causes chronic cough, fatigue, weight loss, and other less specific symptoms. It particularly affects older women who do not have an immune disorder or other lung disease. The syndrome is named for a character in Oscar Wilde's 1892 play *Lady Windermere's Fan*. In the play, Lady Windermere is a very fussy young woman who maintains her composure to the point of refusing to cough in public.

When the syndrome was named in 1992, it was proposed that this suppression of coughing may lead to an inflammation in part of the lungs, and this in turn makes the lungs more prone to a mycobacterial infection.

* **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **sputum** (SPYOO-tum) is a substance that contains mucus and other matter coughed out from the lungs, bronchi, and trachea.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many X-rays of the body to create a three-dimensional picture.

* **endoscopy** (en-DOS-ko-pee) is a type of diagnostic test in which a lighted tube-like instrument is inserted into a part of the body.

slowly, and release a toxin (or poison) that damages the skin and underlying tissue. The infection is relatively painless, but if left untreated it can destroy massive amounts of skin and bone, leading to permanent deformities.

Mycobacterium kansasii Infection with *Mycobacterium kansasii* (kan-ZAS-e-eye) causes a lung disease similar to tuberculosis, although not as severe. Patients may experience fever and cough, and a doctor often hears wheezing and “crackling” when listening to the patient’s lungs. This infection can also involve the lymph nodes and cause skin lesions. In people with weak immune systems, the infection can erupt into widespread disease. This infection is rare in the United States, but people with chronic lung disease are especially susceptible. If left untreated, the disease frequently worsens and can be fatal.

How Do Doctors Diagnose and Treat Atypical Mycobacterial Infections?

A doctor can perform several tests to detect mycobacteria, including examination and culture* of samples of blood, sputum*, bowel movement, or bone marrow. Chest x-rays or computerized tomography* (CT) scans can show disease in the lungs. Some cases may require endoscopy* to collect a sample of lung or stomach tissue or biopsies* of skin or lymph node tissue. A quick diagnosis of mycobacterial infections is crucial, as treatment must begin as soon as possible.

A doctor may also order a PPD (purified protein derivative) skin test for tuberculosis. Because atypical mycobacteria are so similar to the bacterium that causes TB, this test will often be positive in patients with an atypical mycobacterial infection, although not as strongly positive as it would in patients with tuberculosis.

Treatment for mycobacterial infections depends on the type of bacterium, the location and severity of the infection, and on the status of the person’s immune system. Resistant and severe infections usually require treatment with a combination of antibiotics, and doctors may prescribe up to six medications to use at once. Surgery, sometimes along with medications, is the most effective way to treat lymph node infections and skin lesions.

Treatment for MOTT infections can take six months to two years. Antibiotics work during the growth stage of bacteria, and mycobacteria are slow-growing. If left untreated, MOTT infections can spread throughout the body, especially in people with weak immune systems. They can cause abscesses*, bone and joint infections, and infections of the lymph nodes, lungs, or soft tissue. Widespread infections can lead to serious illness and even death.

Can People Prevent Atypical Mycobacterial Infections?

Because mycobacteria are common in the environment, these infections are difficult to prevent, especially in people with weakened immune systems. Doctors may prescribe preventive medications for people who

are at risk, such as those with HIV or AIDS. Getting enough sleep and eating a healthy diet can also help these patients cope with and fight these infections.

▶ See also **AIDS and HIV Infection • Tuberculosis**

Resources

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/000640.htm>.

Mycoplasma Infections

Mycoplasma (my-ko-PLAZ-muh) infections are caused by a type of very small bacteria. These infections usually involve the lungs or the urinary and genital tracts.

What Are Mycoplasma Infections?

Scientists have identified at least 16 species of these tiny bacteria; three have been linked to disease in humans, and researchers have explored possible relationships between other species and a variety of diseases.

Mycoplasma pneumoniae (my-ko-PLAZ-muh nu-MO-nye) is the cause of atypical or “walking” pneumonia (nu-MO-nyah, inflammation in the lungs), a form of pneumonia that is characterized by symptoms similar to those of the flu and is generally less serious than other types of pneumonia. Widespread outbreaks of mycoplasma pneumonia occur every four to eight years. Most people recover without lasting effects, but elderly patients and people with weak immune systems may experience complications from the infection.

Commonly found in the genital and urinary tracts of adults, *Mycoplasma hominis* (HAH-mih-nis) and *Ureaplasma urealyticum* (yoo-REE-uh-plaz-muh yoo-ree-uh-LIH-tih-kum) are known as the genital mycoplasmas. These organisms can cause urethritis* and contribute to vaginitis* in women. They have been associated with sexually transmitted diseases (STDs) and with chronic infections in people with weakened immune systems. Up to 50 percent of sexually active women are colonized* with *U. urealyticum*, which can spread to newborn babies

* **biopsies** (BI-op-seez) are tests in which small samples of skin or other body tissue are removed and examined for signs of disease.

* **abscesses** (AB-seh-sez) are localized or walled off accumulations of pus caused by infection that can occur anywhere within the body.

* **urethritis** (yoo-ree-THRY-tis) is inflammation of the urethra (yoo-REE-thra), which is the tube through which urine passes from the bladder out of the body.

* **vaginitis** (vah-jih-NYE-tis) is inflammation of the vagina (vah-JY-nah), which is the canal in a woman that leads from the uterus to the outside of the body.

* **colonized** means that a group of organisms, particularly bacteria, are living on or inside the body without causing symptoms of infection.

- * **sickle-cell disease** is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.
- * **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **cultures** (KUL-churz) are tests in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

during delivery. In premature infants, *U. urealyticum* may contribute to pneumonia and other infections, as well as to chronic lung disease.

Because these organisms are also found in healthy people and infants, their presence in someone who is sick does not necessarily mean mycoplasma is the culprit behind that particular infection. Although mycoplasma species such as *U. urealyticum* or *M. hominis* may be responsible for some infections, in many cases it appears that they help start or worsen an illness that is actually caused by another infectious organism.

Mycoplasma Pneumonia

The Centers for Disease Control and Prevention estimates that 2 million people contract mycoplasma pneumonia in the United States each year. Of these, 100,000 require hospitalization. Fatal cases are rare and usually occur in the elderly and in people with sickle-cell disease*.

Mycoplasma pneumonia most frequently affects people between the ages of 5 and 40; it is rarely seen in children under the age of 5. Outbreaks are common in groups of young adults, often in places where people are crowded together, such as in military facilities and college dormitories.

Mycoplasma is contagious, spreading through tiny drops of moisture from the nose and throats of infected people when they cough, sneeze, laugh, or talk. Sharing drinking glasses or eating utensils can spread the bacteria as well. Engaging in sexual activity without the use of a condom invites infection from sexually transmitted bacteria. In all cases, to become infected, someone must have close contact with the sick person.

The time between exposure and the appearance of symptoms is relatively long (1–4 weeks), so the disease can spread for months within a home without family members realizing they are passing along the same infection. After a bout of *Mycoplasma pneumoniae* infection, antibodies* will protect a person from re-infection, but this immunity* does not last for life.

Signs and symptoms Symptoms of mycoplasma pneumonia infection come on gradually. Many people have symptoms similar to those of the flu, such as sore throat, headache, weakness, fever, cough, and chills. Less common symptoms include earaches, eye pain, muscle aches, joint stiffness, skin rash, swollen lymph nodes* in the neck, and difficulty breathing. Some people have only a mild illness, whereas others develop the more full-blown classic walking pneumonia.

Diagnosis The physical exam is an important part of diagnosing mycoplasma pneumonia. A school-age child with fever, a cough, and wheezing or crackling sounds in the lungs may have mycoplasma. A chest x-ray helps confirm the diagnosis. Doctors do not usually order cultures* on samples of fluid from the nose or throat because the mycoplasma bacteria do not grow easily in cultures.

Although blood tests are not helpful in making a diagnosis early on, after about a week of illness, a blood test known as cold agglutinins (uh-GLOO-tuh-nins) is positive in half to three-fourths of all patients.

This test is not specific for *M. pneumoniae* (other infections can also give a positive test result), but information from it can help support a diagnosis of suspected walking pneumonia. Tests for specific antibodies produced by the body to mycoplasma require at least two blood samples over time to show the body's response to the infection.

Treatment Antibiotics, along with rest and fluids, help most patients recover. Some people get better without medicine, especially those who have only a mild illness. In severe cases, patients may need to be hospitalized so they can receive oxygen and other breathing support.

Symptoms usually last from one to four weeks, although the dry cough and extreme tiredness may linger for several more weeks.

Complications Few people die from mycoplasma pneumonia, but the elderly are most at risk. Complications are not common but can include acute respiratory distress (extreme difficulty in breathing) and respiratory failure.

Other complications are even rarer: pericarditis (per-ih-kar-DYE-tis, inflammation of the sac around the heart); anemia (uh-NEE-me-uh, a deficiency of red blood cells); and diseases of the central nervous system*, including Guillain-Barré syndrome (GEE-yah bah-RAY SIN-drome, a temporary inflammation of the nerves that causes muscle weakness and paralysis*), encephalitis (en-seh-fuh-LYE-tis, inflammation of the brain), and meningitis (meh-nin-JY-tis, inflammation of the membranes lining the brain and spinal cord).

Prevention The best defenses against mycoplasma pneumonia are frequent, thorough hand washing and not sharing food, drinks, or eating utensils.

Genital Mycoplasma Infection

Mycoplasma hominis infects up to 30 to 50 percent of sexually active men and women. *Ureaplasma urealyticum* may infect more than half of sexually active women and 5 to 20 percent of sexually active men. The habitual use of condoms during sexual activity helps prevent infection from these bacteria.

Twenty percent of newborns are colonized with these bacteria, but colonization rates drop significantly by three months of age. Premature infants have the greatest risk of colonization; up to half of all premature infants less than 34 weeks' gestational* whose mothers are colonized may pick up the bacteria during birth. Genital mycoplasmas spread through direct contact during all forms of sexual intercourse. Mothers also can pass the bacteria to their babies during pregnancy and delivery.

Signs and symptoms Most people with genital mycoplasma infection have no symptoms. Those who do may have a discharge (flow of fluid) from the urethra and pain or difficulty urinating. In rare cases, symptoms can include respiratory problems and joint pain, usually in people with weak immune systems.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **gestational** (jes-TAY-shun-al) means relating to pregnancy.

- * **pelvic inflammatory disease** refers to an infection of a woman's internal reproductive organs, including the fallopian tubes, uterus, cervix, and ovaries.
- * **stillbirth** is the birth of a dead fetus.
- * **premature birth** (pre-ma-CHUR) means born too early. In humans, it means being born after a pregnancy term lasting less than 37 weeks.
- * **infertility** (in-fer-TIH-lih-tee) is the inability of females to become pregnant or of males to cause pregnancy

Occasionally, women develop urethritis from mycoplasma infection, and although genital mycoplasma does not cause vaginitis, it may contribute to infections caused by other vaginal organisms, resulting in vaginal discharge. Pelvic (lower belly) pain may be a symptom of pelvic inflammatory disease* brought on by mycoplasma, alone or with other STDs. In pregnant women, *U. urealyticum* can cause inflammation of the membranes and fluid surrounding the unborn baby called asymptomatic chorioamnionitis (a-simp-toh-MAH-tik kor-e-o-am-nee-ahn-EYE-tis), which has been linked to a greater risk of stillbirth* and premature birth*.

The symptoms of infection in newborns can be subtle. Fever, changes in blood pressure and heart rate, and difficulty breathing may be the first signs of a problem.

Diagnosis Samples are taken from the areas of suspected infection (such as a swab of discharge from the vagina), and the organism is grown with special culture techniques.

Treatment Antibiotics are prescribed to treat genital mycoplasma infections in people who have symptoms. In cases in which mycoplasma is found along with other disease-causing organisms, these other infections must be treated as well.

Genital mycoplasma infections generally respond to treatment within one to two weeks, although these infections commonly return.

Complications Complications are rare in healthy adults but may include inflammation of other parts of the genital tract. Some adults, especially those with weakened immune systems, may have bone and joint infections, skin infections, and lung disease. The bacteria also have been linked to infertility* in women. Infected newborns, especially premature babies, may develop pneumonia or chronic lung disease and are at risk for meningitis and for spread of the disease throughout their bodies.

Prevention Because many people carry genital mycoplasma bacteria but do not know they are infected, preventing their spread is difficult. Regular use of condoms helps prevent the spread of many genital infections, including this one. However, abstaining from all forms of sex (not having sex) is the only sure way to prevent infection.

▶ See also **Pneumonia • Sexually Transmitted Diseases (STDs) • Urinary Tract Infections**

Resources

Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

Myocardial Infarction *See Heart Disease.*

Myocarditis and Pericarditis

Myocarditis (my-ob-kar-DYE-tis) is inflammation of the heart muscle, and pericarditis (per-ih-kar-DYE-tis) is inflammation of the smooth sac surrounding the heart.

What Are Myocarditis and Pericarditis?

Myocarditis, or inflammation of the muscular walls of the heart, is most commonly caused by viruses; however, it can also be caused by bacteria, parasites, and fungi. Other causes of the condition include radiation, chemicals, cocaine use, and prescription medications. Conditions that affect several parts of the body, such as autoimmune disease*, also can be associated with both myocarditis and pericarditis.

When the pericardium (per-ih-KAR-dee-um), the smooth, double-layered sac-like covering that surrounds the heart, becomes inflamed—known as pericarditis—fluid usually accumulates in the space between its layers. As the amount of fluid increases, the buildup puts pressure on the beating heart and can limit its ability to function. Many of the same infections that cause myocarditis can cause pericarditis as well, and the two can appear together. In addition to the infectious causes of pericarditis, heart surgery or a heart attack* can lead to an inflamed pericardium and accumulation of fluid around the heart.

How Common Are Myocarditis and Pericarditis?

Myocarditis and pericarditis are uncommon complications of many infectious diseases. Many cases of myocarditis are mild and go undetected when the person is sick. In fact, it is difficult to determine exactly how many people develop myocarditis or pericarditis. However, some evidence of myocarditis is found in 1 to 4 percent of autopsies*. In almost all of these cases, there were no symptoms of the disease while the person was alive.

Are Myocarditis and Pericarditis Contagious?

Neither myocarditis nor pericarditis is directly contagious. However, many of the organisms that cause infections that can lead to myocarditis or pericarditis are spread from person to person by coughing or sneezing. It is not clear why myocarditis or pericarditis develops in some people but not in others. A combination of the infection, a person's genes*, and an individual's immune response probably determines who will develop these conditions.

* **autoimmune disease** (aw-toh-ih-MYOON) is a disease in which the body's immune system attacks some of the body's own normal tissues and cells.

* **heart attack** is a general term that usually refers to a sudden, intense episode of heart injury. It is usually caused by a blockage of a coronary artery, which stops blood from supplying the heart muscle with oxygen.

* **autopsies** (AW-top-seez) are examinations of bodies after death to look for causes of death or the effects of diseases.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

- * **congestive heart failure** (kon-JES-tiv) or heart failure, is a condition in which a damaged or overworked heart cannot pump enough blood to meet the oxygen and nutrient needs of the body. People with heart failure may find it hard to exercise due to the insufficient blood flow, but many people live a long time with this condition.
- * **electrocardiogram** (e-lek-tro-KAR-dee-o-gram), also known as an EKG, is a test that records and displays the electrical activity of the heart.
- * **echocardiogram** (eh-ko-KAR-dee-uh-gram) is a diagnostic test that uses sound waves to produce images of the heart's chambers and valves and blood flow through the heart.
- * **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- * **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.
- * **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

What Are the Signs and Symptoms of Myocarditis and Pericarditis?

Because both conditions can seriously affect the heart's function, they may lead to signs and symptoms of heart failure. Patients with myocarditis may experience fever, rapid heartbeat, extreme tiredness, difficulty breathing, and chest pain—often described as “sharp” or “stabbing”—that can range from mild to severe, sometimes with heart attack-like intensity. In serious cases, congestive heart failure*, fainting, and, sometimes, sudden death can occur.

Pericarditis often is accompanied by chest pains that radiate from front to back, trouble breathing, and pain when taking a deep breath. These conditions usually improve when the patient is sitting and leaning forward or standing. They usually worsen if the patient is lying flat. Other symptoms may include dry cough, extreme tiredness, fever, rapid heartbeat, and chills.

How Are Myocarditis and Pericarditis Diagnosed?

A doctor suspects myocarditis based on symptoms and a physical exam. For instance, a rapid heartbeat, fluid in the lungs, and swollen ankles and feet may point to heart failure, which can occur with myocarditis. The history of the patient's illness is another important clue, as the patient often has had symptoms of a viral infection within the previous two weeks to six months.

To assess the heart's condition, the doctor may order any of a variety of tests. Although a chest x-ray often appears normal in the early stages of the illness, it may show an enlarged heart or fluid-filled lungs. An electrocardiogram* (EKG) may show evidence of heart inflammation and can help identify a heart attack as the possible cause of the symptoms. An echocardiogram* may show the decreased heart function seen in myocarditis. Blood tests that reveal inflammation of the heart muscle are often abnormal in people with myocarditis and can help in making the diagnosis. A biopsy* of a piece of heart muscle can provide a definitive diagnosis. Other tests may be done to identify a specific virus or other infectious organism, but in many cases the exact cause of the inflammation is never found.

To diagnose pericarditis, doctors look for signs of fluid around the heart. During a physical exam, physicians also listen for a rubbing sound that can be heard when the pericardial sac is inflamed. If enough fluid is present, the heart may appear enlarged on a chest x-ray. The fluid itself can be seen on an echocardiogram, a computerized tomography* (CT) scan, or a magnetic resonance imaging* (MRI) scan. An EKG can be helpful in making the diagnosis as well.

How Are Myocarditis and Pericarditis Treated?

Myocarditis and pericarditis may be difficult or impossible to prevent, but prompt recognition and treatment of these conditions will improve the chances of recovery. With both myocarditis and pericarditis, doctors strive to identify and treat the underlying cause, reduce the inflammation,

and improve the heart's function. These are serious conditions that usually require hospitalization once the patient has developed detectable symptoms.

Anti-inflammatory medicines such as aspirin, nonsteroidal anti-inflammatory medications, or corticosteroids* may be prescribed to reduce inflammation. Patients also may receive medicine to ease pain and diuretics* to remove excess fluid from the body. Depending on the cause and the complications of the inflammation, other treatments may be necessary as well, including antibiotics and medications that control heart rhythm problems and improve heart function.

Some cases of pericarditis may require pericardiocentesis (per-ih-KAR-dee-o-sen-tee-sis), or the removal of fluid from the pericardial sac with a needle. This procedure relieves pressure on the heart and collects fluid for tests. In chronic or recurrent cases, the doctor may recommend surgery to cut or remove part of the pericardium. During recovery, the patient's activity usually is restricted, and doctors typically recommend diet changes such as eating less salt. Cases of myocarditis and pericarditis may last from two weeks to three months, although some people never fully recover their prior heart function.

What Are Some Complications of Myocarditis and Pericarditis?

Complications of these conditions can be very serious. The heart muscle may become damaged and unable to pump effectively. Heart failure, irregular heartbeat, and death may occur. In some cases, if the heart muscle has been severely and permanently damaged, a heart transplant may be considered.

▶ See also **Endocarditis, Infectious • Heart Disease**

Resources

Organization

American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org>.

Myopia See *Nearsightedness*.

* **corticosteroids** (kor-tih-ko-STIROYds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.

* **diuretics** (dye-yoor-EH-tiks) are medications that increase the body's output of urine.

N

Narcolepsy

Narcolepsy (NAR-CO-lep-sy) is a serious, chronic sleep disorder characterized by excessive daytime sleepiness (EDS), fatigue, and sudden sleep attacks, due to the inability of the brain to regulate sleep-wake cycles normally.

What Is Narcolepsy?

The term “narcolepsy” was introduced by the French physician Jean-Baptiste-Édouard Gélinau (1859–1928) in 1876 and literally means a sleep attack (“narco” means “stupor”) and (“lepsy” means “attack”), and the condition is the result of a defect in the ability of the brain to regulate sleep-wake cycles.

How Common Is Narcolepsy?

Narcolepsy is the second most common sleep disorder, affects nearly 1 in 1,000 to 2,000 men and women or about 3 million people worldwide. Symptoms usually start in childhood and adolescence but are often not recognized until between age 35 and 45. Narcoleptic symptoms are often attributed to other conditions such as depression*, epilepsy*, or even laziness.

What Are the Effects of Narcolepsy?

Normally, there are four to six sleep cycles during eight hours of sleep. While falling asleep, brain waves slow down and enter into non-rapid eye movement (NREM) sleep. The purpose of NREM is restorative and refreshing sleep, and it lasts for up to 90 to 120 minutes. This period is followed by rapid eye movement (REM) sleep. REM sleep is characterized by complete paralysis* of all muscles except those of the eye, which leads to rapid eye movements and hence the name. Dreaming occurs most often during this stage, but due to muscle paralysis, dreams cannot be acted out. In narcolepsy, the NREM phase is abbreviated or absent with a quick onset of REM phase, which results in nighttime and daytime sleep attacks with accompanying muscle paralysis and vivid dreaming.

What Are the Symptoms and Signs of Narcolepsy?

There are four classic features of narcolepsy and only about one-third of patients have all symptoms.



▲ People with narcolepsy may fall asleep at any time even while driving. ©by Leitha Etheridge-Sims.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **epilepsy** (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **genetic predisposition** is a tendency to get a certain disease that is inherited from a person's parents.

* **antigen** (AN-tih-jen) is a substance that is recognized as a threat by the body's immune system, which triggers the formation of specific antibodies against the substance.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

Excessive daytime sleepiness Narcoleptics have uncontrollable drowsiness during the day, which is the result of the brain trying to compensate for the lack of NREM sleep at night. It is seen in all patients and is often the first symptom to emerge and the most persistent. Onset of sleep can be unpredictable and physically irresistible. Each sleep period can last a few minutes or up to 30 minutes. In contrast to a person with sleep apnea, the narcoleptic wakes up feeling refreshed and alert. However, this alertness is often followed by another sleep attack at varying intervals. Such sleep behavior is quite disruptive to a person's daily life and can be quite dangerous if it happens during certain situations, such as while driving a car. In addition, narcoleptics can have "microsleep episodes," which last a few seconds and can be accompanied by "automatic behavior" where they continue to talk or act like they are awake but have no recollection of what transpires during these episodes.

Cataplexy The word "cataplexy" is Greek ("Kata" means "down") and ("plexy" means seizure*). It refers to a sudden loss of voluntary muscle control, often triggered by a strong feeling such as what one feels while laughing or when angry. About 70 percent of narcoleptics have experienced at least one episode of cataplexy. The severity of cataplexy can range from mild (slurred speech) to severe (knees buckling and falling down). The episode lasts a few seconds to a few minutes and the person is always conscious. The number of attacks varies from one per day to a few per year.

Sleep paralysis Sleep paralysis are brief (1–2 minute) episodes of inability to talk or move while awakening from sleep or while falling asleep. They are quite frightening, as the person can remember the episode but has no control over it and cannot prevent it. They are often associated with hypnagogic hallucinations. These attacks, however, do not cause any permanent damage, and people recover quickly.

Hallucinations Hallucinations are vivid and often frightening dream-like experiences that occur while falling into REM sleep (*hypnagogic*) or on awakening (*hypnapompic*). They occur due to the intrusion of REM associated dreaming into a wakeful state, resulting in fragmented and restless nighttime sleep with patients acting out their dreams sometimes.

Is Narcolepsy Hereditary?

Narcolepsy occurs sporadically and has some genetic predisposition*. About 50 to 90 percent of patients with narcolepsy and cataplexy have an antigen* on the surface of white blood cells, which is a marker for the disease, but is not the cause of it. For example, 20 percent of normal individuals also have this particular antigen. This specific antigen type is thought to predispose an individual to develop narcolepsy through a hitherto unknown immune system* disturbance. Some 8 to 12 percent of narcoleptics have a close family member with narcolepsy. Relatives of a narcoleptic have a 1 to 2 percent chance of having narcolepsy and a 4 percent chance of having excessive daytime sleepiness (EDS).

What Causes Narcolepsy?

The exact cause of narcolepsy was unknown as of 2009. It is thought that some sort of trigger (such as an infection) might activate the immune system of the individual to attack and destroy specific cells in a part of the brain called the hypothalamus* that normally secrete a chemical called hypocretin, leading to its reduction or complete absence. Hypocretin helps to stabilize wakefulness by stimulating certain alertness centers in the brain and prevents inappropriate transition to REM sleep. It also inhibits REM sleep and REM associated behavior, such as sleep paralysis and dreaming. The total lack or decrease of hypocretin results in the symptoms of narcolepsy. Rarely, patients may have a defect in a receptor leading to normal but ineffective levels of hypocretin. Narcolepsy can also be a manifestation of rare genetic* disorders such as Prader-Willi or Niemann-Pick.

How Is Narcolepsy Diagnosed?

The diagnosis of narcolepsy is usually made by a sleep specialist or in a sleep clinic. A detailed history is taken, including when the symptoms began, what exact symptoms are present and estimation of degree of sleepiness. The Epworth sleepiness scale rates the degree of sleepiness on a numbered scale from 0 (no chance of dozing) to 3 (high chance of dozing) depending on how likely a person is to doze off under eight circumstances, for example, in front of the television, in a public place, or in a car. The total of the responses is the patient's score. A score of 0 to 9 is normal, 10 or above indicates non-normal sleepiness. The sleep specialist may also ask the patient to keep a sleep diary to keep track of episodes of sleepiness and alertness. In addition, a small device called an actigraph 2 may be worn around the wrist like a watch, and it measures how and when a person sleeps.

Polysomnogram Polysomnogram consists of monitoring brain waves (electroencephalogram (EEG)*), muscle activity, breathing, and heart rhythm (electrocardiogram) by electrodes and monitors attached to the scalp, face, eyes, jaw, limbs, chest, and abdomen. The patient sleeps overnight in a monitored environment, such as a sleep clinic. Based on the pattern of NREM, REM and REM-associated behaviors, the diagnosis of narcolepsy is made, and other diagnoses such as sleep apnea are excluded. Narcoleptics fall asleep quickly, go into REM sleep rapidly, exhibit REM behaviors such as cataplexy and have frequent nighttime awakenings.

Multiple sleep latency test The multiple sleep latency test consists of four or five scheduled naps during the day, with naps spaced two hours apart. Based on the time it takes an individual to fall asleep, narcolepsy can be diagnosed. A normal person takes 15 to 20 minutes to fall asleep and gradually progresses through NREM to REM sleep, whereas a narcoleptic falls asleep within five minutes and enters rapidly into REM sleep.

* **hypothalamus** (hy-po-THAL-uh-mus) is a brain structure located deep within the brain that regulates automatic body functions such as heart rate, blood pressure, temperature, respiration, and the release of hormones.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **electroencephalogram** an instrument that records the electrical activity of the brain.

- * **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.
- * **antidepressant medications** are used for the treatment and prevention of depression.
- * **amphetamines** (am-FET-a-meenz) are stimulants, drugs that produce a temporary feeling of alertness, energy, and euphoria.
- * **palpitation** is the sensation of a rapid or irregular heartbeat.
- * **addiction** (a-DIK-shun) is a strong physical or psychological dependence on a physical substance.
- * **impotence** (IM-po-tens) is failure of a man to achieve or to maintain an erection.
- * **stem cell** an unspecialized cell that gives rise to differentiated cells.

Hypocretin and genetic analyses Levels of hypocretin can be measured in the cerebrospinal fluid*. A narcoleptic has low or absent hypocretin levels. Testing for the particular antigen can be done, but as discussed above it is not specific and does not prove that a person has narcolepsy. These research tests are available only at specialized centers.

How Is Narcolepsy Treated?

Narcolepsy is a chronic disorder like diabetes and cannot be cured. Treatment needs to be tailored to the most disturbing symptoms, may take several months to get to an appropriate regimen, and, even then, may result in only partial symptom relief.

Narcolepsy is often treated with medications, namely stimulants and antidepressant medications*.

Amphetamines Amphetamines* stimulate the brain and ensure alertness during the day. Side effects include palpitations*, nervousness, and feeling “high.” They also have abuse and addiction* potential.

Modafinil Modafinil is a non-amphetamine medication approved by the Food and Drug Administration (FDA) in 1999. It does not have addiction potential, but headache is the most common side effect.

Antidepressants Tricyclic antidepressants (Imipramine) and serotonin reuptake inhibitors (SSRIs) such as fluoxetine (Prozac) suppress REM sleep and REM sleep behavior. Side effects include impotence*, heart rhythm abnormalities, and high blood pressure.

Sodium oxybate Sodium oxybate (gamma hydroxy butyrate, Zyrem) is the only medication that controls cataplexy and EDS in patients with resistant narcolepsy. It was approved by FDA in 2002. It is an illegal drug in several countries and is popularly called the “date rape” drug. Side effects include breathing disturbances and bedwetting. Due to safety concerns and abuse potential, it is subject to FDA regulation.

Caution is to be exercised while taking any of the above medications as they can adversely interact with over-the-counter cough and cold remedies. As of 2009, experiments involving stem cell* transplantation and direct delivery of hypocretin into the brain were being conducted in animals, but this research was considered a long way away from human studies.

Lifestyle modifications and behavioral strategies Behavioral strategies include the following:

1. Regular sleep schedule
2. Taking short naps during the day
3. Avoiding alcohol, caffeine, and nicotine at night
4. Regular exercise four to five hours before sleeping
5. Sleeping in a comfortable environment

Narcoleptics should avoid engaging in activities that need long periods of alertness such as operating hazardous machinery or taking long drives. Narcoleptics can request reasonable workplace accommodations in accordance with the Americans with Disabilities Act. Children should work with their school personnel to facilitate modification of class schedules and to take medications. Finally, people around the patient should know about the condition, so they can be supportive and help with the emotional and physical aspects of the condition.

▶ See also **Sleep Apnea • Sleep Disorders**

Resources

Books and Articles

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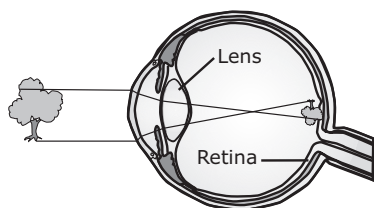
Organizations

Narcolepsy Network. 79 Main Street, North Kingston, RI, 02852. Toll free: 888-292-6522. Web site: <http://narcolepsynetwork.org>.

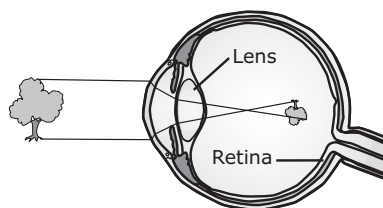
National Sleep Foundation. 1522 K Street NW, Suite 500, Washington, DC, 20005. Telephone: 202-347-3472. Web site: <http://sleepfoundation.org>.

Nearsightedness

Nearsightedness, which is also called myopia (my-O-pee-ah), is an eye condition that causes objects that are not close to a person to appear out of focus or blurry.



Normal vision: far object is focused on the retina



Nearsightedness: far object is focused in front of the retina



Anatomy of the eye showing normal and nearsighted focus. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Kate's Story

Kate noticed she was squinting when she needed to see the board from the back of her classroom. Squinting helped bring the words into focus. It seemed odd to her because she did not remember having to squint when she was younger. But now that she was in middle school, Kate was having trouble seeing things unless they were close.

Kate has a common eye condition known as nearsightedness. It affects more than 60 million people in the United States and often is not noticed until a child is between 8 and 12 years of age. Fortunately, nearsightedness is usually corrected easily with eyeglasses or contact lenses.

What Is Nearsightedness?

Nearsightedness means a person can see objects that are close but has trouble seeing distant objects clearly. The condition results when a person's eyeball is not shaped to focus properly when light passes through it. In most cases the eyeball is too long, but in some cases the front of the eye is curved abnormally.

The image passes through the front of the eyeball, as light does through the lens of a camera. As it does, the image is bent in order to focus it. The bending is known as refraction (re-FRAK-shun), and this process focuses the image on the retina at the rear inside of the eyeball. The retina functions little like the film in a camera. It receives the image. If a person's eyeball is not shaped properly, the light from the image is focused in front of the retina, which results in a blurred image for distant objects.

How Is Nearsightedness Diagnosed?

The first sign that a person is nearsighted usually occurs in childhood between the ages of 8 and 12. Often a teacher notices that a student is having trouble seeing the board. The teacher may notice the student squinting, which can help focus distant objects for nearsighted people. Sometimes the condition is discovered during a routine eye examination during childhood. Nearsightedness also is called myopia, which comes from a Greek word for "closed eyes," perhaps because squinting is common in nearsightedness.

What Are the Treatment Options for Nearsightedness?

Eyeglasses Prescription (pre-SKRIP-shun) eyeglasses are the most common solution for nearsightedness. The glasses change how the light passing through the eye is focused. Contact lenses worn on the eyeball also can help nearsightedness.

As a child passes through the teenage years, nearsightedness often gets worse because as the body grows, the shape of the eyeball changes too. Thus, people with nearsightedness may need to change prescription eyeglasses or contact lenses as they get older. By the time people reach their twenties, however, nearsightedness usually stabilizes and does not get worse.

Surgery Some people with mild or moderate nearsightedness may benefit from refractive surgery. A surgeon makes small incisions in the surface of the eye, known as the cornea, to flatten it. Doing so allows the image to be focused on the retina. Another type of surgery involves a laser that changes the shape of the cornea to achieve the same result. Many people who have the surgery no longer need glasses at all.

▶ See also **Astigmatism • Farsightedness**

Resources

Books and Articles

Kitchen, Clyde K. *Fact and Fiction of Healthy Vision: Eye Care for Adults and Children*. Westport, CT: Praeger, 2007.

Organizations

American Optometric Association. 243 N. Lindbergh Boulevard, St. Louis, MO, 63141. Toll free: 800-365-2219. Web site: <http://www.aoa.org/myopia.xml>.

National Eye Institute. 2020 Vision Place, Bethesda, MD, 20892-3655. Telephone: 301-496-5248. Web site: <http://www.nei.nih.gov>.

Nephrotic Syndrome

Nephrotic (ne-FRAH-tik) syndrome, or nephrosis (ne-FROH-sis), is a disorder of the filtering mechanism of the kidneys that causes the body to lose protein from the blood, which is then sent into the urine. Loss of protein results in such physical problems as excess body fluid, loss of appetite, and general tiredness. The syndrome is characterized by proteinuria (an excess amount of protein in the urine), hypoalbuminemia (an abnormally low level of albumin in the blood), and hyperlipidemia (an excess of fats, especially cholesterol in the blood), and edema. The blood filtering mechanism of the kidneys (glomerular membrane) may be damaged by infection, immune processes, toxins, and other factors. Nephrotic syndrome is a serious condition, but it can be treated effectively with medication and diet. Most children with the condition recover.*

Children—more likely boys—are at an increased risk from nephrosis, especially from minimal change nephrotic syndrome, when they are in the range of ages from eighteen months to four years. In adults, the risk from the disease, especially with regards to membranoproliferative glomerulonephritis, is about equal between men and women.



▲ The armpit of a five-year-old African HIV-positive boy shows swollen lymph glands due to nephrotic syndrome, caused by Kaposi's sarcoma. Dr. M.A. Ansary/Photo Researchers, Inc.

* **edema** (e-DEE-ma) means swelling in the body's tissues caused by excess fluids.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

Sally's Story

During the summer when Sally was seven years old, she stopped eating much of anything at meals, laid around the house all day, and seemed too tired to do her chores or play with friends. At first Sally's mother thought her daughter was just being lazy, but when Sally's whole body began to look puffy, especially her eyes, ankles, and abdomen, her mother began to worry.

The doctor identified Sally's puffiness as edema and asked Sally about how often she had been going to the bathroom. When Sally said she was urinating only about twice per day, the doctor suspected a kidney problem. The doctor ran several tests. An analysis of Sally's urine showed that it contained high levels of protein; and a blood test showed low levels of protein and high levels of cholesterol. These results made the doctor suspect nephrosis.

The doctor performed several additional tests to eliminate other diseases, then he confirmed the diagnosis with a kidney biopsy*. Ultimately, he could not figure out why Sally had developed nephrosis. He explained to Sally and her parents that her condition could not be cured but that medications and a low-fat, low-salt diet would help relieve the symptoms.

What Is Nephrosis?

The kidneys are a pair of bean-shaped organs located in the human abdomen just above the waist. Their chief role is to filter wastes and excess water out of the blood. The filtering units in the kidney are tiny blood vessels (or capillaries) called glomeruli (glom-ER-you-li), which remove body waste from the body as urine. Nephrosis is a kidney disease caused by a defect in the glomeruli.

When the glomeruli are damaged, the filtering mechanism does not work properly. Instead of keeping proteins in the blood—while allowing excess water, fluids, salt, and wastes to pass through the filter into collecting tubules where they become urine—the glomeruli filters leak. This action allows proteins to move out of the bloodstream along with the water, wastes, and other substances, and to be excreted in the urine. Loss of large amounts of protein from the blood allows fluid to leak out of the bloodstream into the body's tissues. The retention of fluid gives the body, especially the face and legs, a puffy and bloated appearance.

What Are the Symptoms of Nephrosis?

The earliest symptom of nephrosis is the observation of foamy looking urine when released into the toilet. Excess proteins in the urine often produce such an effect. The most common symptom of nephrosis is edema in the body, which often shows up as puffiness around the eyes, especially after first waking up from sleep. Puffiness in the hands, feet, ankles, and legs are often noticed, along with a temporary pitting of the skin at some locations. Excess fluid is also found in the pleural cavity (which is the space in the chest that surrounds the lungs) and in the peritoneal cavity

(the space in the abdomen that contains the stomach, liver, and intestines). The individual also feels increasingly fatigued and weak, with an associated reduction in weight due to a lessened appetite. Muscles become smaller and weaker. Abdominal pain, trouble breathing, headaches, fever, and skin sores can also occur. When the body becomes weakened, the hair and nails become brittle, and bones break easily as the body continues to lose nutrients.

What Causes Nephrosis?

Children as well as adults can develop nephrosis. But causes for the glomeruli defect that often results in nephrosis was unknown as of 2009. One facet known about nephrosis, however, is that it can develop as part of other diseases, including the following:

- Hypertension (high blood pressure)
- Infection
- Diabetes, a condition in which the body cannot produce sufficient amounts of the hormone insulin to regulate the amount of sugar in the blood
- Systemic lupus erythematosus (sis-TEM-ik LOO-pus er-i-them-a-TO-sus), sometimes just called lupus, which is a chronic inflammatory disease that can affect the kidneys and other organs
- Amyloidosis (am-i-loy-DO-sis), a condition in which a protein called amyloid collects in the tissues and organs
- Hereditary disorders
- Myeloma (my-e-LO-ma), a tumor derived from bone marrow cells, and multiple myeloma, which involves multiple sites of myeloma
- Glomerulonephritis (glom-er-u-lo-ne-FRY-tis), a condition in which the glomeruli become inflamed and scarred

In addition, overuse of some drugs (such as laxatives), exposure to certain chemicals (e.g., lead or carbon tetrachloride), and, in some people, exposure to certain allergens (such as poison ivy, poison oak, poison sumac, and insect stings) can affect the functioning of the kidneys and lead to nephrosis.

There are four primary types of nephrosis. The types are diagnosed based on the appearance of the kidney tissue in biopsies*. The most common type is minimal change nephrotic syndrome (MCNS), or minimal change disease. MCNS often occurs after upper respiratory infections, during the presence of cancerous tumors, and with adverse reactions to drugs (such as non-steroidal anti-inflammatory drugs [NSAIDs] such as aspirin, ibuprofen*, and naproxen) and bee stings. It occurs in children in about 90 percent of the nephrotic cases, but is found in only one in five adult cases of the condition.

The other three types of nephrosis are classified as membranoproliferative glomerulonephritis (MPGM), which is caused by groups of antigens and antibodies deposited in the glomerular basement membrane;

* **biopsies** (BI-op-seez) are tests in which small samples of skin or other body tissue are removed and examined for signs of disease.

* **ibuprofen** (eye-bew-PRO-fin) is a nonsteroidal anti-inflammatory drug (NISAD) used to reduce fever and relieve pain or inflammation.

* **diuretics** (dye-yoor-EH-tiks) are medications that increase the body's output of urine.

* **triglycerides** (try-GLISS-eh-rides) are a type of fatty substances found in the blood.

membranous glomerulopathy (membranous), which damages the glomerular basement membrane, the membrane that separates blood from urine; and focal segmental glomerulosclerosis (FSGS), which involves only some of the glomeruli, includes only portions of those affected glomeruli, and produces scarring within the affected glomeruli.

How Is Nephrosis Diagnosed?

Several tests are available to diagnose nephrosis. The most important is a urine test that shows the presence of proteinuria. When a person has nephrosis, the level of proteinuria in the urine is greater than two grams when measured over a twenty-four-hour urine collection period.

As a result of abundant proteinuria, the patient develops hypoalbuminemia, which is demonstrated by testing the blood for albumin. Levels generally below three grams per deciliter indicate a very low level of the water-soluble protein albumin in blood serum.

The condition called hypercholesterolemia shows that the body contains high levels of cholesterol in the blood. When nephrosis is present, test results indicate an elevated low-density lipoprotein (LDL), which transports cholesterol within the body, along with a higher-than-normal level of very low-density lipoprotein (VLDL). Both LDL and VLDL are commonly referred to as “bad cholesterol.”

Other tests include evaluating the plasma concentrations of electrolytes (such as calcium, potassium, and sodium), urea, and creatinine in order to test the efficiency of the kidneys to filter out waste products.

A kidney biopsy may also be performed. During the biopsy, a thin needle is inserted under the ribs and a tiny sample of the kidney is removed for examination with an electron microscope, which provides high quality images that are magnified millions of times for accurate analysis of the sample.

It is important to perform several tests because other diseases and conditions can act like nephrosis. Numerous tests help to eliminate the possibility of other problems so that nephrosis can be accurately diagnosed within patients.

What Is the Treatment for Nephrosis?

How nephrosis is treated depends on its cause. If it is caused by another disease, that underlying disease is treated. If the cause of nephrosis is not known, the symptoms may be treated with antibiotic drugs to reduce infections. Diuretics* are used to reduce edema. To reduce protein loss in the urine and hypertension, angiotensin converting enzyme (ACE) inhibitors are prescribed. Prednisone, by itself, or with immunosuppressive drugs are also often used to reduce protein loss. Medicines to reduce high blood pressure, cholesterol, and triglycerides* may be given. Corticosteroid is used to reduce signs of inflammation and allergic reactions. A diet low in fat (especially saturated fat), cholesterol, and salt might be recommended, and fluid intake might be restricted.

People with nephrosis, especially children, often recover when nephrosis is treated promptly and early. However, nephrotic patients may be at increased risk for complications from heart diseases and atherosclerosis, other kidney diseases, infections, and malnutrition. If the kidneys lose their ability to function, dialysis* may be necessary. Difficulties with blood pressure control may also occur.

▶ See also **Diabetes • Hypertension • Kidney Disease • Lupus**

Resources

Books and Articles

Feehally, John, Jurgen Floege, and Richard J. Johnson, eds. *Comprehensive Clinical Nephrology*. Philadelphia, PA: Mosby/Elsevier, 2007.

Schrier, Robert W., ed. *Diseases of the Kidney and Urinary Tract*. Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams and Wilkins, 2007.

Organization

National Kidney and Urologic Diseases Information Clearinghouse.

3 Information Way, Bethesda, MD, 20892-3580. Toll free: 800-891-5390. Web site: <http://www.niddk.nih.gov>.

Neural Tube Defects

Neural tube defects occur when the neural tube fails to close properly during gestation.

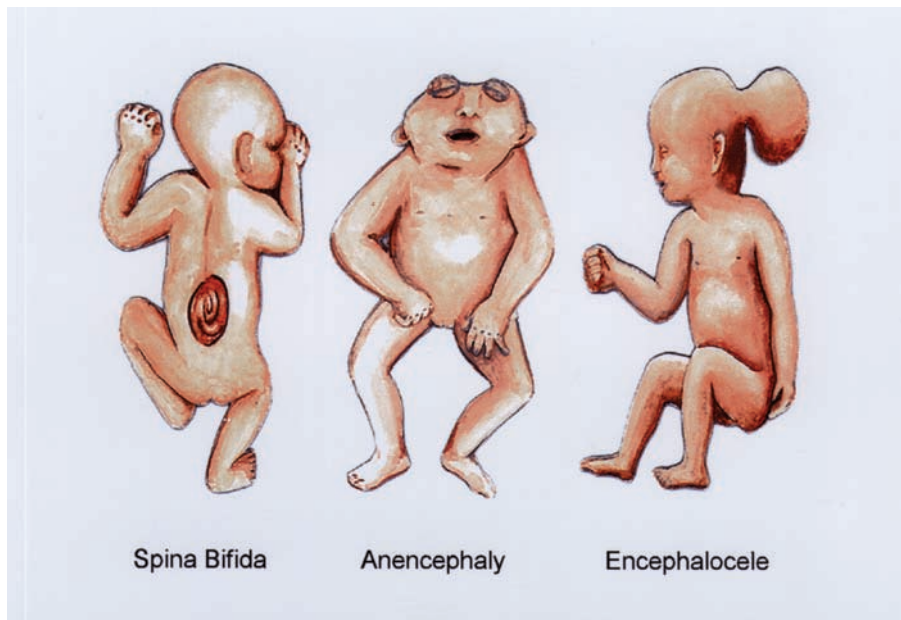
Neural Tube Defects: Overview

During fetal development, a structure known as the neural tube is formed. This tube later develops into the central nervous system* in the adult. The process of neural tube formation is called neurulation. The neural tube must close completely. However, the ends of it may be defective, and most neural tube defects involve the ends of the tube. Complete neurulation is essential to brain formation and function in the adult. Closure defects occur during pregnancy usually around 24 to 28 days after fertilization, or approximately three to four weeks into the pregnancy. Two of the most common neural tube defects are anencephaly and spina bifida. Anencephaly is caused by the improper closure of the anterior (upper) end of the neural tube, resulting in a fetus that is missing some or most of the brain. Spina bifida is caused by the improper closure of the posterior (lower) end of the neural tube, resulting in a lack or partial covering of the end of the spinal cord.

* **dialysis** (dye-AL-uh-sis) is a process that removes waste, toxins (poisons), and extra fluid from the blood. Usually dialysis is done when a person's kidneys are unable to perform these functions normally.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

Three common neural tube defects: Spina bifida (left) appears as a mass on the back/spine covered by skin or the meninges; Anencephaly (center) in which the brain is exposed; Encephalocele (right) in which a mass containing brain is located on the head. *Illustration by Greenwood Genetic Center. Reproduced by permission.*



* **incidence** means rate of occurrence.

How Common Are Neural Tube Defects?

In 2005 spina bifida occurred in nearly 18 individuals per 100,000 live births in the United States. This rate was significantly lower than in previous years. In 2005 the rate of anencephaly was nearly 12 individuals per 100,000 live births, also down from previous years. The overall incidence* of neural tube defects in live births declined through the previous several decades, perhaps due to better screening techniques and early pregnancy termination. The highest incidence in the United States is in the Appalachian regions, and the rate is higher overall in the East than in the West. In the United States, Hispanic people have three times as many neural tube defects as the rest of the population. Females are more likely than males to have anencephaly.

Internationally, neural tube defects are among the most common types of birth defects. Studies done on Caucasian populations show the lowest incidence of neural tube defects in mainland Europe. The highest rates among Caucasians occur in Great Britain, especially in Scotland and Ireland. The highest overall incidence of neural tube defects in the world occurs in Northern China, with a rate of 3.7 cases per 1,000 live births. Areas with high incidence specifically of anencephaly include Ireland, Scotland, Egypt, and New Zealand. Japan has the lowest incidence of anencephaly and other neural tube defects. Individuals of Celtic ethnic origin have the highest incidence of spina bifida.

What Are the Signs and Symptoms of Neural Tube Defects

Neural tube defects generally cause obvious physical features that are readily distinguished. Anencephaly is obvious at birth, because affected babies are missing a good portion of their brain and part of their skull. The

area of missing skull may or may not be covered by skin. Facial features are present and may appear relatively normal. Breathing and reflexes are present, but these babies are missing the portion of the brain responsible for consciousness and are also deaf and blind. Anencephaly causes death either during the pregnancy or shortly after birth. By contrast, symptoms of spina bifida may include a tuft of hair at the base of the spine and an obvious sac in which the spinal cord protrudes and is exposed.

Outcomes for cases of neural tube defect vary. Cases of anencephaly cause death shortly after birth. Other types of neural tube defects may cause progressive deterioration of the nervous system, resulting in a poor prognosis. Mental retardation occurs with some types of neural tube defects. Neural tube defects involving the posterior end of the neural tube may result in paralysis of the lower limbs, as well as bladder and bowel incontinence*. Babies with neural tube defects that are severe enough to expose portions of the central nervous system may have a complication known as meningitis, an infection of the lining of the brain and spinal cord. The type and severity of the neural tube defect determines whether the individual will survive to adulthood.

How Does Folic Acid Prevent Neural Tube Defects?

Folate is a form of folic acid, a type of B vitamin necessary for human health. Folate is found in some food groups and can also be taken as a vitamin supplement. It is a critical component of neural tube formation, although the exact mechanism by which it works in cell growth remained unclear as of 2009. Folic acid is necessary for the production of DNA*, the genetic building blocks of the human body. Cell growth and division requires the synthesis of DNA. Embryonic development, including the nervous system, is a period of rapid and intensive growth involving lots of DNA synthesis. Therefore, folic acid is an absolute requirement for the formation of what will be fetal organs and tissues early on in pregnancy. For this reason it is important to have adequate levels of folic acid in the body not only during pregnancy, but even in the time period right before it. Neural tube formation takes place in the third to fourth week of pregnancy. Many pregnant women are not aware of their pregnancy until after this time, and so they may engage in activities that harm neural tube formation without realizing it. In order to reduce the risk of neural tube defects, sexually active women of child-bearing age are encouraged by healthcare providers to take folic acid supplements.

Among women who have a pregnancy affected by a neural tube defect, the recurrence risk is approximately 2 to 4 percent for subsequent pregnancies. If there are multiple occurrences of neural tube defects within a family history, the risk is higher. These women ought to take even more folic acid than women without this history. Folic acid supplementation is responsible for preventing two-thirds of neural tube defects and is a critical component of prevention.

* **incontinence** (in-KON-ti-nens) is loss of control of urination or bowel movement.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

- * **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.
- * **antihistamines** (an-tie-HIS-tuh-meens) are drugs used to combat allergic reactions and relieve itching.
- * **anticonvulsants** (an-tie-kon-VUL-sents) are medications that affect the electrical activity in the brain and are given to prevent or stop seizures.
- * **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.
- * **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.

What Are Other Causes of Neural Tube Defects?

Many different environmental factors besides folic acid deficiency play a role in the development of neural tube defects. Maternal type 1 diabetes; maternal obesity*; environmental toxins, including some found in corn meal; poisons such as arsenic; and excessively high maternal body temperature may all contribute to neural tube defects during pregnancy. Hyperthermia, a term used to describe excessively high body temperature, may be caused by fever or recreational activities such as using a hot tub. Certain prescription drugs have been linked to the development of neural tube defects, including some antihistamines* and anticonvulsants*. Neural tube defects may also have a genetic component that predisposes certain individuals to respond more to environmental factors.

How Are Neural Tube Defects Diagnosed?

Alpha-fetoprotein (AFP) is a substance made in the liver of the fetus*. AFP can be measured in the blood and amniotic fluid of a pregnant woman. The level of AFP present is used to determine the likelihood of the presence of neural tube defects. In this manner, AFP measurement can generally be used as a screen for neural tube defects. Values of AFP approximately 2.5 times above normal are considered a sign of neural tube defects. If the mother has type 1 diabetes, the production of AFP during pregnancy is delayed and altered and so may be difficult to use as a screen.

How Are Neural Tube Defects Treated?

Neural tube defects may be open, meaning that a portion of the nervous system is exposed to the area outside the enclosed and protected central nervous system, placing the child at risk for infection. Because of this, some open neural tube defects such as spina bifida with an exposed spinal cord are treated with surgery to physically close the defect. In this case, surgical closure generally helps to prevent further complications of injury and infection, but it usually does not correct the other symptoms associated with the defect. Neural tube defects that affect the placement of structures of the brain may be treated surgically to reduce physical pressure on specific brain regions. If the neural tube defect causes blockage in the flow of cerebrospinal fluid* a shunt may be surgically placed in the brain, which allows fluid to drain away and thus prevents pressure build-up.

 See also **Anencephaly • Spina Bifida**

Resources

Organizations

Center for Human Genetics, Duke University Medical Center. Box 3445, Durham, NC, 27710, Web site: <http://www.chg.duke.edu/diseases/ntd.html>.

Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 888-INFO-FDA. Web site: <http://www.fda.org>.

National Institutes of Health. 9000 Rockville Pike, Bethesda, MD, 20892. Telephone: 301-496-4000. Web site: <http://www.nih.gov/index.html>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/neuraltubedefects.html>.

Neuroblastomas

Neuroblastomas are unusual cancers of immature or developing nerve cells in infants or young children. They often metastasize to other parts of the body.

What Are Neuroblastomas?

Neuroblastomas are malignant* tumors* of the autonomic nervous system*. They occur when primitive neurons* fail to mature normally and begin to divide uncontrollably. Neuroblastomas may release hormones* that cause changes in the body. They can also affect some brain functions.

About one-third of all neuroblastomas are diagnosed during the first year of life, and 90 percent are diagnosed by the age of five. Only about 2 percent of neuroblastomas occur in children over 10 years of age or in adults.

Two-thirds of neuroblastomas originate in the abdomen*. About one-half of these begin in the nerve-like cells in the medulla at the center of the adrenal glands* and one-half originate in clusters of nerves called ganglia in the abdomen. Other neuroblastomas may come from the chest or neck ganglia.

Sometimes, especially in very young infants, neuroblastoma cells die on their own and the tumor disappears. Other times the neuroblastoma cells spontaneously mature into ganglion cells that do not continue to divide and the tumor becomes a benign* ganglioneuroma. A ganglioneuroblastoma is a tumor that contains both malignant and non-malignant cells.

What Causes Neuroblastomas?

The causes of neuroblastomas are not well-understood. Nerve and adrenal medulla cells develop from fetal* cells called neuroblasts. Neuroblastomas are believed to occur when neuroblasts fail to mature due to mutations* in their DNA*. Instead the neuroblasts continue to grow and divide.

About 1 to 2 percent of neuroblastomas appear to have a hereditary component, with other family members having had the cancer as infants.

How Common Are Neuroblastomas?

Neuroblastomas are the most common cancer in infants and the fourth most common cancer in children. There are about 650 new cases in the United States every year.

- * **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.
- * **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.
- * **autonomic nervous system** is a branch of the peripheral nervous system that controls various involuntary body activities, such as body temperature, metabolism, heart rate, blood pressure, breathing, and digestion. The autonomic nervous system has two parts—the sympathetic and parasympathetic branches.
- * **neurons** are nerve cells. Most neurons have extensions called axons and dendrites through which they send and receive signals from other neurons.
- * **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.
- * **adrenal glands** (α-DREEN-al glands) are the pair of endocrine organs located near the kidneys.

- * **benign** (be-NINE) means a condition is not cancerous or serious and will probably improve, go away, or not get worse.
- * **fetal** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.
- * **mutations** (mu-TAY-shuns) are changes in a chromosome or a gene.
- * **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.
- * **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).
- * **high blood pressure** also called hypertension, is a condition in which the pressure of the blood in the arteries is above normal.
- * **spasms** (SPAH-zumz) are involuntary muscular tightenings or contractions.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **bone marrow** is the soft tissue inside bones where blood cells are made.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **prenatal** (pre-NAY-tal) means existing or occurring before birth, with reference to the fetus.

Children with this familial form tend to be diagnosed at a younger age, and they often develop neuroblastomas in two or more organs.

What Are the Symptoms of Neuroblastomas?

The symptoms of neuroblastomas depend on the original location of the tumor and how far the cancer has metastasized (spread). The most common sign is a lump or mass, usually in the abdomen. The abdomen may swell, and the child may complain of a stomachache. The mass can be found elsewhere in the body, such as the neck or back of the eye. Depending on the location of the neuroblastoma, symptoms may include constipation or breathing, vision, or behavioral problems. Neuroblastomas frequently spread to the bones, and older children may complain of bone pain or have difficulty walking.

Paraneoplastic (caused by cancer located elsewhere in the body) syndromes are associated with less common symptoms caused by hormone-releasing neuroblastomas:

- Persistent diarrhea*
- High blood pressure* causing irritability
- Rapid heartbeat
- Flushing
- Sweating

Opsoclonus-myoclonus-ataxia syndrome, also known as “dancing eyes, dancing feet,” is an uncommon symptom characterized by irregular, rapid eye movements, muscle spasms*, and difficulty walking and possible difficulty in speaking. Surprisingly, neuroblastomas that cause this syndrome are less life-threatening than other forms.

How Are Neuroblastomas Diagnosed and Treated?

Diagnosis Because of their early age of onset, neuroblastomas can be difficult to diagnose. Up to 60 percent of cases are not diagnosed until they are already in the late stage when they have metastasized, especially to the lymph nodes*, bones, bone marrow*, liver*, or skin. Rarely, neuroblastomas are diagnosed during prenatal* ultrasound*. Sometimes neuroblastomas are discovered during tests for other childhood diseases. These cases usually have good outcomes and may not even require treatment.

About 90 percent of neuroblastomas overproduce chemicals called catecholamines* that can be detected in the blood or urine. Elevated levels of the hormones dopamine* or norepinephrine* in the blood can also be a sign of neuroblastoma. Additional tests measure blood-cell counts, liver and kidney* function, and salt balance.

Imaging tests used to diagnose and stage neuroblastomas include:

- Chest or head x-rays
- CT scans* of the abdomen, pelvis, or chest

HOW ARE NEUROBLASTOMAS STAGED?

The International Neuroblastoma Staging System may be used to measure the extent of the cancer, which helps determine the treatment and prognosis:

- Stage 1: The cancer has not spread, is on only one side of the body, and can be surgically removed.
- Stage 2: The cancer is localized, is on one side of the body, and may or may not be completely removed by surgery.
- Stage 3: The cancer cannot be completely removed surgically or is spreading to the other side of the body.
- Stage 4: The cancer has spread to distant sites or organs.
- Stage 4S (“special”): The child is less than one-year-old; the cancer is localized on one side of the body but may have spread to some lymph nodes, the liver, and skin; no more than 10 percent of bone-marrow cells are cancerous. 4S neuroblastomas often disappear spontaneously.
- Recurrent: The cancer has returned after treatment.

- MRI*
- Ultrasound
- Positron emission tomography*
- MIBG scans, which locate the tumor and metastasized cells. A radioisotope (MIBG, iodine-131-meta-iodobenzylguanidine) is injected into a vein. This compound attaches to specific tumor cells.
- Bone scans

A definitive diagnosis of neuroblastoma requires a biopsy*. The biopsied tissue may be tested with antibodies* against neuroblastoma cells.

About one-half of neuroblastomas spread to the bone marrow. Bone marrow is sampled by aspiration* and biopsy to diagnose and stage the cancer.

Treatment Treatment for neuroblastoma usually includes one or more of the following:

- Surgery to remove all or as much of the tumor as possible
- External-beam radiation therapy* before or after surgery
- A combination of several chemotherapy* drugs before or after surgery or as the primary treatment for metastasized tumors
- A highly radioactive form of MIBG for advanced neuroblastoma
- A treatment with 13-cis-retinoic acid usually for six months following primary treatment, to reduce the risk of recurrence in high-risk children

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **catecholamines** (kat-e-KO-la-meens) are hormones and neurotransmitters such as epinephrine, norepinephrine, and dopamine.

* **dopamine** (DOE-puh-meem) is a neurotransmitter in the brain that is involved in the brain structures that control motor activity (movement).

* **norepinephrine** (NOR-e-pi-nefrin) is a body chemical that can increase the arousal response, heart rate, and blood pressure.

* **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **positron emission tomography** (POZ-i-tron i-MISH-en toe-MAH-gruh-fee) also called PET imaging or PET scanning, uses a radiotracer that accumulates in an area of the body and emits gamma rays that are detected as diagnostic images.

* **biopsy** (Bl-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.
- * **aspiration** (as-puh-RAY-shun) is the sucking of fluid or other material out of the body, such as the removal of a sample of joint fluid through a needle inserted into the joint.
- * **radiation therapy** is a treatment that uses high-energy radiation from x-rays and other sources to kill cancer cells and shrink cancerous growths.
- * **chemotherapy** (KEE-mo-THER-ah-pee) is the treatment of cancer with powerful drugs that kill cancer cells.
- * **transplants** (TRANS-plantz) are organs or tissues from another body used to replace a poorly functioning organ or tissue.
- * **metastases** (me-TAS-tah-seez) are new tumors formed when cancer cells from a tumor spread to other parts of the body.
- * **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.
- * **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.
- * **chromosome** (KRO-mo-zom) is a unit or strand of DNA, the chemical substance that contains the genetic code to build and maintain a living being. Humans have 23 pairs of chromosomes, for a total of 46.

Children who undergo bone-marrow-destroying chemotherapy receive bone-marrow transplants* with their own previously collected stem cells. This treatment has significantly increased the cure rate for neuroblastomas.

Prognosis Early-stage neuroblastomas—before metastases* occur—have a cure rate of over 90 percent. Later-stage neuroblastomas have a cure rate of only 30 percent, despite multimodal therapy.

Children are placed in risk groups based on the cancer stage and other factors:

- Low-risk children are usually cured by surgery alone.
- Intermediate-risk children have an 85–90 percent chance of surviving for five years.
- High-risk children have a five-year-survival of about 30 percent.

Other factors are considered in the prognosis:

- Children aged 12–18 months are more likely to be cured than older children.
- Many dying or dividing tumor cells indicates a less favorable prognosis.
- Fewer growing tumor cells and more mature nerve tissue indicates a better prognosis.
- The amount of DNA* in the tumor cells, the number of copies of certain cancer genes*, chromosome* abnormalities, certain receptors* on the cells, and various factors in the blood can all affect the prognosis.

Can Neuroblastomas Be Prevented?

As of 2009, there was no known prevention for neuroblastomas. Several countries, including Japan, Germany, and Canada, attempted to implement newborn-screening programs for neuroblastoma by measuring the levels of catecholamines in the urine, but these programs failed to improve the cure rate. However, a Canadian study found that eating foods fortified with folate (folic acid) during pregnancy cuts the risk of neuroblastoma by 60 percent. Folate fortification of grain products has been required in the United States since 1998.

▶ See also **Cancer: Overview**

Resources

Books and Articles

Bellenir, Karen, ed. *Cancer Sourcebook*, 5th ed. Detroit, MI: Omnigraphics, 2007.

Birrell, Syd. *Ya Can't Let Cancer Ruin Your Day: The James Emails*. Peterborough, Ontario: Green Train Books, 2006.

Organizations

American Cancer Society. P.O. Box 102454, Atlanta, GA, 30368-2454. Toll free: 800-ACS-2345. Web site: <http://www.cancer.org>.

Children's Neuroblastoma Cancer Foundation. P.O. Box 6635, Bloomington, IL, 61018. Toll free: 866-671-2623. Web site: <http://www.nbhope.org>.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov>.

Neurochemistry See *Brain Chemistry (Neurochemistry)*.

Neurofibromatosis

Neurofibromatosis (noor-o-fy-bro-ma-TO-sis) is a genetic disorder that causes tumors to grow on nerves and that is also characterized by skin changes and deformities in bone.

What Is Neurofibromatosis?

The most common form, called neurofibromatosis type 1 or NF-1, mainly affects nerves in the skin, producing soft nodules or bumps. Neurofibromatosis type 2 (NF-2) is a very rare disorder that affects the auditory nerves



* **receptors** are cell structures that form a chemical bond with specific substances, such as neurotransmitters. This leads to a specific effect.



The characteristic skin changes and bone deformities of neurofibromatosis are often visible on the face and head. *AP Images.*

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

responsible for hearing and balance. Both types are caused by defective genes*.

Neurofibromatosis also is called Recklinghausen's disease, after the German physician Friedrich von Recklinghausen (1833–1910), who described it in 1882. The tumors he noted, called neurofibromas (noo-rof-y-BRO-mas), arise from the cells that make up the covering sheaths of the nerves.

NF-1 and NF-2 neurofibromatoses occur in both sexes and in all racial and ethnic groups. In the United States, NF-1 occurs in about 1 of 4,000 persons. NF-2 is ten times less common, occurring in about 1 in 40,000 people.

What Causes Neurofibromatosis?

Although many people who have neurofibromatosis inherited it from one of their parents, between 30 and 50 percent developed it spontaneously from a mutation (change) in their genes before birth.

Neurofibromatosis is inherited as an autosomal (non-sex-linked) dominant disorder, which means that each child born to a parent with neurofibromatosis has a 50 percent chance of inheriting the defective gene and developing the disease.

Genes produce proteins that determine a person's body physical and metabolic characteristics, everything from the color of a person's hair to how fast a person burns fat. Scientists have discovered that the neurofibromatosis genes, when normal, produce proteins that suppress tumors. This function suggests that when the genes are defective, they may fail to produce enough of these proteins, thus allowing the growth of tumors. Further research in the early 2000s was needed to confirm this theory, however.

What Are the Signs and Symptoms of Neurofibromatosis?

The signs and symptoms of neurofibromatosis vary greatly among individuals even in the same family. Many people do not know that they have NF-1 until it is diagnosed during a routine physical exam. The disease is usually mild.

NF-1 produces many soft, bumpy or stalk-like tumors under the skin. Another common sign of this disorder is light-brown patches on the skin called cafe-au-lait spots. Although these spots may appear in people who do not have NF-1, people with NF-1 usually have six or more of them. Signs may also include freckles in the armpits or groin areas, growths in the eye or on the optic nerve, deformation of bones, and scoliosis, a side-to-side curvature of the spine.

These signs first appear in infancy or early childhood and increase as a person grows older. Occasionally, tumors are massive or in rare cases become cancerous. They may also occur inside the body, squeezing or blocking internal organs.

The symptoms of NF-2 include tumors on the auditory (acoustic) nerves. These growths can cause loss of hearing and may damage nearby

nerves and structures in the brain. Tinnitus (ti-NY-tus; a ringing in the ears), balance disturbances, or headache can also occur. People with NF-2 may first notice these symptoms in their teen or early adult years.

It should be noted that the presence of significant high blood pressure in a patient with neurofibromatosis should cause the physician to search for an associated tumor of the adrenal gland called pheochromocytoma, which causes hypertension by the release of catecholamines*.

How Is Neurofibromatosis Treated?

The diagnosis of neurofibromatosis is made mainly by noting its outward signs. Internal viewing techniques, such as MRI (magnetic resonance imaging), are sometimes needed as well. Treatment is then designed to control symptoms.

Operations and braces may be needed to correct scoliosis. Surgery may also be performed to remove tumors that are exceptionally large, painful, or that press on organs. The tumors often grow back, however.

Various cancer treatments may be used in rare instances in which tumors become malignant*. Progress in biomedical research into the causes of neurofibromatosis in the late 1990s and early 2000s raised hopes that someday there would be treatment to slow or halt the growth of its tumors.

Some cases of neurofibromatosis can be severely debilitating, and its complications can be fatal. In most instances, however, symptoms are mild, and the person with the disorder can lead a normal, productive life.

Genetic tests and counseling are available for people with neurofibromatosis. These can help people learn more about their condition or that of a family member and can assist them in making decisions about having children of their own.

▶ See also **Genetic Diseases**

Resources

Books and Articles

Korf, Bruce R., and Allan E. Rubenstein. *Neurofibromatosis: A Handbook for Patients, Families, and Health Care Professionals*, 2nd ed. New York: Thieme Medical, 2005.

Organizations

Children's Tumor Foundation. 95 Pine Street, 16th Floor, New York, NY, 10005. Toll free: 800-323-7938. Web site: <http://www.ctf.org>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824, Web site: <http://www.ninds.nih.gov/disorders/neurofibromatosis/neurofibromatosis.htm>.

The Elephant Man

Neurofibromatosis has long been associated with the “Elephant Man,” the name given to the Englishman Joseph (John) Carey Merrick (1862–1890), who was exhibited in public as a medical freak because of his grotesque disfigurements. Merrick was thought to have had a severe form of neurofibromatosis, but accumulating evidence later indicated that he was suffering from a much rarer disease called Proteus syndrome. Nonetheless, public awareness of neurofibromatosis was greatly increased after the production of a play in 1979 and a film in 1980 on the life of Merrick.

* **catecholamines** (kat-e-KO-la-meens) are hormones and neurotransmitters such as epinephrine and dopamine.

* **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

Neurosis See *Psychosis*.

Newborn Infections See *Congenital Infections*.

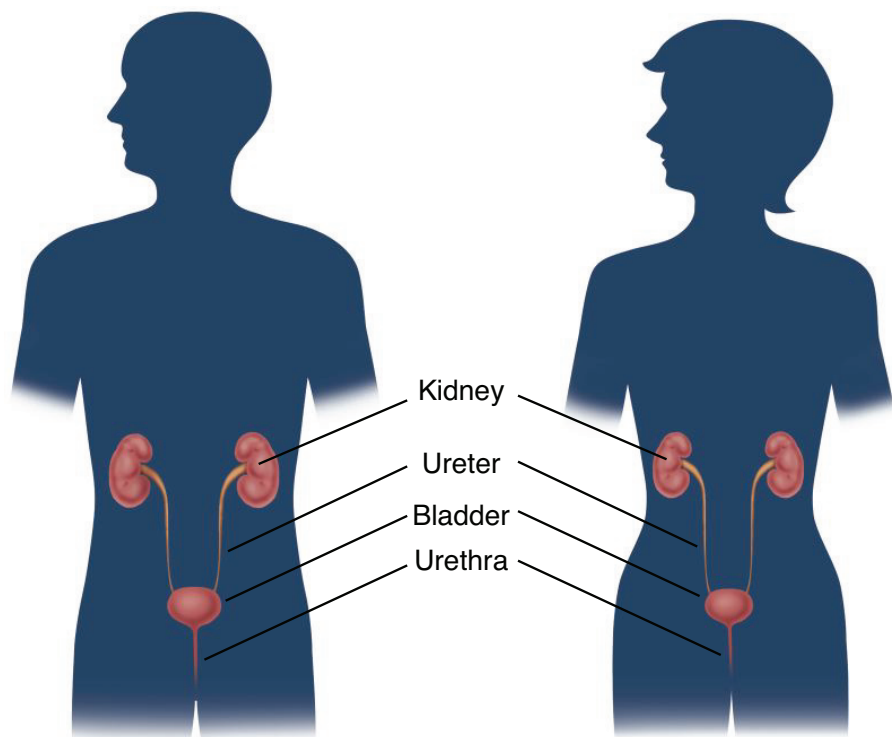
Night Terrors/Nightmares See *Sleep Disorders*.

Nonspecific Urethritis

Nonspecific urethritis (NSU) is an inflammation or infection of the urethra (yoo-REE-thra), more often diagnosed in men, in which the cause is not defined. The urethra is the tube through which urine passes from the bladder to the outside of the body.*

What Is Nonspecific Urethritis?

Nonspecific urethritis (yoo-re-THRY-tis) is a common urinary tract infection. It is also called nongonococcal (non-gon-o-KOK-al) urethritis. “Nongonococcal” means that the urethritis is not caused by gonococcus,



The organs of the urinary tract.
Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

the bacterium (bak-TEE-ree-um) that causes gonorrhea (gon-o-REE-a), a sexually transmitted disease (STD). However, nonspecific or nongonococcal urethritis is also considered to be an STD. It is most often caused by *Chlamydia* (kla-MID-ee-a), but other germs such as yeast*, herpesvirus*, intestinal bacteria*, or any of a number of other microorganisms. Although classified as an STD, nonspecific urethritis is not always caused by sexual activity. For example, it can be caused by an infection from intestinal bacteria that enters the urethra from skin around the anus*, or it may result from insertion of an object into the urethra. Although NSU is possible in either men or women and can affect individuals of all ages, this condition most commonly affects men.

What Are the Symptoms of Nonspecific Urethritis?

A common symptom of NSU is a tingling or burning sensation while urinating. Sometimes, there is also a slight, usually clear discharge. This discharge may be present only in the morning, before urination.

Signs and symptoms of NSU usually appear two to three weeks after infection. Sometimes, symptoms are mild or absent, especially in females.

How Is Nonspecific Urethritis Diagnosed and Treated?

The diagnosis of NSU is made by taking urine and discharge samples and conducting laboratory tests to identify the infecting organism. A direct swab of the urethra is usually performed and tested in an effort to demonstrate the causative organism. In many instances, however, the cause cannot be determined.

NSU is treated with antibiotics*. It is extremely important to finish the prescribed amount of these medications. Otherwise, the infecting organisms may not all be killed, and the disease can come back.

NSU is treated with antibiotics; several regimens are available, and treatment length depends on the specific antibiotic selected by the doctor. During this time, sexual activity must be avoided to keep from spreading the infection. Relapses are common, and follow-up visits may be needed to confirm a cure.

What Are the Complications of Nonspecific Urethritis?

Sometimes, treatment of NSU is unsuccessful, especially if the cause is not found. Possible complications may include chronic* urethritis and cystitis (sis-TY-tis), a bladder infection. The infection sometimes may reach the kidneys*.

How Can Nonspecific Urethritis Be Prevented?

General measures that can decrease the likelihood of NSU include frequent bathing. Especially good hygiene is needed in the genital area. Bubble baths should be avoided, because they can irritate the urethra.

* **yeast** (YEEST) is a general term describing single-celled fungi that reproduce by budding.

* **herpesvirus** (her-pee-z-VY-rus) is a member of a family of viruses that can store themselves permanently in the body. The family includes varicella virus, Epstein-Barr virus, and herpes simplex virus.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **anus** (A-nus) is the opening at the end of the digestive system, through which waste leaves the body.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **kidneys** are the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

With regard to sexual transmission, as for any STD, not having sex is the only sure means of prevention. The risk of getting NSU is lowered by limiting the number of one's sexual partners. Condoms can decrease the rate of transmitting the infection.

NSU and other urinary tract infections are not contagious* in people who are not sexually active.

▶ *See also* **Bacterial Infections • Chlamydial Infections • Fungal Infections • Gonorrhea • Infection • Sexually Transmitted Diseases (STDs) • Urinary Tract Infections • Viral Infections**

Resources

Organizations

McKinley Health Center. 1109 S. Lincoln Avenue, Urbana, IL, 61801. Telephone: 217-333-2701. Web site: http://www.mckinley.uiuc.edu/handouts/non_gonococcal_urethritis.htm.

Royal Adelaide Hospital. 275 North Terrace, First Floor, Adelaide, SA, 5000, Australia. Telephone: +61 (8) 8222 5075. Web site: <http://www.stdservices.on.net/std/nsu/facts.htm>.

Nosebleeds

A nosebleed is bleeding that begins inside the nostrils. Its medical name is "epistaxis."

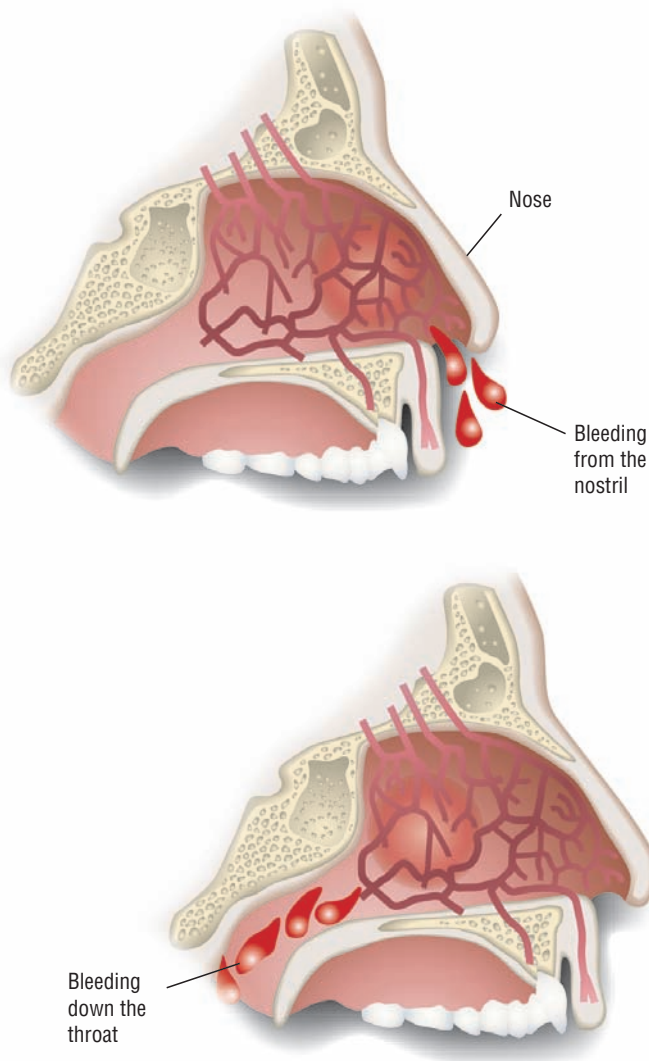
What Are Nosebleeds?

Most nosebleeds occur in children and older people and last for a short time. In rare cases, nosebleeds can be associated with other illnesses.

What Causes Nosebleeds?

Nosebleeds usually start after a bump to the nose or when the lining of the nostrils becomes irritated, crusted, or dry. This precondition often happens when someone has a cold, infection, or allergy that affects the amount of mucus secreted from the nose. A high fever can also dry out the lining of the nose. When a person removes the crusts that may appear in the nose, bleeding may occur.

Nosebleeds have other causes, too. People with systemic hypertension, which is high blood pressure, are prone to nosebleeds because their blood vessels do not function well. Hypertension is quite common among older adults, but not all of them have problems with nosebleeds. Another cause



Anatomical sideview of two types of nosebleeds. *Illustration by GGS Information Services, Inc. Reproduced by permission of Gale, a part of Cengage Learning.*



of nosebleed is the abuse of inhaled drugs, such as cocaine*, that irritate the lining of the nose.

What Is the Treatment for Nosebleeds?

Most nosebleeds are quite easy to treat. A person with a nosebleed should sit down, lean slightly forward, and breathe through the mouth while holding the nostrils firmly closed between the thumb and forefinger. After 10 to 15 minutes, sometimes less, the bleeding should have stopped. The person should avoid blowing the nose for 12 hours after a nosebleed, because doing so could restart the bleeding. If the nosebleed does not stop after a few attempts at pinching the nostrils closed for 10 to 15 minutes each time, then a doctor should be contacted. The doctor might put cotton gauze with medication into the nostril to stop the bleeding. In some cases, he or she may also prescribe nose drops to be used by the patient for a few days to help control further bleeding.

* **cocaine** (ko-KAYN) is a stimulant, a drug that produces a temporary feeling of alertness, energy, and euphoria.

* **hemophilia** (hee-mo-FIL-ee-a) is a hereditary disease that results in abnormal bleeding because the blood fails to clot. It occurs almost exclusively in males.

Prolonged nose bleeding may be a sign of serious injury to the head or an indication of an illness, such as hypertension or sinus blockage. A doctor will recommend treatment suited to the cause of the nosebleed.

Although rare, nosebleeds are sometimes the result of serious diseases. These include leukemia (cancer of the white blood cells), liver disease, atherosclerosis (also called hardening of the arteries), and some hereditary bleeding disorders such as hemophilia*, in which the blood fails to clot properly.

Can Nosebleeds Be Prevented?

The best way to prevent nosebleeds is to avoid bumping or picking the nose. People involved in contact sports, such as football or boxing, are more likely to receive bumps to the head or nose that result in nosebleeds. Medical professionals recommend wearing appropriate protective gear, such as face guards and masks, to help prevent these injuries. In general, humidifying (adding moisture to) the air indoors in the winter, when the air is very dry because of central heating, also helps protect individuals from nosebleeds.

Resources

Books and Articles

Landau, Elaine. *Nosebleeds*. New York: Marshall Cavendish Benchmark, 2010.

Organization

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://familydoctor.org/online/famdocen/home/healthy/firstaid/basics/132.html>.

O

Obesity

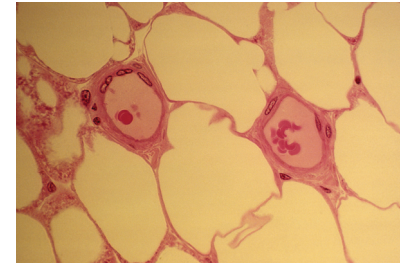
Obesity (o-BEE-si-tee) is a significant excess of body fat to the point where the ratio of body fat to total body mass is higher than accepted norms. Obese children are at higher risk for obesity as adults. People who are overweight or obese are at higher risk for high blood pressure, diabetes, joint pain, and other health problems. In cultures that value being thin, obese people may experience emotional distress and social stigmatization.

Karen's Story

Karen was a normal, healthy baby who grew into a very chubby child. By the time she was 12 years old, Karen was 50 pounds overweight. Because she was so heavy, she did not enjoy sports or other physical activities, so she spent much of her free time snacking in front of the television or chatting online with friends. As Karen gained weight, it became more difficult for her to catch her breath when she was active. She hated gym class and found it hard to deal with the teasing of classmates. Finally after talking to the mother of a friend who had lost weight, Karen decided she needed to make changes to lose weight. Because both of her parents were overweight, too, Karen enlisted them to make weight loss a family project. Karen and her parents began going to the local YMCA to exercise. They also slowly changed their eating habits and stopped buying so much snack food until they were eating a leaner, healthier diet. Even though it sometimes seemed difficult and took longer than she had hoped, Karen lost weight and began to enjoy a more active lifestyle.

What Is Obesity?

Obesity is an abnormal accumulation of body fat or approximately 20 percent or more over an individual's ideal body weight. The number of people, especially children, who are obese is increasing at an alarming rate in the United States and other parts of the developed world where lifestyles make it easy for people to take in more calories* than their bodies use. People can take in too many calories by eating too many burgers and fries, chips, dips, and nachos, and by drinking too many supersized sweetened soft drinks. They use too few calories by taking car rides instead of walking or riding a bike and by spending too much time seated in front of a television and video games instead of engaging in sports or other physical activities. Over time as the amount of calories from food is greater than



▲
Fat or adipose cells magnified 150 times.
©Dr. David M. Phillips/Visuals Unlimited/
Alamy.

* **calories** (KAL-o-reez) are units of energy that are used to measure both the amount of energy in food and the amount of energy the body uses.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

the amount of calories used by activity, people gain weight and become overweight or obese. Obesity is a health concern because it is associated with increased risk of illness, disability, and death.

Lifestyle is not the only cause of obesity. Researchers believe that genes* and heredity also play a role in the tendency to gain weight. People with a history of obesity in one or both parents are at higher risk of becoming obese themselves. Studies of adopted children confirm this relationship: The majority of adoptees followed a pattern of weight gain that more closely resembled that of their birth parents than their adoptive parents. Researchers think that people who have inherited "obesity genes" may use calories at a slower rate than others, or they may not have the same appetite shutoff control system that helps lean

BODY MASS INDEX

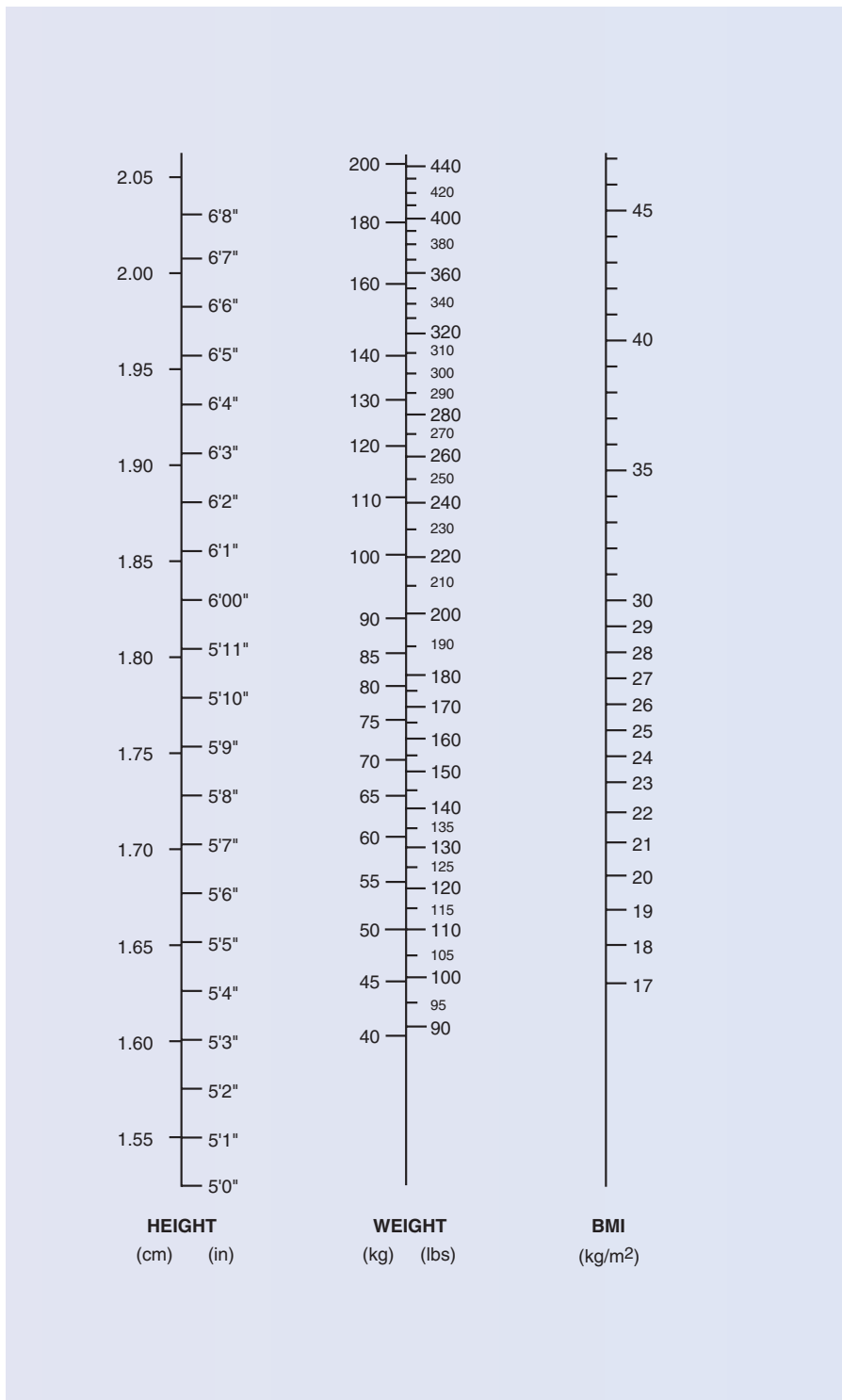
Obesity was traditionally defined as a weight at least 20 percent above the weight corresponding to the lowest death rate for individuals of a specific height, gender, and age. This weight was designated the ideal weight. Current guidelines for obesity use a measurement called the body mass index (BMI). BMI is a mathematical formula that uses height and weight to compare the ratio of body fat to total body mass. To calculate the BMI in metric units weight measured in kilograms and height measured in meters: $BMI = \text{kg}/\text{m}^2$. To calculate BMI in English units, weight in pounds (lb) is divided by height squared in inches (in) and then multiplied by 703. This calculation produces a number that is the individual's BMI. An online BMI calculator can be found at <http://www.nhlbisupport.com/bmi>

All adults age 20 and older are evaluated on the same BMI scale as follows:

- BMI below 18.5: underweight
- BMI 18.5–24.9: normal weight
- BMI 25.0–29.9: overweight
- BMI 30 and above: obese

The BMI of children is calculated in the same way as adults, but instead of assigning a child to a specific weight category based on his or her BMI, a child's BMI is compared to that of other children of the same age and sex. Children are then assigned a percentile based on their BMI. The percentile tells them how their weight compares to that of other children who are their age and gender as follows:

- Below the 5th percentile: underweight
- 5th percentile to less than the 85th percentile: healthy weight
- 85th percentile to less than the 95th percentile: at risk of overweight
- 95th percentile and above: overweight



Doctors use charts showing height, weight, and body mass index as guidelines for determining whether people are at a healthy weight or whether they are overweight. *Illustration by Argosy. Reproduced by permission of Gale, a part of Cengage Learning.*



people stop eating when they have taken in enough calories. Also, people who become obese as children may increase the total number of fat cells in their bodies, making it much more likely that they will be obese as adults. Nevertheless, a genetic predisposition to weight gain does not

* **cholesterol** (ko-LES-ter-ol) is a fatlike substance found in the blood and body tissues.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **eating disorders** are conditions in which a person's eating behaviors and food habits are so unbalanced that they cause physical and emotional problems.

automatically mean that a person will be obese. Eating habits and patterns of physical activity also play a significant role in the amount of weight a person gains.

According to the Centers for Disease Control and Prevention (CDC), between the mid-1970s and the early 2000s, the percentage of overweight and obese American adults ages 20 to 74 increased from 15.0 percent to 32.9 percent. During this same time, the percentage of overweight children two to five years of age increased from 5.0 percent to 13.9 percent and for children aged 6 to 11 years from 6.5 percent to 18.8 percent. Overweight and obesity in teens increased from 5.0 percent to 17.4 percent. In 2007, the World Health Organization (WHO) estimated that 1.6 billion people worldwide over age 15 were overweight and at least 400 million were obese.

What Are the Health Risks Related to Obesity?

Children Children who are in the 85th percentile or above are at risk for developing health problems related to obesity beginning in childhood. Children may have fewer visible health problems from being heavy than adults do. However, the more overweight the child is, the more likely he or she will develop high blood pressure, high levels of cholesterol*, and type 2 diabetes*. Often obese children and teens experience social and emotional difficulties because their weight sets them apart from their friends.

Childhood obesity can set the stage for a lifetime of weight control struggles. In childhood, excess calories are converted into new fat cells, while excess calories consumed in adulthood only expand existing fat cells. Because dieting and exercise can only reduce the size of fat cells, not eliminate them, people who are obese as children can have great difficulty losing weight as adults, because they may have up to five times more fat cells than someone who first becomes overweight as an adult.

Teens Obese teenagers may have the same problems as obese children, but they also may start having aches and pains as the extra fat in their bodies stresses their joints and overloads their muscles and tendons. Obese teens, as well as some younger children, may show the same health problems commonly seen in obese adults such as high blood pressure and type 2 diabetes. Socially, obesity tends to have an effect on the dating and social lives of teens. Overweight teens also may be at risk for eating disorders*.

Adults For adults, obesity is a serious health risk. Severe obesity is called "morbid" obesity because it is so frequently accompanied by serious health complications. On average, a BMI of greater than 40 (morbidly obese) reduces the lifespan of men by as much as 20 years and of women by 5 years. This is especially true in people who are obese and who also smoke. People who are obese for ten or more years are more likely to die earlier than people who maintain a healthy weight. The quality of life of an obese person is often diminished by a variety of serious health problems. Some of the risks of adult obesity are listed below.

HEART DISEASE AND STROKE The leading causes of death and disability in the United States are heart disease, heart attack, and stroke. Stroke is a disorder that occurs when a blood vessel to the brain is blocked or bursts. People who are obese are more likely to have high blood pressure (hypertension), which increases the risk of heart disease and stroke. Obesity is also linked to having higher levels of cholesterol and fats (triglycerides) in the blood, which can lead to heart disease.

DIABETES Type 2 diabetes is the most common form of diabetes. This disorder reduces the body's ability to use insulin to control blood sugar levels. It is a major cause of early death, heart disease, kidney disease, stroke, and blindness. Obese people are twice as likely as other people to develop type 2 diabetes. Of particular concern is the fact that type 2 diabetes is occurring with increased frequency among obese children and teens.

CANCER Men who are obese are more likely than other men to get cancer of the colon (main part of the large intestine), rectum (lower part of the large intestine), and prostate (PROS-tate; male gland in front of the rectum). Obese women are more likely than other women to get cancer of the colon, uterus, cervix (lower part of the uterus), ovaries (female glands where egg cells develop), gallbladder (small sac under the liver), and breast. For some types of cancer, such as colon and breast, it is not clear whether the greater risk is due to extra body fat or to a high-fat and high-calorie diet.

GALLBLADDER DISEASE Obese people are more likely than other people to develop gallbladder disease and gallstones, rock-like lumps that form in the gallbladder. Ironically, rapid weight loss itself can also lead to gallstones. Slower weight loss of about one pound a week is less likely to cause this problem.

OSTEOARTHRITIS Osteoarthritis (os-te-o-ar-THRY-tis) is a common disease that affects the joints (places where bones meet), especially those in the knees, hips, and lower back. Extra weight seems to promote osteoarthritis by putting extra pressure on these joints and wearing away the tissue that cushions and protects them.

GOUT Gout (GOWT) is a joint disease that can lead to problems with the kidneys (organs that filter blood and get rid of waste products and excess water as urine). Gout is more common in people with obesity. Some diets may cause an attack of gout in people who are prone to it. Such people should visit a doctor and ask if they need to be on a special diet.

SLEEP APNEA Sleep apnea (AP-nee-a) is a serious breathing disorder, which can cause a person to stop breathing for short periods during sleep and to snore heavily. It can lead to daytime sleepiness and sometimes heart failure. The more severe the obesity a person has, the greater their risk of getting sleep apnea.

Social and psychological conditions People who are obese may face discrimination when they apply for jobs or promotions, and studies

When Obesity Is Not Caused by Overeating

Obesity can also be a side effect of certain disorders and conditions, including the following:

- Cushing's syndrome, a disorder involving the excessive release of the hormone cortisol
- Hypothyroidism, a condition caused by an underactive thyroid gland
- Neurologic disturbances, such as damage to the hypothalamus, a structure located deep within the brain that helps regulate appetite
- Consumption of such drugs as steroids, antipsychotic medications, or antidepressants

Fad Diets

Fad diets are diets that claim to help people lose a lot of weight in a short time, often without making lifestyle changes. They become fads when they are widely advertised and reported in magazines, newspapers, television, and radio.

Fad diets often require eating a particular food or food group. Examples of fad diets include the cabbage soup diet, the grapefruit diet, the high fat, high protein, low carbohydrate diet, and the fat burning diet. These diets are not nutritionally balanced and can lead to serious health problems.

Realistic long-term expectations for weight loss from dieting are the loss of about one half pound (250 grams) of fat over one week. Any more weight lost than that probably will consist of water.

The best diets recommend exercising and eating controlled amounts of a balance of foods from all food groups. It is important to talk with a doctor before trying any diet.

have shown that they may be unfairly viewed by others as lazy or less intelligent. Obese adults often experience the inconvenience and frustration of needing large-size clothing, large-size movie seats and airplane seats, and large-size seat belts in a world designed by and for medium-size people. Depression, anger, frustration, and a feeling that their world is out of control are common among people who are obese.

Many people eat when they feel bored, sad, or angry. In general, though, most obese people are as mentally healthy as anyone else. However, about 30 percent of people who are treated for severe obesity have trouble with binge eating, which means that they eat large amounts of food in a short period while feeling that they cannot control how much they are eating.

How Is Obesity Treated?

Research shows that the best way for people of all ages to control their weight is through regular exercise and a portion-controlled balanced diet. Adults can improve their health by losing as little as 5 percent of their body weight. To lose weight, people must take in fewer calories than they use. They can do this by becoming more active and/or eating less. The best weight-loss programs combine both of these approaches and also teach people healthy habits that they can follow for the rest of their lives.

Exercise Studies show that regular physical activity, combined with a good diet, is the healthiest and most effective way to control weight. Even people who lose very little weight can improve their health by exercising and eating a nutritionally balanced diet. Exercise uses excess calories that would otherwise be stored as fat.

Aerobic (air-O-bik) exercises are any extended activities that make a person breathe harder while using the large muscles at a regular, even pace. Such exercises burn more calories than other activities. They also strengthen the heart and lungs. Examples include brisk walking, jogging, bicycling, lap swimming, aerobic dancing, and using a treadmill or stationary bike. For the best results, aerobic exercise should be done for 20 to 30 minutes at a time, three or more times a week. People who are out of shape should begin by exercising for briefer periods.

Muscle strengthening exercises, such as weight training, and stretching exercises should also be part of a balanced exercise program. In addition to burning calories, these activities strengthen the muscles and bones and help prevent injury. Such exercises should be done at least twice a week.

Diet Children should never go on a diet to lose weight unless a doctor tells them to do so for medical reasons. Limiting what children eat can interfere with their growth and may be harmful to their health. Instead, children should shift to eating better foods, with most coming from the grain, vegetable, and fruit groups. Some foods from the milk and the meat and bean groups should also be included. Junk foods, which provide

few vitamins and minerals but are full of fat and sugar, should be eaten sparingly or avoided altogether. Fat should not be restricted in the diet of very young children. By the time children are five years old, however, they should get no more than 30 percent of their total calories from fat. Simple ways to cut back on fat include eating low-fat or nonfat dairy products, lean meats, and other low-fat or fat-free foods.

Adults who are trying to lose weight often go on low-calorie diets. Such diets typically contain 1,000 to 1,500 calories per day. The exact number of calories that is right depends on a person's size and activity level. The goal should be to lose no more than one pound a week while still eating a varied diet that includes plenty of grains, vegetables, fruits, and other healthful foods.

A doctor may prescribe a medically supervised, very low-calorie diet for severely obese individuals. These specially formulated diets contain no more than 800 calories a day. Such diets can lead to faster weight loss than ordinary low-calorie diets. Because serious side effects can develop, very-low-calorie diets should always be supervised by a physician and/or nutritionist.

Drugs Appetite-suppressant drugs are sometimes prescribed to aid in weight loss. These drugs work by increasing levels of brain chemicals that control feelings of fullness. Appetite suppressants, though, are rarely truly effective, because most of the weight lost while taking them is regained after stopping them. Also, suppressants containing amphetamines can be potentially abused by patients. These drugs may have potentially harmful side effects. Two appetite-suppressant drugs, dexfenfluramine hydrochloride (Redux) and fenfluramine (Pondimin) as well as a combination fenfluramine-phentermine (Fen/Phen) drug, were taken off the market when they were shown to cause potentially fatal heart defects.

The Food and Drug Administration (FDA) approved weight-loss drugs include sibutramine (Meridia), diethylpropion (Tenuate, Tenuate dospan), mazindol (Mazanor, Sanorex), phendimetrazine (Bontril, Plegine, Prelu-2, X-Trozone), orlistat (Xenical), and phentermine (Adipex-P, Fastin, Ionamin, Oby-trim). These drugs are available only with a doctor's prescription. All of them have significant side effects and should be taken only under medical supervision. Alli is a version of orlistat approved by the FDA for sale without a prescription. Some doctors have also found that antidepressant medications* help obese people gain control over their eating habits.

Surgery Obesity surgery, also called bariatric surgery, reduces or bypasses the stomach or a portion of the small intestine so that severely overweight people can achieve significant and permanent weight loss by taking in or absorbing fewer calories. Surgery is generally performed only on severely obese people who have tried and failed at losing weight using other methods.

Surgical procedures reduce the size of the stomach through stapling or banding so that the person feels full quickly. The exit to the stomach

Weight-loss Supplements

The weight-loss supplement industry is a big business. Dietary supplements that claim to suppress appetite, burn more calories, and produce dramatic weight loss are sold over-the-counter (without a prescription) and are not subject to the same rigor testing for safety and effectiveness as over-the-counter or prescription drugs.

Many heavily promoted weight-loss products are based on fads or gimmicks that create false hopes but rarely produce long-term weight loss. Some of these products, even ones promoted as natural or herbal, can actually endanger health, especially in people who have other chronic illness (e.g., diabetes, heart disease). Individuals should consult a physician before taking any weight-loss product.

* **antidepressant medications** are used for the treatment and prevention of depression.

may also be relocated to bypass part of the small intestine so that fewer calories are absorbed into the blood. Weight-loss surgery has some major risks and side effects. It is only performed after extensive medical tests and psychological, behavioral, and nutritional counseling on people for whom the benefits outweigh the risks. The cost of this surgery is sometimes covered by insurance.

Controlling Weight

Weight control is not easy and requires a long-term effort. It does not help much for a person to lose lots of weight only to regain it. Keeping weight off is the toughest part of a weight-loss program for most people. The key to keeping pounds off or stopping obesity before it starts is to learn healthy habits that last a lifetime. Here are some hints:

- Get moving. Turn off the television, computer, and video games in favor of physical activities. Have fun with friends and family by sharing activities that are good exercise, such as walking, dancing, or bicycling. In addition, look for other ways to become more active throughout the day. For example, walk around during school breaks and take the stairs instead of the elevator.
- Eat slowly. This makes it easier for a person to recognize feelings of fullness. One way for a person to slow down at meals is to make the meals as pleasant as possible. If meals are stressful, a person is tempted to eat faster in order to leave the table sooner.
- Snack wisely. Unplanned snacking often leads to overeating. Planned snacks at particular times of the day can be part of a balanced diet without spoiling the appetite at mealtimes. It is also important to choose healthy snacks, such as fresh fruit, raw vegetables, and low-fat yogurt.
- Avoid unconscious eating in front of the television or computer. People who are paying attention to a television or a computer are less likely to pay attention to feelings of fullness and, therefore, may eat too much.

▶ See also **Binge Eating Disorder • Body Image • Diabetes • Eating Disorders: Overview**

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American Dietetic Association. 216 West Jackson Boulevard, Suite 800, Chicago, IL, 60606-6995. Toll free: 800-366-1655. Web site: <http://www.eatright.org>.

Shape Up America! 6707 Democracy Boulevard, Suite 306, Bethesda, MD, 20817. Web site: <http://www.shapeup.org>.

TOPS Club. 4575 South Fifth Street, Milwaukee, WI, 53207-0360. Toll free: 800-932-8677. Web site: <http://www.tops.org>.

Weight-control Information Network. 1 WIN Way, Bethesda, MD, 20892-3665. Toll free: 877-946-4627. Web site: <http://win.niddk.nih.gov>.

Obsessive-Compulsive Disorder

Obsessive-compulsive (ob-SES-iv-kom-PUL-siv) disorder (OCD) causes people to become trapped in a pattern of repeated, unwanted thoughts, called obsessions (ob-SESH-unz), and a pattern of repetitive behavior, called compulsions (kom-PUL-shunz). Thoughts that feel impossible to control cause distress and anxiety (ang-ZY-e-tee) that is often neutralized, or temporarily relieved, by a particular compulsive behavior.

Melvin and Adrian

In the 1997 movie *As Good as It Gets*, actor Jack Nicholson portrays Melvin Udall, a man who acts in ways that seem odd to others. He feels as if he has to eat lunch at the same table each day, and he always brings his own plastic utensils. He follows a complicated procedure to lock his front door. Much of what he does, from the way he walks around cracks to the way he talks and thinks, make his life difficult. This character has obsessive-compulsive disorder. Adrian Monk, the main character on the television series *Monk* (played by Tony Shalhoub), also has OCD. According to the National Institute of Mental Health, in 2007 about 2.2 million Americans over age 18 were living with OCD.

What Is Obsessive-Compulsive Disorder?

Many people knock on wood to ward off bad luck. Others may walk around, rather than under, ladders, or they may step over, rather than on, cracks in the sidewalk. These are familiar examples of superstitions and rituals. Superstitions are irrational beliefs resulting from false ideas, fear of

These PANDAS Are a Bear

PANDAS (Pediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcal Infections) is a term for unusual, OCD-like symptoms that arise in a small number of children after strep throat, a common throat infection caused by bacteria. The behavior of the children usually changes quite suddenly. Almost overnight, they develop obsessions, compulsions, tics, uncontrollable muscle twitches, or verbal outbursts. As of 2009, the cause remained unknown. One theory, though, suggested that a strep infection in childhood prompts the body to form antibodies (AN-ti-bo-deez), substances in the blood that fight bacteria and other foreign matter. The next time strep develops, the body is ready to fight back. It releases a barrage of antibodies, but some miss their mark and head for the part of the brain that is thought to affect behavior and movement, resulting in OCD symptoms.

* **nervous system** is a network of specialized tissue made of nerve cells, or neurons, that processes messages to and from different parts of the human body.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

the unknown, or trust in magic or chance. Superstitions are common in everyday life and generally are harmless. People with obsessive-compulsive disorder, however, go much further, to the point of becoming trapped in a pattern of repeated, unwanted behaviors and thoughts that are senseless and upsetting but that seem impossible to control. The behaviors and thoughts can take up so much time and energy that they interfere with the individual's daily life.

OCD usually begins with an obsession. Obsessions are repeated thoughts, urges, or images that intrude into a person's mind and seem senseless and distressing. People then go through repeated rituals, called compulsions, in an effort to prevent these thoughts or make the anxiety and distress they cause go away. For example, people may wash their hands, check to make sure the stove is turned off, or check a door lock over and over again. For people with OCD, there is no pleasure in doing these acts. There is only short-lived relief from the upsetting thoughts (for example, that their hands are contaminated, the house will catch on fire, or a thief will come in the door), which all too soon return. Most people have a few repetitive habits. The difference between a harmless ritual or superstition and obsessive-compulsive disorder is that with OCD the thoughts and behaviors disrupt the lives of people with the disorder. People with OCD are aware that their thoughts and actions make little sense are abnormal, but they cannot control their obsessions and compulsions.

What Causes Obsessive-Compulsive Disorder?

Scientists do not know exactly why some people develop OCD. About 2 percent of adults in the United States have OCD in any given year. The disorder usually begins during childhood or the teenage years, and it affects men and women equally. In the past, it was believed that OCD was due mainly to family problems or attitudes learned as children. Later, researchers stressed the interaction between biological factors and life experiences. Brain imaging studies (special brain x-rays) have shown that people with OCD have patterns of brain activity that differ from the patterns of people with other mental disorders and of people with no disorders at all.

OCD occurs more often than average in people with certain other conditions that affect the brain and nervous system*. For example, there is an increased risk of OCD in people with Tourette's (tu-RETZ) syndrome, an inherited nervous system disorder that causes repeated, uncontrollable muscle twitches and verbal outbursts. Researchers have thought there may be a genetic* factor in the development of both OCD and Tourette's syndrome.

What Are the Symptoms of Obsessive-Compulsive Disorder?

The first signs of obsessive-compulsive disorder typically appear between the ages of 10 and 24. An obsession, or intrusive thought, creates constant worry and fear that the person tries to hold in check with a repeated

behavior or compulsion. People who do not experience OCD believe that the worry is silly or strange. People with OCD can also agree that the worry is needless; however, they cannot stop feeling the worry that comes with the thought. Interestingly, obsessions and compulsions do not have to be related. The thought “I might get sick” could be followed by the behavior of counting to seven rather than repeated hand washing. Compulsions also include a wide variety of checking rituals, such as returning often to check a door lock, even though each time the person finds it locked. Another common compulsion is the need to order or arrange precisely certain objects such as stuffed animals or action figures or to count certain objects. Some people with obsessive-compulsive disorder have violent thoughts. They may fear that they or someone they love will die in a horrible accident or that they will harm someone. For example, a driver with OCD may fear that he or she has run over someone and return to the spot over and over to check that no one has been harmed.

How Is Obsessive-Compulsive Disorder Treated?

OCD is a mental health disorder that is diagnosed by a psychiatrist*. It is a type of anxiety disorder and can be present alone or with other mental health disorders. Diagnosis involves a patient history, looking for symptoms, and ruling out other physical and mental conditions, including other anxiety disorders*.

Medications Studies have shown that medicines that affect a brain chemical called serotonin* can reduce the symptoms of OCD. Whereas medicines may help control OCD, the symptoms may return once people stop taking medication. For this reason, doctors often recommend a combination of prescription medication and visits to a behavior therapist. Some individuals whose OCD is not significantly debilitating* might choose behavior therapy alone as the preferred treatment.

Behavioral therapy Behavioral (be-HAY-vyor-al) therapy seeks to help people change specific unwanted behaviors. For OCD, doing so entails using an approach called exposure and response prevention. In this approach, people purposely are exposed to a feared object or idea, either directly or through imagination. Then they prevent themselves from carrying out the usual response (the compulsion), instead using other methods to manage the anxiety they feel. For example, people with a hand-washing compulsion might be encouraged to touch objects that they believe to be dirty. Then with the therapist’s help, they resist the compulsion to wash for several hours. During this time, the anxiety associated with the obsession decreases and so does the compulsion to wash. Research has shown that this approach can be effective for treating OCD. People who remain in therapy may gradually learn to worry less about their obsessive thoughts, and eventually they may learn to go for long periods without falling back on their old compulsive actions. With exposure and response prevention, thoughts and compulsions frequently (and sometimes quickly) disappear or become manageable.

* **psychiatrist** (sy-KY-uh-trist) is a medical doctor who has completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can diagnose mental illnesses, provide mental health counseling, and prescribe medications.

* **anxiety disorders** (ang-ZY-e-tee dis-OR-derz) are a group of conditions that cause people to feel extreme fear or worry that sometimes is accompanied by symptoms such as dizziness, chest pain, or difficulty sleeping or concentrating.

* **serotonin** (ser-o-TO-nin) is a neurotransmitter, a substance that helps transmit information from one nerve cell to another.

* **debilitating** (de-BI-li-tay-ting) means making weak or sapping strength.



▲
A child with Burkitt's lymphoma, a type of tumor first discovered in Africa. The African form of Burkitt's lymphoma is strongly associated with early childhood infection by the Epstein-Barr virus.

*Custom Medical Stock Photo, Inc.
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* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

▶ See also **Anxiety and Anxiety Disorders • Tourette Syndrome**

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Organizations

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.healthyminds.org/letstalkfacts.cfm#ocd>.

Anxiety Disorders Association of America. 8730 Georgia Avenue, Suite 600, Silver Spring, MD, 20910. Telephone: 240-485-1001. Web site: <http://www.adaa.org>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov/health/topics/obsessive-compulsive-disorder-ocd/index.shtml>.

Obsessive-Compulsive Foundation. P.O. Box 961029, Boston, MA, 02196. Telephone: 617-973-5801. Web site: <http://www.ocfoundation.org>.

Oncogenic Infections

Oncogenic (on-ko-JEH-nik) infections are those that may increase a person's risk for developing a certain type or types of cancer.

What Are Oncogenic Infections?

Cancer often is linked to lifestyle choices (such as smoking), a person's genetic* makeup, and environmental influences. However, connections between the development of certain types of cancer and specific viral,

bacterial, and parasitic infections also exist. These infections are referred to as oncogenic, or tumor-producing, infections.

An oncogenic virus* transfers its genetic material to other cells and then remains in the body for a long time as a latent infection (meaning dormant, or inactive, but not dead) or as a chronic (KRAH-nik) infection (meaning that the infection continues for a long time). For example, Epstein-Barr (EP-steen BAR) virus remains in the body for life, occasionally flaring up and being subdued by the body’s immune system*. Chronic infections such as hepatitis (heh-puh-TIE-tis) B or C often damage the body slowly, over many years.

Another characteristic of oncogenic infections is that they seem to encourage cells to reproduce at an unusually fast rate, which may damage the genetic material in those cells. Additional factors, such as smoking or exposure to other carcinogens*, may be needed to trigger the final change of a normal cell into a cancer cell. These exposures, along with each person’s individual genetic makeup, may explain why cancer develops in some people who have had oncogenic infections but not others.

What Are Specific Oncogenic Infections and Their Treatment?

Several infections have been linked to the development of cancer. Human papillomavirus (pah-pih-LO-muh-vy-rus), or HPV, is a family of more than 70 different types of viruses that can produce warts* on various parts of the body. Some strains* of HPV are spread sexually and cause genital* warts. Certain sexually transmitted HPVs are linked to the development

- * **virus** (VY-rus) is a tiny infectious agent that can cause infectious diseases. A virus can only reproduce within the cells it infects.
- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.
- * **carcinogens** (kar-SIH-no-jenz) are substances or agents that can cause cancer.
- * **warts** are small, hard growths on the skin or inner linings of the body that are caused by a type of virus.
- * **strains** are various subtypes of organisms, such as viruses or bacteria.
- * **genital** (JEH-nih-tul) refers to the external sexual organs.

Oncogenic Infections	Associated Cancers
Human papilloma virus (HPV) infection	Cervical and penile cancers
Epstein-Barr virus (EBV) infection	Lymphomas and nasopharyngeal cancer
Hepatitis B and C virus (HBV or HCV) infection	Liver cancer
<i>Helicobacter pylori</i> infection	Stomach cancer
Human lymphotropic virus type 1 (HLTV-1) infection	Lymphomas

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

- * **cervical** refers to the cervix (SIR-viks), the lower, narrow end of the uterus that opens into the vagina.
- * **penile** (PEE-nile) refers to the penis, the external male sexual organ.
- * **anal** refers to the anus, the opening at the end of the digestive system through which waste leaves the body.
- * **Pap smear** is a common diagnostic test used to look for cancerous cells in the tissue of the cervix.
- * **mononucleosis** (mah-no-nu-kee-O-sis) is an infectious illness caused by a virus with symptoms that typically include fever, sore throat, swollen glands, and tiredness.
- * **lymphocytes** (LIM-fo-sites) are white blood cells, which play a part in the body's immune system, particularly the production of antibodies and other substances to fight infection.
- * **lymphoma** (lim-FO-muh) refers to a cancerous tumor of lymphocytes, cells that normally help the body fight infection.
- * **lymphatic system** (lim-FAH-tik) is a system that contains lymph nodes and a network of channels that carry fluid and cells of the immune system through the body.
- * **nasopharyngeal** (nay-zo-fair-in-JEE-ul) refers to the nose and pharynx (FAIR-inks), or throat.
- * **carcinoma** (kar-sih-NO-muh) is a cancerous tumor that arises in the epithelium (eh-puh-THÉE-lee-um), the sheets of cells that line body surfaces, such as the insides of hollow organs and cavities.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

of cervical*, penile*, and anal* cancer. (Anal and penile cancers are rare in the United States.)

According to the American Cancer Society, the most important risk factor for a woman in the development of cervical cancer is HPV infection. HPV is found in 90 percent of cervical cancer cases. Its presence may make a woman more likely to have cervical dysplasia (SIR-vih-kul dis-PLAY-zhuh), or precancerous cells in the cervix. This condition can lead to cancer if it is left untreated. Just having one of the oncogenic strains of HPV, however, does not mean cancer will eventually develop. Early discovery and treatment can lessen a woman's risk of cervical cancer, and doctors advise women diagnosed with HPV to have frequent Pap smears*. HPV is the most common sexually transmitted disease in the United States, with five million new infections diagnosed each year. Although there is no cure for HPV, there are treatment options aimed at controlling the infection. Prevention of HPV infection is possible, thanks to the HPV vaccine. The American College of Obstetrics and Gynecology and the federal Advisory Committee on Immunization Practices recommend that girls receive this three-immunization series prior to becoming sexually active. The target age range for administration is age 11 or 12, although it can be given at any point between ages 9 and 26. Research has demonstrated that the HPV vaccine can prevent more than 70 percent of all cervical cancers.

Epstein-Barr virus (EBV) is commonly known as the virus that causes infectious mononucleosis*. Up to 95 percent of adults in the United States have been infected with the virus by the time they are 40 years old. EBV is transmitted through contact with saliva of someone who is infected. Children who contract EBV rarely have symptoms, and when they do, the symptoms typically are the same as those of common viral infections. When adolescents or adults are infected with EBV, they can have infectious mononucleosis.

EBV remains in the body, primarily in the lymphocytes*, for the rest of a person's life. It is dormant for much of the time, although it occasionally flares up without causing any real harm. People with weakened immune systems are at particular risk that EBV will flare up and cause illness. EBV is associated primarily with the development of Hodgkin's disease and non-Hodgkin's lymphoma* (both cancers of the lymphatic system*), nasopharyngeal* carcinoma*, and Burkitt's lymphoma, a rare cancer arising in the lymph nodes* that is a common type of childhood tumor in some parts of the world, primarily central Africa.

Hepatitis B and C virus (HBV and HCV) infections primarily affect the liver. They are spread through contact with infected blood, such as through the sharing of needles (including needles for tattooing, body piercing, and drug use). HBV can also spread through contact with the body fluids of an infected person during sexual intercourse. Some people with hepatitis have no symptoms at all, but in others the infection can eventually result in liver cancer or liver damage from cirrhosis (sir-O-sis), a condition in which liver cells die and are replaced with scar tissue.

Because HBV and HCV infections generally are chronic, the viruses are present in the body for a long time and can do significant damage. As the body tries to overcome this damage, new cells are created at a faster rate, increasing the risk of cell mutation* and liver cancer. Hepatitis B can be treated with a 4-month series of injections of interferon (in-ter-FEER-on) alpha-2b, a drug that strengthens the immune system to fight the virus; a once-a-day oral pill called lamivudine, given for about a year; or a once-a-day oral pill called adefovir dipivoxil, given for about one year. If HBV infection affects the liver severely, shutting it down, a liver transplant may be necessary. HBV infection can be prevented by vaccination* against the infection. HCV infection can be treated with a specialized form of interferon called pegylated interferon or peginterferon. This type of interferon only requires weekly administration, whereas infusions of standard interferon would be required multiple times per week. This treatment is usually given in conjunction with an oral treatment, ribavirin. Giving two drugs together is called combination therapy. Combination therapy is much more effective than monotherapy and is usually administered for about 48 weeks. Most infections with HBV or HCV do not result in liver cancer.

The *Helicobacter pylori** bacterium is linked to most cases of gastric (stomach) and duodenal* ulcers*. The infection can be treated with antibiotics. People infected with *H. pylori* are at higher risk of stomach cancers, such as gastric lymphoma and adenocarcinoma (ah-deh-no-kar-sin-O-muh). Gastric cancer has been diagnosed more often in countries where *H. pylori* infection is common, such as China and Colombia, and it is believed that the combination of infection, diet, and other factors contributes to these cancers. The bacteria may spread through contact with feces (FEE-seez), or bowel movements, found in contaminated water sources or on hands that have not been washed thoroughly.

Human lymphotropic (lim-fo-TRO-fik) virus type 1 is a virus that has been linked to the development of certain types of leukemia* and lymphoma primarily in people from Japan, the southern Pacific islands, the Caribbean, parts of central Asia, and central and western Africa. Infection with the virus often occurs at birth, but it can remain inactive for years and sometimes decades before cancer develops. The virus usually is spread through contact with contaminated blood, from prolonged exposure to an infected sexual partner, or from mother to child through breast milk. The earlier a person contracts the infection, the higher the risk for lymphoma. Most people who are infected with this virus, however, do not develop a cancer. This virus is related to the human immunodeficiency (ih-myoo-no-dih-FIH-shen-see) virus (HIV), the cause of acquired immunodeficiency syndrome (AIDS). HIV itself is an oncogenic virus that has been linked to several types of cancer, including Kaposi's sarcoma (a tumor that originates in cells that line the blood and lymph vessels), and non-Hodgkin's lymphoma (cancer of the immune system).

- * **mutation** (myoo-TAY-shun) is a change in an organism's gene or genes.
- * **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.
- * ***Helicobacter pylori*** (HEEL-ih-ko-bak-ter pie-LOR-eye) is a bacterium that causes inflammation and ulcers, or sores, in the lining of the stomach and the upper part of the small intestine, also known as peptic ulcer disease.
- * **duodenal** (do-uh-DEE-nul) refers to the upper part of the small intestine.
- * **ulcers** are open sores on the skin or the lining of a hollow body organ, such as the stomach or intestine. They may or may not be painful.
- * **leukemia** (loo-KEE-me-uh) is a form of cancer characterized by the body's uncontrolled production of abnormal white blood cells.



▲ Nerve paralysis caused this man to lose control of his eye movements. When the man looks to the right, the left eye does not move, giving him a cross-eyed appearance. ©Chris Barry/Phototake. Reproduced by permission.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **syndrome** is a group or pattern of symptoms or signs that occur together.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

How Can Oncogenic Infections Be Prevented?

Exposure to oncogenic infections does not mean that individuals will get cancer. Many people contract such infections and never get cancer. Many factors play a role in the development of cancer, and these infectious agents increase the risk only for some people. Nonetheless, avoiding exposure to these infections can lower the risk of certain types of cancer. People can avoid HIV infection, as well as human lymphotropic virus type 1 and HPV infection, by limiting the number of their sexual partners and practicing abstinence (not having sex) or safe sex. To prevent hepatitis B and C, it is essential to avoid poorly sanitized needles for tattoos, piercing, or illegal intravenous* drug use. Thorough hand washing, particularly after using a bathroom or changing a diaper, can lessen the risk of infection with *H. pylori*. It is almost impossible to avoid exposure to Epstein-Barr virus.

▶ See also **AIDS and HIV Infection • Helicobacter Pylori Infection • Hepatitis • Mononucleosis, Infectious • Sexually Transmitted Diseases (STDs) • Warts**

Resources

Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

Ophthalmoplegic Syndromes

Ophthalmoplegic syndromes are conditions in which there is complete weakness or paralysis of one or more of the muscles controlling eye movement.

What Is an Ophthalmoplegic Syndrome?

An ophthalmoplegic (off-thal-mo-ple-gik) syndrome* refers to a condition in which there is complete weakness or paralysis* of one or more of the muscles controlling eye movement. (“Ophtho” means “eye” and “plegia” means “paralysis”).

How Are Eye Movements Controlled?

The control of eye movements is complex and involves muscles, nerves, and interconnecting pathways. Three pairs of muscles are involved: the superior and inferior oblique, superior and inferior recti, and lateral and medial recti. “Recti” is the plural of “rectus,” the name for any of the four muscles of the eyeball that begin at the border of the optic opening and run forward to insert into the sclera (tissue) of the eyeball. The three nerves that originate

from the brain stem* and supply the extraocular muscles are the oculomotor (third cranial nerve), trochlear (fourth cranial nerve), and abducens (sixth cranial nerve). The medial longitudinal fasciculus (MLF) is a fiber tract that connects the third and sixth nerve nuclei of opposite sides. Various other pathways connect the cranial nerve nuclei to other parts of the brain. A disturbance in any of these components leads to ophthalmoplegia.

What Are the Symptoms for Ophthalmoplegic Syndromes?

The most common symptom is *diplopia* or double vision*. Depending on which muscle or muscles are involved, the double vision can be either in the horizontal, vertical, or slanted axis. Diplopia can involve one or both eyes, can be painful or painless, can come on suddenly or gradually, and can be congenital* or acquired. In ophthalmoplegic syndromes, besides diplopia, other neurological* symptoms and signs are also present depending on the particular syndrome (e.g., headache, limb weakness, eye swelling, lack of coordination, and numbness).

What Are Some of the Common Ophthalmoplegic Syndromes?

Congenital ophthalmoplegia

Congenital ophthalmoplegia is a rare non-progressive syndrome due to fibrosis (increased fibrous tissue) of one or several of the muscles supplied by the third nerve, leading to restriction of upward gaze.

Acquired ophthalmoplegic syndromes Acquired ophthalmoplegic syndromes can be classified by the part of the eye movement control apparatus that is involved.

Orbit In Graves' disease, in which there is too much functioning of the thyroid gland*, the extraocular muscles become bulky due to fat and connective tissue* deposits leading to a "staring look" with restriction of eye movements. Orbital fractures, direct trauma* to the eye, or tumors* may lead to muscle entrapment and ophthalmoplegia.

Extraocular muscles Progressive external ophthalmoplegia develops in late childhood or adolescence with paralysis of the extraocular muscles, droopy eyelids (ptosis), hearing loss, cataracts*, neuropathy, lack of coordination (ataxia), and sexual dysfunction.

Kearns-Sayre syndrome starts in the first or second decade with ophthalmoplegia, retinal* degeneration, ataxia, deafness, muscle weakness (face and swallowing), and heart rhythm abnormalities. These disorders are due to DNA mutation and are either inherited or occur sporadically.

Neuromuscular junction The typical disorder is myasthenia gravis, which is characterized by ptosis and extraocular, skeletal, and respiratory* muscle weakness that typically worsens with activity and improves with rest. It occurs at any age from childhood to adulthood and is due to an

* **brain stem** is the part of the brain that connects to the spinal cord. The brain stem controls the basic functions of life, such as breathing and blood pressure.

* **double vision** is a vision problem in which a person sees two images of a single object.

* **congenital** (kon-JEH-nih-tul) means present at birth.

* **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.

* **thyroid gland** (THY-roid GLAND) is located in the lower part of the front of the neck. The thyroid produces hormones that regulate the body's metabolism (me-TAB-o-LIZ-um), the processes the body uses to produce energy, to grow, and to maintain body tissues.

* **connective tissue** helps hold the body together, is found in skin, joints and bones.

* **trauma** refers to a wound or injury, whether psychological or physical. Psychological trauma refers to an emotional shock that leads to lasting psychological damage.

* **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **cataracts** (KAH-tuh-rakts) are areas of cloudiness of the lens of the eye that can interfere with vision.

* **retina** (RET-i-na) is the tissue that forms the inner surface of the back of the eyeballs; it receives the light that enters the eye and transmits it through the optic nerves to the brain to produce visual images.

* **respiratory** (RES-pi-ra-tor-ee) refers to the breathing passages and lungs.

- * **immune** (ih-MYOON) means resistant to or not susceptible to a disease.
- * **receptors** are cell structures that form a chemical bond with specific substances, such as neurotransmitters. This leads to a specific effect.
- * **toxin** is a substance that causes harm to the body.
- * **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.
- * **strokes** are events that occur when a blood vessel bringing oxygen and nutrients to the brain bursts or becomes clogged by a blood clot or other particle. As a result, nerve cells in the affected area of the brain cannot function properly.
- * **multiple sclerosis** (skluh-RO-sis), or MS, is an inflammatory disease of the nervous system that disrupts communication between the brain and other parts of the body. MS can result in paralysis, loss of vision, and other symptoms.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.
- * **Parkinson's disease** is a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.

immune* attack on acetylcholine (a chemical involved in neuromuscular transmission) receptors*.

Another disorder is botulism, in which the botulinum toxin* from certain bacteria* leads to pupil dilatation and ophthalmoplegia.

Cranial nerves or their nuclei in the brainstem A tumor, aneurysm, or clot located behind the eye can lead to painful, puffy, and paralyzed eyes. Tolosa-Hunt syndrome is an inflammatory condition of the same region that causes painful ophthalmoplegia. Various infections or infiltration of cancer cells can affect the cranial nerves, resulting in ophthalmoplegia. In the brainstem, strokes*, tumors, and multiple sclerosis* can all result in it. **Ophthalmoplegic migraine** is a type of headache that causes transient paralysis of the extraocular muscles. In diabetes*, due to interruption of blood supply, painful paralysis of one or more muscles supplied by that cranial nerve occurs.

Brainstem pathways In internuclear ophthalmoplegia, the MLF is affected by multiple sclerosis, tumor, or stroke, leading to a disturbance in conjugate (paired or parallel) eye movements.

Supranuclear structures Progressive supranuclear palsy is a rare neurodegenerative disorder affecting certain parts of the brain that exert control over the nuclei involved in eye movement, resulting in restricted upgaze, gait imbalance, dementia* and Parkinson's disease* like features. Neurodegenerative diseases such as Huntington's disease*, Wilson's disease due to impaired copper metabolism and Wernicke's disease due to thiamine deficiency from chronic alcohol use also cause impaired upward gaze.

Higher brain structures Injury to various parts of the cerebral cortex* due to tumors, strokes, and trauma can also result in ophthalmoplegia.

Medications Intoxication with antipsychotics* such as phenothiazines, antidepressants used for treating depression, and anticonvulsants* such as phenytoin can result in ophthalmoplegia. Deficiency of thiamine and vitamin E can also cause it.

How Is an Ophthalmoplegic Syndrome Diagnosed?

Diagnosis is made by a neurologist*, an ophthalmologist*, or by a neurologist who specializes in eye disorders (neuro-ophthalmologist). Diagnosis is made by a combination of thorough history taking, physical exam, and laboratory tests.

History Taking a thorough medical history requires asking such questions as the following:

- How did the diplopia start?
- How long has it been present? Is there any fluctuation in the diplopia?

- In which direction is the diplopia worst? Does it get better by covering one eye or by tilting the head?
- Is there any pain?
- Was there any trauma?
- Are there other family members with diplopia?
- Are there other eye symptoms, such as ptosis, decreased vision, or uncontrollable jerking of eyes?
- Are there other symptoms, such as headache, muscle weakness, or numbness?
- Is there any history of diabetes, stroke, migraine, or thyroid problems?

Physical examination Eyes are examined for protrusion, redness, ptosis, and tenderness. Then, eye movements are examined separately in each eye and together in both eyes. A red glass or prism in front of each eye helps to pinpoint the eye and the muscle that is responsible for the false image leading to diplopia. Pupils are examined with respect to their reaction to light. A dilated eye exam is done to examine other structures, such as the retina. Finally a thorough neurological* exam includes systematic tests of how well various parts of the nervous system are functioning. A general physical exam is performed also.

Laboratory testing Laboratory testing includes a complete blood count, blood chemistry profile, and thyroid testing. Based on the history and physical exam, one or more of the following tests may be performed:

1. Brain imaging by computerized tomography* (CT scan) or magnetic resonance imaging* (MRI) to rule out stroke, cancer, aneurysm, or multiple sclerosis
2. Electromyogram to determine muscle electrical activity
3. Nerve conduction or evoked potential testing for determining nerve activity and response for conditions such as diabetes and multiple sclerosis respectively
4. Cerebrospinal fluid* analysis by spinal tap for infections, multiple sclerosis, and cancer
5. Tests for electrical activity of the heart (electrocardiogram) and hearing (audiogram)
6. Muscle biopsy* in conditions such as muscular dystrophy*.
7. In myasthenia, testing for acetylcholine activity (Tensilon test) or detecting acetylcholine receptor antibodies
8. Genetic analysis for DNA* mutation*

How Is Ophthalmoplegia Treated?

Specific treatment depends on the syndrome. Myasthenia gravis is treated with corticosteroids*; diabetes with insulin* or medications; and multiple sclerosis with immunosuppressants*. Vitamin E has been tried in

* **Huntington's disease** is a genetic condition that leads to involuntary twitching or jerking of the muscles in the face, arms, and legs along with a gradual loss of mental abilities.

* **cerebral cortex** (suh-REE-brul KOR-tek) is the part of the brain that controls functions such as conscious thought, listening, and speaking.

* **antipsychotics** describes a type of medication that counteracts or reduces the symptoms of a severe mental disorder such as schizophrenia.

* **anticonvulsants** (an-tie-kon-VUL-sents) are medications that affect the electrical activity in the brain and are given to prevent or stop seizures.

* **neurologist** (new-RHAL-eh-jist) a physician who specializes in diagnosing and treating diseases of the nervous system.

* **ophthalmologist** (off-thal-MOLL-o-jist) is a medical doctor who specializes in treating diseases of the eye.

* **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

* **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.

- * **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- * **muscular dystrophy** (DIS-tro-fee) is a group of inherited disorders that causes muscle weakening that worsens over time.
- * **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.
- * **mutation** (myoo-TAY-shun) is a change in an organism's gene or genes.
- * **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.
- * **insulin** is a kind of hormone, or chemical produced in the body, that is crucial in controlling the level of glucose (sugar) in the blood and in helping the body use glucose to produce energy. When the body cannot produce or use insulin properly, a person must take insulin or other medications.
- * **immunosuppressants** (im-yoo-no-su-PRES-ants) are substances that weaken the body's immune system.
- * **pacemaker** a device whose function is to send electrical signals that control the heartbeat. The heart's natural pacemaker is the sinoatrial node, a special group of cells. Sometimes it is necessary to implant a battery-powered pacemaker that sends small electrical charges through an electrode placed next to the wall of the heart.

Kearns-Sayre syndrome and Coenzyme Q in progressive external ophthalmoplegia, but there is no definitive treatment for these. A pacemaker* may be needed in Kearns-Sayre syndrome. All syndromes benefit from symptomatic treatment for alleviating diplopia. The basic principle is to abolish the abnormal image from the eye with the weak muscle by using an eye patch, special glasses with prisms, or by surgery for ptosis.

What Is the Prognosis for Ophthalmoplegic Syndromes?

The prognosis depends to a large part on the underlying condition that produced the ophthalmoplegia and the presence of additional organ or neurological dysfunction. Several ophthalmoplegic syndromes resolve with time, such as those due to diabetes and mild trauma. Kearns-Sayre syndrome is disabling and shortens life expectancy. Patients with multiple sclerosis have significant disability from other neurological complications and have a slightly shortened life expectancy.

Resources

Books and Articles

Wong, Agnes. *Eye Movement Disorders*. New York: Oxford University Press, 2008.

Organizations

American Academy of Neurology. 1080 Montreal Ave, St. Paul, MN, 55116. Telephone: 612-695-1940. Web site: <http://aan.com>.

American Academy of Ophthalmology. P.O. Box 7424, San Francisco, CA, 94120. Telephone: 415-561-8500. Web site: <http://aao.org>.

Oppositional Defiant Disorder

A child whose behavior is overly hostile, negative, and purposefully disobedient much of the time for a period of more than six months may have oppositional (op-po-ZI-shun-al) defiant* (dee-FY-ent) disorder.*

What Is Oppositional Defiant Disorder?

Oppositional defiant disorder (ODD) is a type of disruptive behavior problem in children. Children with ODD often lose their temper, act stubborn and willful, argue, and refuse to follow rules, and they may annoy others on purpose. Some oppositional behavior is quite common

and normal in children. Examples of oppositional behavior are refusing to follow rules, directions, or requests given by adults in charge. While all children may act in these ways occasionally, ODD is diagnosed in those children who act in these ways frequently and whose oppositional behavior seriously interferes with their ability to get along with others in school, on the playground, or at home. ODD can start as early as the preschool years and can be diagnosed in children and adolescents of any age whose defiant behavior is the cause of problems at home, in school, or with peers. Children with ODD have at least four of the following problem behaviors to a greater degree than expected for their age for at least six months:

- Become easily annoyed
- Lose temper often
- Feel and act angry and resentful
- Argue with adults
- Refuse to do what adults request
- Actively defy the rules of behavior at home or in the classroom
- Blame others for their own mistakes
- Deliberately annoy others

Children with ODD are often set in their ways (inflexible) and stubborn. They may have other problems as well, such as hyperactivity*, anxiety*, or depression*. ODD is sometimes an early sign of another behavioral disorder called conduct disorder*. Some, but not all, children with ODD go on to show signs of conduct disorder when they are older. While there are some similarities between ODD and conduct disorder, children and adolescents with ODD do not demonstrate the physical aggression or property destruction that is typical of those with conduct disorder.

What Causes Oppositional Defiant Disorder?

There is no single cause of ODD. Some experts believe that certain children may develop oppositional problems because they are less adaptable and overly sensitive by nature. For example, some children seem to find it especially hard to handle frustration and who become easily upset even by minor situations or disappointments. When they are frustrated, such children have extreme difficulty coping and adapting. They may act stubborn, defiant, and inflexible. Some children are more irritable and touchy by nature. They may be particularly upset by the way certain clothing feels or by tastes or smells, and they may act even more cranky, oppositional, and defiant when they are tired or hungry.

Family environment also can contribute to oppositional defiant disorder. In families in which there is much conflict, harsh discipline, aggressive behavior, or inconsistent rules for behavior, children are more likely to develop oppositional defiant disorder because they are learning to relate to others in hostile, argumentative ways.

* **oppositional** (op-po-ZI-shun-al) is an attitude of going against something or refusing in a combative way.

* **defiant** (dee-FY-ent) is an attitude of challenging the rules in a hostile way or of being disobedient on purpose.

* **hyperactivity** (hy-per-ak-TI-vi-tee) is overly active behavior, which makes it hard for a person to sit still.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **conduct disorder** is diagnosed in children and adolescents who have had serious problems with lying, stealing, and aggressive behavior for at least 6 months.

* **salivary glands** (SAL-i-var-ee glands) are the three pairs of glands that produce the liquid called saliva, which aids in the digestion of food.

* **mucous membranes** are the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.

How Is Oppositional Defiant Disorder Treated?

Children with oppositional defiant disorder may work with a mental health expert. Often children with ODD are referred by their parents or by school personnel because their behavior is so difficult to manage. Treatment involves helping the child learn to handle frustration, develop more cooperative forms of behavior, and acquire more skills for solving problems and adapting to situations. Parents may be coached to make clear and simple rules for the child, to reward the child's positive behavior patterns, and to enforce consequences for the oppositional ones. When oppositional defiant disorder is treated early, more serious problems with conduct disorder may be prevented.

▶ See also **Conduct Disorder**

Resources

Books and Articles

Barkley, Russell A., and Arthur L. Robin. *Your Defiant Teen: 10 Steps to Resolve Conflict and Rebuild Your Relationship*. New York: Guilford Press, 2008.

Long, Jody E., Nicholas J. Long, and Signe Whitson. *The Angry Smile: The Psychology of Passive-Aggressive Behavior in Families, Schools, and Workplaces*, 2nd ed. Austin, TX: Pro-Ed, 2009.

Organizations

American Academy of Child and Adolescent Psychiatry. 3615 Wisconsin Avenue NW, Washington, DC, 20016-3007. Telephone: 202-966-7300. Web site: http://www.aacap.org/cs/root/facts_for_families/children_with_oppositional_defiant_disorder.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/001537.htm>.

Oral Cancer

Oral cancer (also known as mouth cancer) occurs when cells in the tissues of the mouth or throat divide without control or order, forming abnormal growths.

What Is Oral Cancer?

Oral cancer usually begins in the tissues that make up the lips, tongue, or cheek lining, but it also can affect the gums, the floor or the roof of the mouth, or the salivary glands*. In almost all cases, it is caused by the use of substances that irritate the mucous membranes* in the mouth: spit

tobacco (also called chewing tobacco or snuff), cigarettes, cigars, pipes, or alcohol. Over time, this constant irritation takes its toll, and some of the tissue takes on an abnormal appearance and eventually turns cancerous. Oral cancer most commonly appears in men over the age of 45 who have been longtime users of tobacco and alcohol.

Many oral cancers begin as whitish or reddish patches in the mouth, called leukoplakia (loo-ko-PLAY-kee-a) or erythroplakia (e-rith-row-PLAY-kee-a). Other symptoms may include the following:

- a sore on the lip or in the mouth that does not heal
- a lump on the lip or in the mouth or throat
- unusual bleeding, pain, or numbness in the mouth
- a sore throat that does not go away or a feeling that something is caught in the throat
- difficulty or pain with chewing or swallowing
- swelling of the jaw
- pain in the ear
- a change in the voice

Most dentists check for signs of oral cancer as part of a usual dental examination. Early detection is the key to treating it successfully.



▲ A polyp, or mucocele (MU-ko-seel), formed inside the mouth's mucous membrane is a common sign of oral cancer. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

A MAJOR LEAGUE FIGHT AGAINST SPIT TOBACCO

For many years, baseball great Joe Garagiola (b. 1926) waged a one-man battle against the prevalent use of spit tobacco, also called chewing tobacco, snuff, or chew, by major league baseball players. A former user of spit tobacco, Garagiola was concerned both about the players' health and about the effect their behavior was having on young fans. He wanted to convey the message that just because spit tobacco is smokeless does not mean it is safe. To the contrary, it is a major cause of oral cancer.

In 1996, Garagiola collaborated with the group Oral Health America to found the National Spit Tobacco Education Program (NSTEP) and get other players involved with the cause. Bill Tuttle, who started using spit tobacco as an outfielder in the 1950s and 1960s, gave talks based on his own experiences with oral cancer. NSTEP recruited players Lenny Dykstra, Mike Piazza, Tino Martinez, Alex Rodriguez, and Paul Molitor to do anti-tobacco spots that were broadcast during games. In 2009 Garagiola continued his involvement with NSTEP and served as one of their speakers.

The mission of the National Spit Tobacco Education Program is to prevent people, especially young people, from starting to use spit tobacco and to help all users quit.

* **lymphatic system** (lim-FAH-tik) is a system that contains lymph nodes and a network of channels that carry fluid and cells of the immune system through the body.

* **radiation** is energy that is transmitted in the form of rays, waves, or particles. Only high-energy radiation, such as that found in x-rays and the sun's ultraviolet rays, has been proven to cause human cancer.

* **gum disease** is an infection caused by bacteria that affect the tissues surrounding and supporting the teeth.

* **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.

Otherwise, it can spread throughout the mouth, throat, neck, and even to distant parts of the body through the lymphatic system*.

How Is Oral Cancer Diagnosed and Treated?

When dentists or doctors find a suspicious-looking area in the mouth, they may order a biopsy. During this procedure, a surgeon removes part or all of the suspect tissue. Examination under a microscope determines whether cancer cells are present. Once oral cancer is diagnosed, doctors then need to find out whether the cancer has spread.

The first course of treatment is to remove the tumor and any cancerous tissue in the mouth. If there is evidence that the cancer has spread, the surgeon may also remove lymph nodes in the neck as well as part or all of the tongue, cheek, or jaw.

Doctors may also order radiation* therapy, either before the surgery to shrink the tumors, or afterward to destroy any remaining cancer cells. In some cases, surgeons may place tiny "seeds" containing radioactive material directly into or near the tumor. Generally, this implant is left in place for several days, and the patient stays in the hospital.

ORAL CANCER AND TOBACCO

The Centers for Disease Control and Prevention and the National Association of Health Education Centers have compiled statistics about spit tobacco use.

- In the United States, about one out of ten boys and one out of fifty girls in high school use smokeless or spit tobacco.
- According to a 2005 survey, an estimated 3 percent of adults in the United States were currently smokeless tobacco users. Smokeless tobacco use is much higher among men (6%) than women (0.4%). Smokeless tobacco use is most common among young adults ages 18 to 25.
- Another 2005 survey found that an estimated 8 percent of high school students were currently smokeless tobacco users. Smokeless tobacco is more common among males (13.6%) than female high school students (2.2%). Estimates by race/ethnicity are 10.2% for white, 5.1% for Hispanic, and 1.7% for African-American high school students.
- Smokeless tobacco contains 28 cancer-causing agents (carcinogens).
- Spit tobacco use by adolescents is associated with early indicators of gum disease* and unusual lesions* in oral tissue.

A 2008 study from the WHO International Agency for Research on Cancer concluded that smokeless tobacco users have an 80 percent higher risk of developing oral cancer and a 60 percent higher risk of developing pancreatic and esophageal cancer.

Chemotherapy is another possible treatment for oral cancer, especially when it has spread beyond the mouth. It involves taking anti-cancer drugs by injection or in pill form.

Life after Oral Cancer

People who are treated for large or widely spread oral tumors often experience permanent changes that are challenging to deal with, both emotionally and physically. If they lose part of their jaw, tongue, cheek, or palate (the roof of the mouth), they need reconstructive and plastic surgery. If surgery is not possible, they may need to use an artificial dental or facial part called a prosthesis*. In either case, their appearance will be changed permanently.

These people are also likely to have some difficulty chewing and swallowing, and they may lose their sense of taste. For these reasons, weight loss can be a problem after treatment for oral cancer.

Many patients have trouble speaking after losing part of their mouth or tongue. Speech therapists work with them both during and after their hospital stay to help them get back to speaking as normally as possible.

How Is Oral Cancer Prevented?

People can prevent oral cancer by not using spit tobacco or smoking cigarettes, cigars, or pipes, or quitting if they already do. If they drink alcohol, they should not have more than one or two drinks per day.

▶ See also **Cancer: Overview • Tobacco-Related Diseases**

Resources

Books and Articles

Sharp, Katie John. *Smokeless Tobacco: Not a Safe Alternative*. Broomall, PA: Mason Crest, 2009.

Organizations

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://cancernet.nci.nih.gov/cancertopics/wyntk/oral>.

National Institute of Dental and Craniofacial Research. 45 Center Drive, MSC 6400, Bethesda, MD, 20892. Telephone: 301-496-4261. Web site: <http://www.nidcr.nih.gov/OralHealth/Topics/OralCancer>.

Oral Cancer Foundation. 3419 Via Lido, #205, Newport Beach, CA, 92663. Telephone: 949-646-8000. Web site: <http://www.oralcancerfoundation.org>.

* **prosthesis** (pros-THEE-sis) is an artificial substitute for a missing body part. It can be used for appearance only or to replace the function of the missing part (as with a prosthetic leg).

* **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.

* **benign** (be-NINE) means a condition is not cancerous or serious and will probably improve, go away, or not get worse.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.

Oral Infections

Oral infections are infections that occur in or around the mouth.

What Are Oral Infections?

Bacteria and viruses usually cause oral infections. They can affect the teeth, gums, palate (PAL-it, the roof of the mouth), tongue, lips, and inside of the cheeks. Simple oral infections are limited to the mouth and are different from oral lesions*, which are non-infectious and may be a sign of an illness that involves other parts of the body.

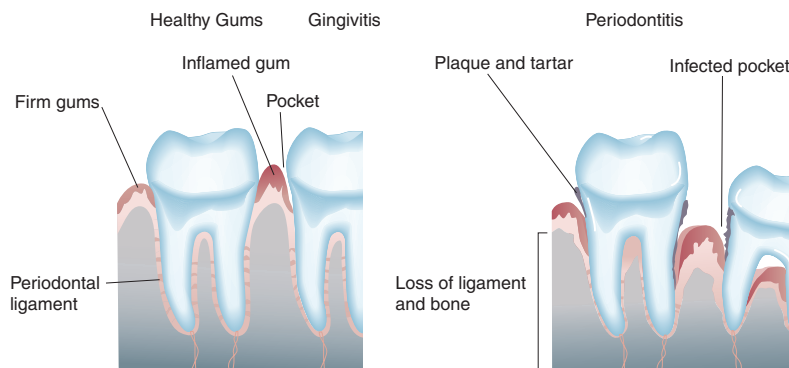
Oral infections are very common. Tooth decay is the second most common infectious condition, after the common cold.

Many oral infections are not contagious because bacteria that exist naturally in every person's mouth cause them. However, herpangina (herpan-JY-na) and recurrent herpes labialis (HER-pee-z lay-be-AL-us) are contagious and spread through contact with fluid from an infected person's mouth and nose.

What Are Some Common Oral Infections?

Canker sores Canker sores, also called aphthous (AF-thus) ulcers, are painful but benign* sores that occur on the tongue, inside of the lips and cheeks, gums, and palate. There is no evidence that canker sores are caused by an infectious organism. However, they are very common and can be confused with the sores that appear with some mouth infections. The ulcers may appear one at a time or in groups. They are small, pale, shallow, gray-white, and usually surrounded by bright red tissue.

These sores most frequently affect children and young adults. Sometimes they erupt when people accidentally bite the inside of their mouth or at the spot where braces rub the inside of the cheek. Stress, sensitivity to a particular food, not getting enough iron or B vitamins, and changes in hormones*, like those that occur during women's normal menstrual cycle*, also may trigger canker sores. Often there is no apparent



Healthy gums (left) with no pockets or redness; gingivitis (center) with inflamed gum and pocket; and periodontitis (right) with infected pockets, plaque and tartar. *Illustration by Argosy. Reproduced by permission of Gale, a part of Cengage Learning.*

reason why a person develops a canker sore, although some people may be more likely to have them, especially if other people in their family have had canker sores. Canker sores were once thought to result from infection, but no infectious agent was identified. Later it was suspected that something triggers the immune system, and the cells that normally fight infection “attack” the body’s own tissue, leading to a canker sore.

Someone who has a canker sore may feel a tingling or burning sensation before a sore, reddish spot appears. The pain from a canker sore lasts up to 10 days, and the sore heals completely in one to three weeks. Canker sores usually come and go throughout a person’s life. Occasionally, a person who develops a severe outbreak of canker sores may have a fever or a generally ill feeling.

A doctor (or dentist) usually diagnoses canker sores simply by examining the sore. Rarely, a biopsy* may be taken if the sore is unusually large or is not healing as expected; such a test can distinguish the canker sore from other types of mouth ulcers. These sores heal without treatment, but over-the-counter medicines for canker sores can ease pain. People with more serious sores may be prescribed medication to apply to them. Experts advise anyone with a canker sore to avoid acidic, hot, or spicy foods and to rinse the mouth and gargle with warm saltwater to relieve pain. There is no known way to prevent the sores.

Cavities Dental caries (KARE-eez), also known as tooth decay and cavities, are areas where the hard enamel of a tooth has been destroyed, leaving small holes that are susceptible to further decay. Tooth decay occurs most frequently in children and teens and is the leading cause of tooth loss in younger people. Up to 80 percent of teens have had cavities by the time they finish high school, although tooth decay is much less common in the early 2000s than it was before fluoride supplements and regular dental care were available to most people.

Bacteria that live in the mouth, especially certain kinds of streptococcus (strep-tuh-KAH-kus), cause tooth decay. The bacteria change food, particularly sweet and starchy foods, into acid, which eats away at the enamel of teeth. The acid, bacteria, and bits of food in the mouth combine into a thin film called plaque (PLAK), which coats the teeth and collects in their grooves. A person with dental caries may experience pain or sensitivity in the affected tooth, usually when eating cold, hot, or sweet foods. Some people may not feel anything at all until the cavity extends into the middle part of the tooth, which houses the tooth’s blood vessels and nerves. If left untreated, caries can lead to long-term tooth sensitivity, abscesses*, weakened teeth that can break easily, and even tooth loss.

Sugary foods and drinks and other foods contain carbohydrates* that increase the risk of tooth decay. Frequent meals and snacks also give the bacteria more chances to produce acid. Infants and young children who sip milk or juice throughout the day or go to bed with a bottle may develop bottle caries, a pattern of tooth decay that can damage baby teeth extensively.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **abscesses** (AB-seh-sez) are localized or walled off accumulations of pus caused by infection that can occur anywhere within the body.

* **carbohydrates** are nutrients in food that help provide energy to the body.

* **ligaments** (LIG-a-ments) are bands of fibrous tissue that connect bones or cartilage, supporting and strengthening the joints. Ligaments in the mouth hold the roots of teeth in the tooth sockets.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

* **periodontal** (pare-e-o-DON-tul) means located around a tooth.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **tonsils** are paired clusters of lymphatic tissue in the throat that help protect the body from bacteria and viruses that enter through a person's nose or mouth.

Tooth decay usually is diagnosed during regular dental visits, and, depending on how badly the tooth has decayed, it may be treated with a filling, crown, or root canal (surgery to remove the pulp of the tooth). A dentist can apply a protective sealant to the molars or use fluoride to help prevent caries. Limiting sweets and frequent snacks; good dental hygiene (brushing and flossing); getting fluoride from drinking water, toothpaste, or other supplements; and regular dental visits are the best ways to prevent tooth decay.

Gingivitis Gingivitis (jin-juh-VY-tis) is inflammation of the gums, also known as the gingiva. It is caused by plaque that coats the teeth along the gum line. The bacteria and acid inflame and irritate the gums, making them red, swollen, and tender. If the plaque is not removed by brushing, flossing, and regular dental visits, it hardens into tartar at the base of the teeth and at the gum line, which further irritates the gums. As gingivitis progresses, the buildup of plaque and tartar causes the gums to recede and affects the ligaments* and bones supporting the teeth. Gingivitis often appears during puberty* or early adulthood, and it is the first stage of periodontal* disease.

Causes of gum irritation, which can lead to gingivitis, include the following:

- poor dental care and habits
- dental devices or appliances (such as bridges or braces) that have rough, irritating edges
- extremely vigorous tooth brushing or flossing
- teeth that are not aligned properly
- pregnancy
- poorly controlled diabetes* or certain other long-lasting illnesses

Swollen, bright red, tender gums that bleed easily and mouth sores are signs of gingivitis. It is diagnosed by examining the gums during a dental visit, and dental x-rays may be taken to determine how much damage has been done to underlying structures in the mouth. People with gingivitis are treated with a thorough dental cleaning, followed by careful and regular at-home cleaning of the teeth and gums. Antibacterial mouthwash also may be prescribed. Gingivitis will not clear up on its own and can progress to serious periodontal disease that eventually affects the ligaments that hold the teeth in the gums and the tooth sockets, leading to tooth loss. Untreated gingivitis also may cause abscesses or a condition known as trench mouth, which is a severe and painful form of gum disease.

Herpangina Herpangina is an infection marked by painful sores on the roof of the mouth, the tonsils*, and sometimes the inside of the cheeks. The lesions start as small bumps but become whitish sores with a red border. Herpangina usually is caused by coxsackievirus (kok-SAH-kee-vy-rus), which also causes hand, foot, and mouth disease; in hand,

foot, and mouth disease, small blisters are found on the palms and the soles as well as in the mouth. A day or two before the sores of herpangina appear, a person may have a fever, sore throat, and headache. Symptoms last less than a week.

Herpangina tends to affect young children and occurs most frequently in summer and fall. Like many other infections from common viruses, it is difficult to prevent. A doctor diagnoses herpangina by examining the appearance and location of the patient's lesions. Treatment includes drinking enough fluid and using over-the-counter medication such as acetaminophen* for pain and fever relief. A person may also apply numbing cream to the lesions to ease discomfort.

Gingivostomatitis Gingivostomatitis (jin-juh-vo-sto-muh-TY-tis) is an infection of the gums and mouth caused by herpes simplex virus type 1 (genital* herpes is caused by herpes simplex virus type 2) and other common childhood viruses. As with herpangina, fever and illness appear before the mouth sores do. The lesions begin as blisters that pop soon after they form, leaving the base of the blister. When this covering peels off, a tender ulcer is formed. It looks grayish or yellowish with a red border. These painful sores often make it difficult to eat.

The diagnosis of gingivostomatitis is based on the presence of mouth sores, usually accompanied by other symptoms of a viral illness. Gingivostomatitis caused by herpes virus has a distinctive appearance and usually does not require more tests. Cultures* or biopsies* rarely are done. Treatment for gingivostomatitis includes easing pain and preventing dehydration*. Over-the-counter pain medicine, medicated mouthwash or saltwater gargles, or numbing cream may provide some relief. Brushing teeth and gums gently helps prevent bacterial infection of the sores. Fluids and a bland diet are recommended as well.

Herpes Recurrent herpes labialis, also known as cold sores or fever blisters, is a condition caused by herpes simplex virus type 1. Cold sores are extremely common. Most Americans are infected with the virus by age 20. The virus stays in the body for life, although it usually causes no disease or only an occasional cold sore in most people. Many factors can trigger a reactivation of the herpes virus and recurrent cold sores, such as fever, sun exposure, and stress.

Burning, tingling, or itching may occur a day or two before a small, sometimes painful blister appears on the gums, lips, inside of the mouth, or around the mouth. The blister is filled with clear or yellowish fluid. Shortly after it forms, the sore crusts over, and the crust eventually falls off. Sometimes a person also develops a mild fever or feels ill.

A doctor diagnoses herpes labialis based on the appearance of the cold sores, although fluid from a blister may be examined or cultured to confirm the diagnosis. Patients with cold sores often report having had them before. The blisters usually disappear on their own after one to two weeks, but if a person has frequent or severe cold sores, a doctor may prescribe

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **genital** (JEH-nih-tul) refers to the external sexual organs.

* **cultures** (KUL-churz) are tests in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **biopsies** (Bl-op-seez) are tests in which small samples of skin or other body tissue are removed and examined for signs of disease.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **vaginal** (VAH-jih-nul) refers to the canal in a woman that leads from the uterus to the outside of the body.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

antiviral medication to shorten the outbreak. However, the medicine does not get rid of the virus. When cold sores appear, ice or warm compresses may ease any discomfort or pain.

Cold sores are contagious. Kissing spreads the virus by direct contact, but the virus may spread indirectly by sharing food, drinks, lipstick, or utensils. It is difficult to prevent this infection because it can spread when no sores are visible.

Thrush Thrush, or candidiasis (kan-dih-DYE-uh-sis), is an overgrowth of *Candida*, a yeast-like fungus that can thrive in moist areas around body openings such as the mouth. Candidiasis can cause cracks in the corners of the mouth, and the lips, tongue, palate, and inside of the cheeks can have crusty whitish or yellowish patches. *Candida* also can cause other conditions, such as diaper rash and vaginal* yeast infections.

Thrush generally is not contagious, but newborns may come in contact with the fungus during birth if the mother has a vaginal yeast infection. People with weakened immune systems, such as those with AIDS* or cancer, may be more susceptible to thrush.

How Can People Prevent Oral Infections?

Frequent hand washing and avoiding exposure to people who are sick whenever possible helps prevent the spread of viral infections. Taking care of the teeth and mouth also goes a long way toward preventing oral infections. Tips for good oral hygiene include the following:

- Visiting a dentist regularly (every six months) for teeth cleanings and check-ups, and brushing teeth twice daily. Fluoride toothpaste is recommended for children; anti-tartar toothpaste is recommended for adults.
- Brushing the gums and tongue gently.
- Flossing daily.
- Brushing teeth after eating sugary or starchy foods.
- Wearing a helmet, and possibly a mouth guard, when playing certain sports, such as football or hockey, to protect teeth from injury.
- Not using tobacco products.

▶ See also **Abscesses • Coxsackievirus and Other Enteroviruses • Herpes Simplex Virus Infections**

Resources

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/OralHealth/index.htm>.

National Institute of Dental and Craniofacial Research. 45 Center Drive, MSC 6400, Bethesda, MD 20892. Telephone: 301-496-4261. Web site: <http://www.nidcr.nih.gov>.

Osgood-Schlatter Disease

Osgood-Schlatter disease is a condition that causes knee pain in some children during their adolescent growth spurt.

Danny's Story

Danny's twelfth birthday marked the beginning of soccer season, a four-inch growth spurt, and a lot of pain in his right knee. When Danny's coach asked him why he was limping, Danny told him that his knee hurt, especially when climbing stairs, kneeling, or jumping. His coach called his parents and suggested they take Danny to the doctor.

Danny's doctor examined the tender, swollen knee. When she gently pressed the area just below the kneecap, Danny grimaced in pain. The results from the rest of the examination were normal. Danny was diagnosed as having Osgood-Schlatter (OZ-good SHLAT-er) disease.

This diagnosis scared Danny at first, but quickly the doctor eased his mind by explaining that Osgood-Schlatter disease is a condition in adolescents that almost always goes away on its own. It was named for an American surgeon, Robert Bayley Osgood (1873–1956), and a Swiss surgeon, Carl Schlatter (1864–1934), hence the long, serious-sounding name.

What Is Osgood-Schlatter Disease?

Osgood-Schlatter disease refers to pain that occurs at the bump on the shin bone, or tibia (TIB-e-a), just below the knee. At this spot a tendon* from the muscles of the thigh attaches to the shin after passing over the kneecap. Sometimes, especially during the adolescent growth spurt, the place where the shin bone is actively growing partially detaches from the rest of the bone, resulting in pain and swelling. This problem most often occurs in children between the ages of 10 and 15, especially those who are active in sports, and it affects more boys than girls.

Osgood-Schlatter disease usually goes away after the growth spurt ends. To treat the symptoms, doctors suggest taking over-the-counter pain medicine such as ibuprofen* or acetaminophen*, stretching well before exercising, and cutting back on sports that require contraction of the quadriceps (KWOD-riseps) muscle of the thigh, such as squat thrusts or running. Some doctors put a cast on the leg to limit a child's activity. Continuing to play sports usually does not make the condition worse, but it can delay the healing process. In a few cases, the problem does not go away on its own because abnormal bony structures form or small pieces of bone become detached. In these cases, surgery may be required to remove the bone fragments.

Remember R-I-C-E

When treating pain from sprains, strains, or other limb-related conditions, it's helpful to remember the "RICE" treatment.

R = Rest the injury from the painful activity.

I = Ice the affected area for 20 minutes, 3 times a day.

C = Compress the painful area with an elastic bandage.

E = Elevate the leg.

* **tendon** (TEN-don) is a fibrous cord of connective tissue that attaches a muscle to a bone or other structure.

* **ibuprofen** (eye-bew-PRO-fin) is a nonsteroidal anti-inflammatory drug (NISAD) used to reduce fever and relieve pain or inflammation.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

Resources

Organizations

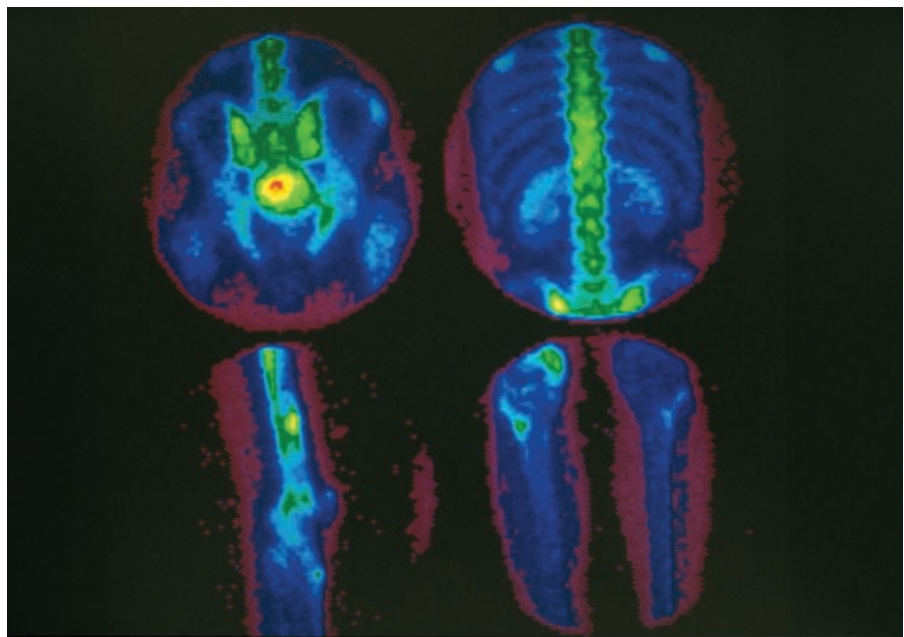
American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://familydoctor.org/online/famdocen/home/children/parents/special/bone/135.html>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/MEDLINEPLUS/ency/article/001258.htm>.

Osteoarthritis *See Arthritis.*

Osteomyelitis

Osteomyelitis (ah-stee-o-my-uh-LYE-tis) is a bone infection that is usually caused by bacteria. It can involve any bone in the body, but it most commonly affects the long bones of the arms and legs.



Special bone scans are used to diagnose osteomyelitis. The affected areas of bone “light up” on these scans. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

What is Osteomyelitis?

Osteomyelitis usually is caused by infection with bacteria. *Staphylococcus aureus* (stah-fih-lo-KAH-kus ARE-ree-us), streptococcal (strep-tuh-KAH-kul) species of bacteria, and *Pseudomonas aeruginosa* (su-doe-MO-nas-air-ew-jih-NO-suh) are the major organisms associated with osteomyelitis. These bacterial intruders can travel from other parts of the body, such as the ear, throat, or intestines*, through the bloodstream and to a bone, where they can start an infection. Bones that have been weakened or damaged, such as one that has been injured recently, are more susceptible to bacterial invasion. When there is trauma* to the bone, such as a puncture wound from stepping on a nail, bacteria can infect the bone directly. Rarely, fungi may cause osteomyelitis and the spread through the body of tuberculosis (too-ber-kyoo-LO-sis), a contagious disease caused by another bacteria mycobacterium tuberculosis, that typically affects the lungs, also can lead to bone infection, usually in the spine.

In children, osteomyelitis occurs most often in the long bones of the leg, such as the femur (FEE-mur) and tibia (TIH-be-uh). Adults tend to have the infection in the hipbones and vertebrae*, where it may occur following surgery on a bone or from an infection that has spread from the skin. People with diabetes* can have osteomyelitis in the foot bones from ulcerations* ulcers* on their feet.

Acute versus Chronic Osteomyelitis

Osteomyelitis that evolves rapidly is called acute* osteomyelitis. If a bone infection persists because it is not treated or it does not respond to treatment, it is known as chronic* osteomyelitis.

When the bone becomes infected in acute osteomyelitis, the skin that covers the bone usually becomes inflamed and swollen. The condition is diagnosed by a blood culture, by a biopsy* (tissue sample), or by an x-ray or bone scan examination. If acute osteomyelitis is confirmed, antibiotic treatment begins immediately, often with an excellent chance of complete recovery.

When osteomyelitis is not treated or does not respond to treatment, it may become a chronic, or long-term, condition. In its chronic stages, osteomyelitis can be very painful and cause considerable damage to the infected bones. Sometimes this chronic form develops from compound fractures (in which case the broken bone punctures the skin and is exposed). Antibiotics are used to treat chronic osteomyelitis, but sometimes surgery is also required to remove infected areas of bone because over time, the infection may interfere with the blood supply to the bone, causing the bone tissue to die.

In rare cases, tuberculosis, an infection of the lungs and sometimes other parts of the body, can spread to bones (especially the spine), causing a form of osteomyelitis. When tuberculosis is involved, drugs to combat tuberculosis are used to treat both conditions.

- * **intestines** are the muscular tubes that food passes through during digestion after it exits the stomach.
- * **trauma** refers to a wound or injury, whether psychological or physical. Psychological trauma refers to an emotional shock that leads to lasting psychological damage.
- * **vertebrae** (VER-tuh-bray) are the bones that form a column surrounding the spinal cord; there are 39 vertebrae in the spine.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **ulcerations** are open sores on the skin or tissue lining a body part.
- * **ulcers** are open sores on the skin or the lining of a hollow body organ, such as the stomach or intestine. They may or may not be painful.
- * **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.
- * **chronic** (KRAH-nik) lasting a long time or recurring frequently.
- * **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **pus** is a thick, creamy fluid, usually yellow or ivory in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

How Common Is Osteomyelitis?

Chronic osteomyelitis occurs in about 2 in 10,000 adults. Children have the acute form of the disease more often than adults do, at a rate of about 1 in 5,000. Children commonly have blood stream spread of infection to long bones because actively growing bones are quite vascular. Adults in whom the long bones are not growing and are less vascular have blood stream spread to the bones of the spine. People who have diabetes, who have had a traumatic injury recently, or who use intravenous* drugs are at greatest risk for chronic infection.

Is It Contagious?

Bone infections are not contagious. However, some types of bacteria that cause the infections that can progress to osteomyelitis are passed from person to person.

What Are the Signs and Symptoms of Osteomyelitis?

The first sign of acute infection may be a fever that begins suddenly. The area over the infected bone may become warm, red, and swollen, and the joints next to the bone may swell as well. As the infection progresses, it can cause pain in the affected bone and may limit the person's movement in that area. Individuals with acute osteomyelitis may feel irritable, nauseated, and generally, very ill. They usually respond to intravenous antibiotic treatment; however, the medication is often irritating at the site of infusion.

Patients with chronic bone infection may experience drainage of pus* through the skin covering the affected bone. Due to local pain and drainage caused by the infection, individuals having chronic osteomyelitis usually require surgical removal of dead infected bone.

A HISTORIC INFECTION

Some cases of osteomyelitis last for years, even a lifetime. Joshua Lawrence Chamberlain (1828–1914) rose to the rank of general during the American Civil War and was a hero in the Battle of Gettysburg. General Ulysses S. Grant selected Chamberlain to receive the official surrender of the Confederate Army's weapons at Appomattox, Virginia, in 1865. Chamberlain later served as governor of Maine and president of Bowdoin College. Before he reached that lofty standing, Confederate soldiers had shot him in the groin in a battle at Petersburg, Virginia, in 1864. The ball pierced both hipbones, but despite the crude battlefield surgery of the time he survived his injury. His wound never healed completely, though, and Chamberlain lived another 50 years with chronic osteomyelitis. He died in 1914, at the age of 85, from complications of that long-lasting wound.

How Is the Disease Diagnosed?

To help make the diagnosis, a doctor may order an x-ray of the suspect area to look for signs of bone inflammation or damage, but changes in the bone may not show up for weeks after the infection begins. Magnetic resonance imaging* (MRI) or a computerized tomography* (CT) scan may show changes that reflect osteomyelitis sooner than x-rays will. Radionuclide scans* may help pinpoint the location of the infection early in the course of the disease. Blood cultures* or, less commonly, a bone biopsy may identify the infectious agent.

What Is the Treatment for Osteomyelitis?

Patients with osteomyelitis usually need to be hospitalized. They typically receive antibiotics for four to six weeks to combat the infection. At first, the medication is given intravenously, but patients may be switched to oral (by mouth) medicine as the treatment continues and their condition improves. In more serious and chronic cases, patients may need an operation to remove bits of bone that have died. To help new bone grow, surgeons may perform a bone graft, in which bone from another part of the body is placed in the spot where dead bone has been removed; doctors may use packing material to fill in the open area temporarily.

How Long Does the Disease Last?

Patients with osteomyelitis often need several weeks or months of treatment before the infection clears up. Acute cases may resolve after as little as one month of antibiotic therapy, but chronic cases can linger much longer.

What Are the Complications?

In children, osteomyelitis can damage growing bones permanently, especially if it is not promptly and adequately treated. Infection may spread to the blood, overlying skin, or nearby joints. Bones may be weakened and break more easily. Movement of nearby joints or limbs may become limited. Occasionally in chronic cases, severe infection or damage to the bone may result in the need to amputate, or remove, part or all of a limb.

How Can Osteomyelitis Be Prevented?

Quick, thorough treatment of any infection, particularly those from deep wounds, can lower the risk of osteomyelitis. Skin is the most common initial site of infection (spreading to the bones via the blood stream), so proper treatment of all breaks in the skin is an important first step in preventing this bone infection. It is recommended that patients who are more susceptible to osteomyelitis, such as those with diabetes, contact a doctor promptly if they notice signs of infection.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **radionuclide (ray-dee-o-NU-klide) scans** are tests that begin by giving a patient a small amount of a radioactive substance. The radioactive substance shows up on a scan, producing a view of the structure or function of the part of the body being studied.

* **cultures** (KUL-churz) are tests in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

▶ See also **Bacterial Infections • Staphylococcal Infections • Streptococcal Infections**

Resources

Books and Articles

Skinner, Harry. *Current Diagnosis and Treatment in Orthopedics*. New York: McGraw-Hill, 2006.

Organizations

American Association of Orthopedic Surgeons. 6330 North River Road, Rosemount, IL, 60018. Telephone: 708-823-7186. Web site: <http://www.aaos.org>.

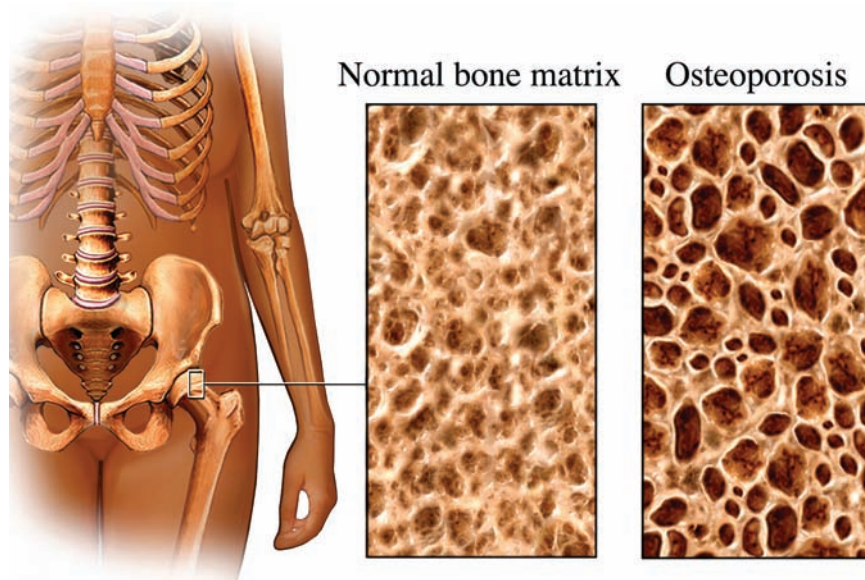
National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-226-4267. Web site: <http://www.niams.nih.gov>.

Osteoporosis

Osteoporosis (os-te-o-po-RO-sis), which literally means “porous bones,” is a disease that occurs when there is loss of bone density, which increases the likelihood of a bone fracture from even a minor fall or bump.

What Is Bone?

Bone is living tissue. There are two general types of bone tissue: cortical and spongy. Cortical bone is dense and compact and generally forms the outer layer of bones. Spongy, or cancellous, bone generally forms



A normal bone (left) and one with osteoporosis (right). ©PHOTOTAKE Inc./Alamy.

the inner layer. Spongy bone is mesh-like and contains bone marrow* within its meshwork. Osteoporosis is more common in bones with a large percentage of spongy bone. These include the vertebrae (bones of the spine), the hips, and the wrists. These bones are more fragile and are especially prone to fracture when they have been affected by osteoporosis.

Because bone is living tissue, old bone is constantly being broken down (bone resorption) and new bone is constantly being deposited (bone formation). Until late adolescence, bone mass and density increase because more bone is formed than is resorbed. When people are in their mid-twenties to their mid-thirties their bones are at their maximum mass and strength. After that, more bone is resorbed than is formed, and bone mass and strength are gradually lost. Osteoporosis develops gradually over time, although rates vary among individuals.

How Many People Have Osteoporosis?

Osteoporosis is a serious public health problem, costing approximately \$20 billion each year in the United States. In 2008 the National Osteoporosis Foundation estimated that 10 million people in the United States over age 50 had osteoporosis and another 34 million were at risk for developing the disease. Women with osteoporosis outnumber men by a ratio of four to one. Although persons of either sex and people of any ethnic background can develop osteoporosis, it is especially common among white and Asian women over age 50. Many persons do not become aware that they have osteoporosis until they fracture (break) a bone. Typically, in persons who have osteoporosis, fracture is the result of a simple fall that would not have caused a fracture in a young adult.

In the United States, osteoporosis is responsible for approximately 2 million bone fractures annually. These fractures, which are often the first evidence of the disease, can occur in any bone, but the most common locations are the hip (annually about 300,000 fractures), spine (700,000 fractures), and wrist (250,000 fractures). Breaks in the hip and spine are of special concern because they usually require hospitalization and major surgery. Because many people with osteoporosis-related fractures are elderly, the fractures often lead to other serious consequences, including permanent disability and even death. Only about 15 percent of people who fracture a hip are able to walk across a room unaided six months later and about one-fourth of people over age 50 who fracture a hip die within one year.

Types and Causes of Osteoporosis

Osteoporosis is classified as primary or secondary. Primary osteoporosis is part of the aging process and is not associated with any other disease process. Secondary osteoporosis is a result of another disease, treatment, or abnormality.

Primary osteoporosis Primary osteoporosis is associated with aging. It is the most common form of the disease, accounting for about 95 percent of osteoporosis in women and at least 80 percent in men.

* **bone marrow** is the soft tissue inside bones where blood cells are made.

* **menopause** (MEN-o-pawz) is the end of menstruation.

* **genes** (JEENS) are the functional units of heredity that are composed of deoxyribonucleic acid (DNA) and help to determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are segments of chromosomes found in the nuclei of the body's cells.

* **endocrine** (EN-do-krin) refers to a group of glands, such as the thyroid, adrenal, and pituitary glands, and the hormones they produce. The endocrine glands secrete their hormones into the bloodstream, and the hormones travel to the cells that have receptors for them. Certain hormones have effects on mood and sometimes cause emotional swings.

* **anorexia nervosa** (an-o-REK-se-a ner-VO-sa) is a psychiatric illness characterized by a distorted body image and a fear of gaining weight, which usually lead to self-starvation and dangerous weight loss and malnutrition.

* **bulimia** (bu-LEE-me-a) is characterized by episodes of out-of-control eating, or binge eating, and by self-induced vomiting the use of laxatives.

In women, primary osteoporosis is often referred to as “postmenopausal osteoporosis,” which results from the accelerated bone loss that occurs in women during and after menopause*. After menopause, ovaries produce very little estrogen, a hormone that helps to maintain bone mass.

Several factors influence whether a person develops primary osteoporosis. These include:

- **Sex.** Women are smaller, start out with less bone mass, and lose bone mass more rapidly as they age.
- **Figure type.** People with small bones and those who are thin are more likely to have osteoporosis.
- **Early menopause.** Women who stop menstruating early lose large amounts of bone tissue fairly early in life. The female sex hormone estrogen helps to protect bone mass. When women stop menstruating, the level of estrogen in their bodies drops, and the protective effect is lost.
- **Lifestyle.** People who smoke, use alcohol heavily, and/or exercise little have an increased chance of developing osteoporosis.
- **Diet.** Those who do not get enough calcium or protein may be more likely to have osteoporosis.
- **Genetics.** The amount of bone formation that occurs during adolescence and rate at which it is broken down later in life appears to be influenced by genes* (heredity). Researchers believe that they may have identified a few specific genes and gene variations that play a role in the development of osteoporosis.

Secondary osteoporosis Secondary osteoporosis is osteoporosis that results from another, underlying medical condition or the result of taking medication. Secondary osteoporosis can have many causes. Confinement to a wheelchair or bed can cause the bones to lose mass and density. This effect also has been observed in astronauts who have undergone prolonged periods of weightlessness in space, as it is impossible to get proper exercise when there is no gravity to work against. Cancer, some endocrine* diseases, and some liver and digestive diseases can also lead to secondary osteoporosis, as can the eating disorders anorexia nervosa* and bulimia*.

Signs and Symptoms

Osteoporosis does not always produce obvious symptoms. Often an older person first learns of his or her condition after breaking a bone in a fall, when an x-ray reveals decreased bone density. Although falls are the most common cause of fractures, the thinning vertebrae in a person with osteoporosis may actually collapse under the weight of the upper body. Called compression fractures, these fractures can cause severe pain, usually in the mid or lower back. Chronic, or long-lasting, pain may develop after several such fractures have occurred. The person may gradually lose inches of height, and the upper back may curve forward, creating the hunchback appearance that one sees in many elderly women.

Diagnosing Osteoporosis

If a doctor suspects the presence of osteoporosis, he or she will take a complete medical history, conduct a physical examination, and order x-rays, as well as blood and urine tests, in an effort to rule out other diseases that can cause loss of bone mass. However, the only way to confirm a diagnosis of osteoporosis is to measure bone density. A standard x-ray may reveal that the bones are less dense than normal, but osteoporosis is usually advanced by the time it is evident on an x-ray.

Special imaging techniques may be conducted, including a computerized tomography* scan and bone density scan, also called bone photon densitometry (FO-ton den-si-TOM-e-tree), which is an enhanced form of x-ray technology that is used to measure degrees of bone loss. Bone density scanning is painless and exposes the patient to only a small amount of radiation—about one-fiftieth that of a chest x-ray.

In some instances, a blood test and bone biopsy (removal of a tiny sample of bone for examination) may be used to rule out the possibility of osteomalacia (OS-te-o-ma-LAY-she-a), a closely related condition, known as rickets when it affects children, that usually results from a lack of vitamin D.

Treating Osteoporosis

Osteoporosis cannot be cured, but it can be treated. Treatment usually is multi-sided and is aimed primarily at stopping or slowing bone loss.

Lifestyle Changes The lifestyle changes that help slow bone loss are beneficial to people of all ages, including the elderly, in whom there is going to be at least some measure of osteoporosis. Exercise, especially weight bearing exercise or strength training, is important to the maintenance of bone strength. Even frail individuals with chronic health problems can exercise with weights under the supervision of a physical therapist or health professional familiar with the American College of Sports Medicine strength-training guidelines for older people. Exercise that improves flexibility and balance can also improve coordination and help to prevent falls and fractures.

A diet that includes enough calcium and vitamin D also helps slow osteoporosis. Calcium is the main mineral in bones, and very few people get enough of it in their diet. Experts recommend 1,500 mg of calcium per day for adolescents, pregnant or breast-feeding women, post-menopausal women, and adults over age 65. All others should get at least 1,000 mg per day. Foods are the best source for this important mineral. Milk, cheese, and yogurt have the highest amounts. Other foods that are high in calcium are green leafy vegetables, tofu, shellfish, Brazil nuts, sardines, and almonds.

People who do not get enough calcium from food may need to take calcium supplements. Calcium supplements vary in calcium content and absorbability. Calcium carbonate is the most common and least expensive calcium supplement. Five- or six-hundred mg calcium tablets can

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of a region of the body to put together a cross-sectional picture.

be taken one to three times daily. It is recommended that individuals, in addition to getting enough calcium, get 800 to 1,000 international units (IU) of vitamin D daily. Vitamin D helps the body absorb calcium in the digestive tract.

Other lifestyle choices include not smoking and not drinking alcohol. Older people should assess their homes for hazards that might cause falls. Protecting against falls might include removing small, loose rugs; installing grab bars in showers; improving lighting on stairs; marking the final stair with reflective tape; avoiding loose, floppy footwear; and placing often-used kitchen supplies where they can be reached without climbing on a stool or chair.

Drugs In the past, women often received estrogen/progesterone hormone replacement therapy (HRT) to ease the symptoms of menopause. Because HRT artificially increased the amount of estrogen in the body, it had the added effect of slowing or preventing bone loss. However, large studies have shown that HRT can also increase the risks of heart disease and breast cancer. In the early 2000s, under most circumstances, HRT was used sparingly and only for a short time.

Several drugs belonging to a group called bisphosphonates have been approved in the United States for treatment and/or prevention of osteoporosis. These drugs slow the breakdown of bone. Some are approved exclusively for use in women, whereas others can also be taken by men. Drugs in this category include alendronate, ibandronate, and risedronate. Another drug calcitonin is produced by the thyroid gland and suppresses bone resorption; it is approved for the treatment of osteoporosis. Raloxifene has effects on bone similar to those of estrogen and is used in the treatment of osteoporosis. Teriparatide, a form of human parathyroid hormone, has been shown to actually stimulate bone growth. Patients should discuss with their doctor the risks and benefits of these drugs based on their individual situation, as they should for all drugs.

Preventing Osteoporosis

The best time to take steps to promote bone growth (and make osteoporosis less likely in later years) is during the childhood and teen years. This is particularly so for young women with small frames and who have close relatives with osteoporosis. For young people, just as for the elderly, getting plenty of regular exercise is important, as is calcium in the diet. It is estimated that more than 70 percent of children and teenagers fail to consume adequate amounts of calcium. The aim is to achieve full bone density in the skeleton by the time individuals have reached their early twenties.

Beginning in adolescence, not smoking and not drinking alcohol are important. Fad diets that promise rapid weight loss need to be avoided. While exercise, particularly supervised weight training, is important in the prevention of osteoporosis, extreme exercise, especially when combined with dieting and weight loss, can stop menstrual periods and reduce estrogen levels in young women. This decreased estrogen can cause significant bone loss.

▶ See also **Ageing • Broken Bones (Fractures) • Eating Disorders: Overview • Rickets • Thyroid Disease**

* **eustachian tubes** (yoo-STAY-she-un) are the tiny channels that connect and allow air to flow between the middle ears and the throat.

Resources

Books and Articles

Mayo Clinic Guide to Preventing and Treating Osteoporosis. Rochester, MN: Mayo Clinic, 2008.

Reid, David M., Alison J. Black, and Rena Sandison. *Osteoporosis.* New York: Oxford University Press, 2009.

Organizations

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-22-NIAMS (226-4267). Web site: http://www.niams.nih.gov/Health_Info/Bone/Osteoporosis/default.asp.

National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center. 2 AMS Circle, Bethesda, MD, 20892-3676. Toll free: 800-624-2663(BONE). Web site: http://www.niams.nih.gov/Health_Info/Bone.

National Osteoporosis Foundation. 1232 Twenty-second Street NW, Washington, DC, 20037-1292. Toll free: 800-231-4222. Web site: <http://www.nof.org>.

Otitis (Ear Infections)

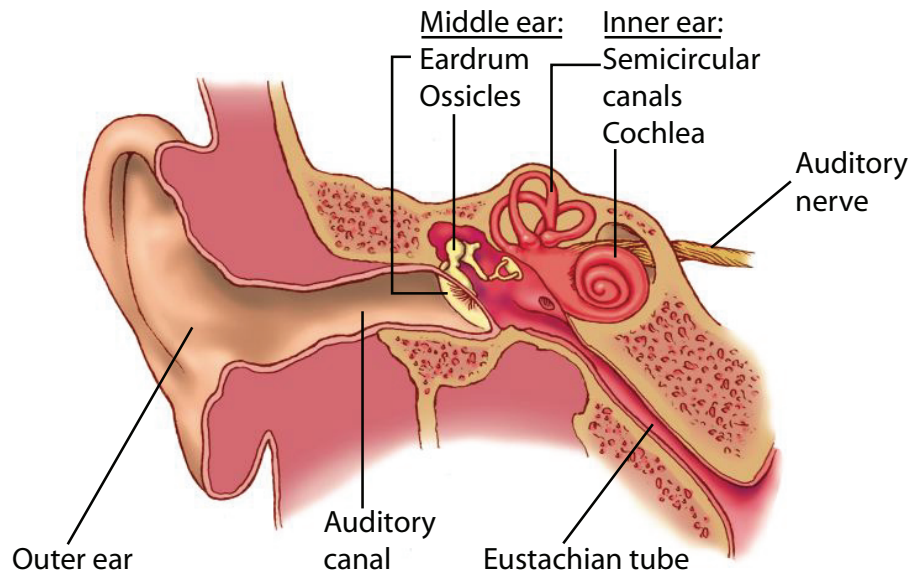
Otitis (o-TIE-tis) is an inflammation of the internal or external parts of the ear, usually caused by infection.

The Anatomy of the Ear

The ear has three main parts: outer, middle, and inner. The outer ear consists of the pinna, or visible tissue attached to the head, and the external auditory canal, which is the visible entrance into the ear. Earwax made in the outer ear lubricates the tissue, keeps it from itching, and helps prevent bacteria from entering the middle ear. The middle ear consists of the eardrum (tympanum) and three small bones (the malleus, incus, and stapes). The Eustachian tube* connects the middle ear to the throat. The inner ear contains fluid and sensitive hairs that vibrate in response to sound and send information to the brain. When the ear becomes infected, an

Otitis (Ear Infections)

Anatomy of the ear. Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

* **pus** is a thick, creamy fluid, usually yellow or ivory in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **effusion** (ih-FYOO-zhun) is an excessive accumulation of body fluid in a body space or cavity, such as the middle ear.

* **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

earache may occur. There are two common types of ear infection: otitis media and otitis externa.

What Is Otitis Media (Middle Ear Infection)?

Otitis media or middle ear infection is extremely common, especially in young children. It occurs when the eustachian tube becomes blocked and fluid collects in the middle ear. This condition occurs when a person has a cold or other upper respiratory symptoms, such as those caused by allergies. The fluid that accumulates in the middle ear provides a warm, moist place for bacteria to grow, which results in an infection of the middle ear that usually becomes apparent when the ear begins to ache. In acute* otitis media, the middle ear becomes inflamed and fills with fluid or pus*.

Chronic* otitis media results when the infection does not go away (with or without treatment) within a few weeks. In more severe or long-lasting cases of chronic otitis media, the eardrum may become permanently damaged or the infection may spread to surrounding structures. More often in chronic otitis media, the infection clears up, but fluid remains and the eardrum cannot move freely to transmit sound waves. This condition is known as chronic otitis media with effusion*, and it can cause a temporary hearing loss in the affected ear. Otitis media is labeled recurrent when a person has repeated ear infections but gets better between infections.

Otitis media is not contagious, but common colds and other infections of the respiratory tract* that can lead to it are. When people cough, sneeze, laugh, or talk, they can spread the viruses or bacteria that cause colds and respiratory illnesses to their hands, to the surfaces around them, and into the air. Other people can touch contaminated surfaces with their hands or can breathe in these germs and spread the germs to their noses and mouths. If the conditions are right, the germs enter the middle ear

through the eustachian tube or cause a blockage in the eustachian tube, setting the stage for an ear infection to develop.

Adults can get otitis media, but it is much more common in children, especially those under three years of age. The eustachian tubes of children are narrower, shorter, and more horizontal than those in adults, making it easier for germs to enter and fluid to build up. Young children also have more frequent respiratory infections than adults.

What Are the Signs and Symptoms of Otitis Media?

Signs and symptoms of otitis media include the following:

- In babies, irritability, fussiness, or tugging on the ear
- Ear pain or a feeling of pressure in the ear
- Buzzing or ringing sounds in the ear
- Pus draining from or bleeding from the ear (if the eardrum has ruptured)
- Mild hearing loss
- Fever

Complications of otitis media include a ruptured eardrum due to high-pressure fluid buildup in the middle ear. Hearing loss may also occur. Hearing loss is usually temporary, except in long-standing chronic cases. Occasionally an ear infection develops into mastoiditis*, and, rarely, the infection spreads to the brain.

What Is Otitis Externa (Swimmer's Ear)?

Otitis externa, often called swimmer's ear, is an inflammation or infection of the outer ear canal. It is not contagious but occurs when bacteria or fungi enter through a break in the skin inside the ear.

Otitis externa often occurs after swimming or diving when moisture breaks down the protective wax and skin in the ear canal. Although it is called swimmer's ear, otitis externa can occur if these barriers are broken in other ways, such as by frequent cleaning with cotton swabs or scratching inside the ear too roughly. Once the skin is broken, bacteria can enter and cause infection. The ear becomes red, swollen, and painful to the touch. Otitis externa is common. It affects mostly teens and young adults. People who spend a lot of time swimming or diving are most susceptible.

Occasionally otitis externa can have complications. In about 1 percent of cases, the infection persists and results in chronic otitis externa. Rarely, this condition can lead to malignant* otitis externa, a serious condition in which the infection spreads to the bones and nerves of the ear, skull, and brain; this condition occurs almost exclusively among elderly people with diabetes*. Malignant otitis is a serious condition that requires hospitalization, treatment with intravenous* antibiotics, and sometimes surgery to remove the infected tissue.

Three by Three

According to the American Academy of Otolaryngology, one-third of all children experience three or more ear infections by the time they are three years of age. Otitis media is the most frequent diagnosis among children for sick visits to the doctor, and it is the leading cause of hearing loss in children.

* **mastoiditis** (mas-toy-DYE-tis) is an infection of the mastoid bone, located behind the ear.

* **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

What Are the Signs and Symptoms of Swimmer's Ear?

Signs and symptoms of otitis externa include:

- Ear pain that usually worsens if the ear is touched or pulled
- Red, swollen outer ear canal
- Green or yellow pus draining from the ear
- Mild loss of hearing

Other Ear Infections

Malignant otitis is a serious condition that rarely occurs in children but does occasionally occur in the elderly, especially in those people with diabetes or other chronic diseases that weaken the immune system. Bacteria invade the cartilage and bone of the head in this rare but serious condition. Treatment involves hospitalization, intravenous antibiotics, and sometimes surgery to remove the infected tissue.

How Are Ear Infections Diagnosed?

A doctor examines a person's ears, inside and out, checking for redness, swelling, and abnormal collections of fluid. The doctor takes a close look at the eardrum by using a lighted instrument called an otoscope (O-toh-sko-pe). With an otoscope, the doctor can see if there is fluid in the middle ear making the eardrum bulge. In the case of chronic middle ear infections, an audiogram may be performed to test the person's hearing, and a tympanogram (tim-PAH-no-gram) may be done to check for normal vibration of the eardrum and pressure levels in the middle ear. In cases that do not respond to treatment, samples of fluid, pus, and blood from inside the ear may be tested to discover whether a bacterium, virus, or fungus is causing the infection. If the doctor thinks the infection has spread to surrounding bone or cartilage, an x-ray or computerized tomography* (CT) scan of the head may be performed.

How Do Doctors Treat Ear Infections?

Over-the-counter, non-aspirin painkillers such as acetaminophen* and warm heating pads can be used to ease the throbbing pain of earaches. Antibiotic eardrops are used to treat otitis externa. Oral (by mouth) antibiotics may be prescribed to treat otitis media and in more severe cases of otitis externa. However, the medical community is concerned about the overuse of antibiotics. Antibiotics may not always be necessary to treat otitis media. Some cases of otitis media are caused by viruses, which do not respond to antibiotic treatment, but it is often difficult to tell the difference. Even if bacteria are the cause of an ear infection, most people will get better on their own, although antibiotic treatment lowers the risk of the infection spreading and clears up symptoms sooner. Typically, the symptoms of acute otitis media improve within the first two to three days of antibiotic treatment. Chronic infections, however, can last several

weeks or months. In children with chronic otitis media, it may be helpful to surgically insert a small plastic tube in the eardrum that allows air to flow into the middle ear and prevent fluid buildup that can interfere with hearing.

In cases of external otitis, doctors recommend that water be kept out of the ear canal during recovery; earplugs or shower caps can help keep out water while bathing, and swimming should be avoided.

How Can Ear Infections Be Prevented?

Frequent hand washing can help prevent spread of the germs that cause colds and other respiratory illnesses, which often lead to ear infections, especially in young children. Toys should be washed often to keep infections from spreading among babies and young children in daycare settings.

To prevent fluid from pooling in eustachian tubes, experts recommend that bottle-fed babies be held in an upright position. Babies should not be put to sleep with a bottle. Breastfeeding also can help prevent otitis media in babies, as can avoiding exposure to cigarette smoke. The use of pacifiers may also contribute to ear infections.

Vaccination* of children with the pneumococcal conjugate vaccine (PCV) protects against infection by 23 types of bacteria, including *Streptococcus pneumoniae* (strep-tuh-KAH-kus nu-MO-nye), a common cause of otitis media. The American Academy of Family Physicians estimates that widespread use of PCV has reduced the number of ear infections in young children by at least 5 million each year. Vaccination against influenza* also can reduce the likelihood of contracting otitis media. Treating allergies or removing enlarged adenoids* that block the eustachian tubes may decrease the chances of having recurrent or chronic ear infection in some patients.

After swimming or bathing, thoroughly drying ears with a towel can help get rid of water and lower the risk of contracting otitis externa. For avid swimmers, preventive eardrops can be used after swimming. Nothing should be inserted into the ears because of the risk of injuring the skin of the ear canal or damaging the eardrum. Ear wax serves a protective function and should be removed only when it builds up and clogs the external auditory canal.

▶ See also **Common Cold • Influenza • Streptococcal Infections**

Resources

Books and Articles

Glaser, Jason. *Ear Infections*. Mankato, MN: Capstone Press, 2007.

Weisman, Roanne, with John D. Mark. *Your Sick Child: Fever, Allergies, Ear Infections, Colds, and More*. Deerfield Beach, FL: Health Communications, 2006.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

* **influenza** (in-floo-EN-zuh), also known as the flu, is a contagious viral infection that attacks the respiratory tract, including the nose, throat, and lungs.

* **adenoids** (AH-din-oyds) are the fleshy lumps of tissue behind the nose that contain collections of infection-fighting cells of the immune system.

* **tumor** (TOO-mor) is an abnormal growth of body tissue that has no known cause or physiologic purpose. A tumor may or may not be cancerous.

Organizations

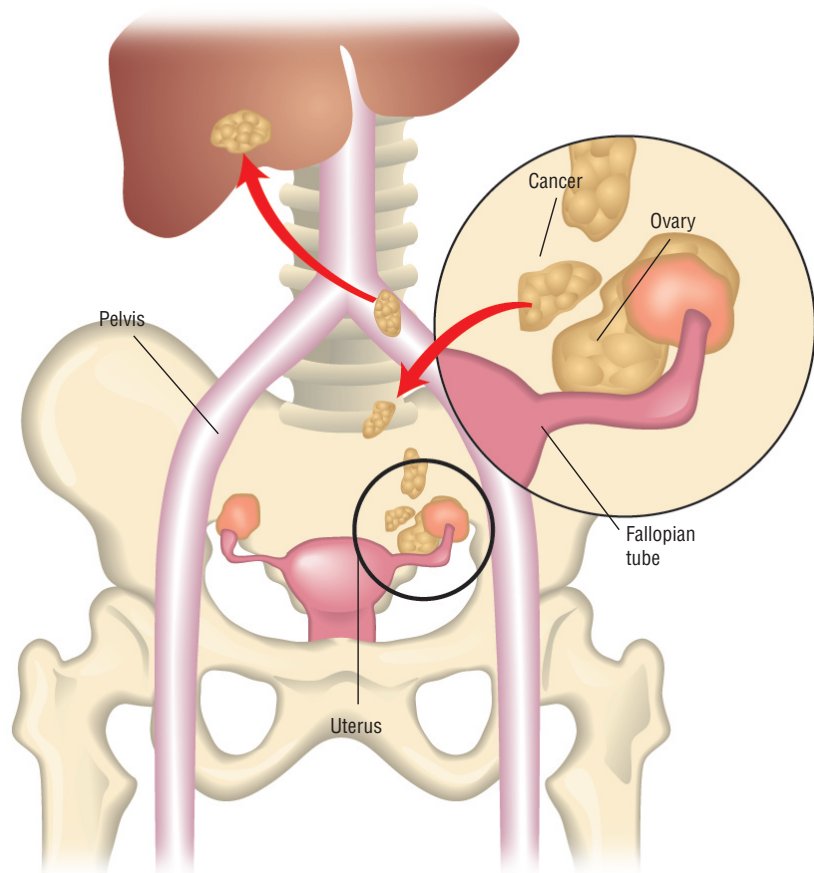
American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org/online/en/home/clinical/clinicalrecs/aom.html>.

American Academy of Otolaryngology, Head and Neck Surgery. 1650 Diagonal Road, Alexandria, VA, 22314-2857. Telephone: 703-836-4444. Web site: <http://www.entnet.org/HealthInformation/otitisMediaHearingLoss.cfm>.

American Academy of Pediatrics. 141 Northwest Point Boulevard, Elk Grove Village, IL, 60007-1098. Telephone: 847-434-4000. Web site: <http://www.aap.org/advocacy/releases/aomqa.htm>.

Ovarian Cancer

Ovarian cancer occurs when cells in the ovaries, the reproductive glands from which a woman's eggs are released, begin to grow rapidly and out of control, forming a tumor.*



Anatomical view of the pelvis, ovaries, and fallopian tubes with a tumor on an ovary. *Illustration by GGS Information Services, Inc. Reproduced by permission of Gale, a part of Cengage Learning.*

What Are the Ovaries?

The ovaries* are the two glands located on opposite sides of a woman's uterus*. They are responsible for producing the hormones estrogen and progesterone. During the childbearing years, they are also responsible for releasing eggs for fertilization every month. After the eggs are released by the ovaries, they travel through the fallopian tubes* to the uterus where they can be fertilized by sperm. After a woman reaches menopause*, the ovaries no longer produce eggs, and they produce a much lower level of hormones.

What Are Ovarian Cysts?

Cysts are fluid-filled sacs that can form in any structure in the body. Ovarian cysts are fairly common, especially during the childbearing years. They can cause discomfort, swelling, or pressure in the abdomen, pain during sex, difficulty urinating, and weight gain. Ovarian cysts often resolve spontaneously. If they do not resolve, they are removed surgically. Ovarian cysts are usually not cancerous and are not life threatening.

What Is Ovarian Cancer?

Ovarian cancer occurs when cells divide and multiply too rapidly. Normally, when old cells die, the body gets rid of them to make room for new cells. These new replacement cells divide and multiply rapidly. This is only a problem when the body cannot rid itself of the old cells, and there are too many cells. This buildup of cells forms a mass called a tumor. There are two kinds of tumors. Benign* tumors are not cancerous, and malignant* tumors are. While they can both be removed, malignant tumors sometimes grow back. Malignant cells can grow rapidly in the tumor, and they can spread to other parts of the body. This spreading is called metastasis. As a cancer metastasizes, the patient's prognosis becomes bleaker, which is why early detection of cancer is so important.

What Are the Symptoms of Ovarian Cancer?

Because its symptoms are often nonspecific, ovarian cancer can be very difficult to detect. Women often mistake its symptoms for another condition and do not seek treatment until after the cancer has metastasized.

The most common symptoms of ovarian cancer include abdominal discomfort and/or swelling; pressure in the back, abdomen, pelvis, or legs; nausea; indigestion; pain during sexual intercourse; and fatigue.

How Is Ovarian Cancer Diagnosed?

Physicians may use several tests to diagnose ovarian cancer. These include:

- A physical exam, which helps physicians to determine a person's overall health by measuring blood pressure, weight, and temperature.
- A pelvic exam, which allows the physician to feel the ovaries and determine if there is any change in their size or shape. He or she may also be able to feel any growths that may be present on the ovaries.



▲ Gilda Radner (1946–1989) in a photo taken January 1, 1983. *Ann Clifford/DMI/Time Life Pictures/Getty Images.*

- * **ovaries** (O-vuh-reez) are the sexual glands from which ova, or eggs, are released in women.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.
- * **fallopian tubes** (fa-LO-pee-an tubes) are the two slender tubes that connect the ovaries and the uterus in females. They carry the ova, or eggs, from the ovaries to the uterus.
- * **menopause** (MEN-o-pawz) is the end of menstruation.
- * **benign** (be-NINE) means a condition is not cancerous or serious and will probably improve, go away, or not get worse.
- * **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.

- * **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.
- * **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.
- * **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.
- * **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.

GILDA'S CLUB

In 1989 Gilda Radner, one of *Saturday Night Live's* most beloved stars, died from ovarian cancer. She was just 42 years old. Radner had first been diagnosed with ovarian cancer in 1986 after experiencing fatigue and leg pain. After chemotherapy and radiation treatment, Radner went into remission, only to have her cancer return just a few years later. After undergoing a routine procedure, Radner slipped into a coma and never regained consciousness.

In 1991 Radner's husband Gene Wilder, along with Joanna Bull and Joel Siegel, established Gilda's Club in her memory. Upon being diagnosed with ovarian cancer, Radner had been quoted as saying, "Having cancer gave me membership in an elite club I'd rather not belong to." The mission of Gilda's Club is to create welcoming communities of free support for everyone living with cancer—men, women, teens, and children—along with their families and friends (more information available at www.gildasclub.org).

- Imaging tests, which allow the physician to see a picture of the ovaries to determine whether there are any abnormal changes. These include ultrasound*, MRI*, and CT scans*.
- Blood tests, which let the physician see the levels of certain hormones and proteins in the blood that may or may not indicate cancer

In order to confirm a diagnosis of ovarian cancer, physicians will perform a laparotomy so that they may perform a biopsy* on the tumor. A small incision in the abdomen so that the doctor can explore the abdominal cavity. The physician will usually remove a small tissue sample for biopsy. The information from examining the biopsied tissue is used to stage the cancer and determine an appropriate treatment plan.

How Is Ovarian Cancer Treated?

Treatment for ovarian cancer depends on the stage of the cancer when the cancer is detected. In early stage of ovarian cancer, the most common treatment is the surgical removal of all visible signs of cancer, including the affected ovary and its fallopian tube, the adjoining lymph nodes*, and attached fatty tissue. Biopsy of any suspected tissues is performed. In these cases for women of childbearing age, the uterus, healthy ovary, and healthy fallopian tube remain, leaving open the possibility for future pregnancies.

In more advanced stages of ovarian cancer, women often undergo a complete hysterectomy, which involves the removal of the uterus, cervix*, fallopian tubes, and ovaries. Any visible signs of cancer in the nearby lymph nodes and attached fatty tissue are also removed. Physicians perform a biopsy on any tissue that appears abnormal. In the event of total hysterectomy, there is no possibility for future pregnancy.

For most women, physicians recommend chemotherapy* following surgery. Chemotherapy is treatment with drugs that are meant to kill remaining cancer cells anywhere in the body. Chemotherapy can cause side effects such as pain, nausea, and vomiting. Immunotherapy, which works by boosting the immune system, also showed promise as of 2009.

In addition to these treatments, a healthy diet, plenty of exercise, and a strong support system are also important for women who are battling ovarian cancer.

▶ See also **Cancer: Overview**

Resources

Books and Articles

Conner, Kristine, and Lauren Langford. *Ovarian Cancer*. Cambridge, MA: O'Reilly Media, 2003.

Dizon, Don S. *100 Questions & Answers about Ovarian Cancer*, 2nd ed. Sudbury, MA: Jones and Bartlett, 2006.

Organizations

Ovarian Cancer National Alliance. 910 Seventeenth Street NW, Suite 1190, Washington, DC, 20006. Toll free: 866-399-6262. Web site: www.ovariancancer.org.

National Ovarian Cancer Coalition. 2501 Oak Lawn Avenue, Suite 435, Dallas, TX, 75219. Toll free: 888-682-7426. Web site: www.ovarian.org.

Ovarian Cysts

Any ovarian follicle, a small hollow sphere-shaped group of cells in the ovary that contains a single ovum or egg, that is larger than 0.8 inches (2 centimeters) is considered an ovarian cyst. Ovarian cysts can be as small as a pea or as large as an orange or cantaloupe.

Tanya's Story

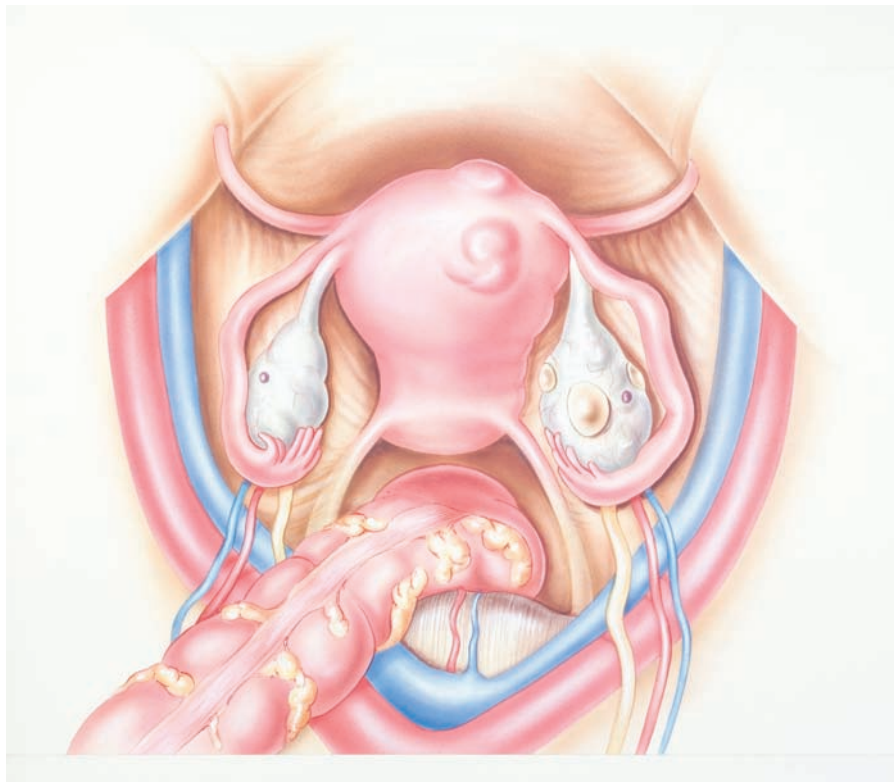
Tanya is an eighth-grader who had her first menstrual* period shortly after her twelfth birthday. Her periods were irregular for the first several months, which she knew is normal for girls in early puberty*. After her periods became more regular, however, Tanya noticed a sharp cramping pain on one side of her abdomen between periods. At first she did not think much

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **menstrual** (MEN-stroo-al) refers to menstruation (men-stroo-AY-shun), the discharging through the vagina of blood and tissue from the uterus that recurs each month in women of reproductive age.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

Illustration of a human uterus and ovaries. Shown is a comparison of a normal ovary (left) to an ovary with small ovarian cysts (right). Also shown are a normal uterus (left side) and a uterus with fibroids (right side). The colon is shown at the bottom of the illustration. ©PHOTOTAKE Inc./ Alamy. ▶



* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **mittelschmerz** (MITT-el-shmairts) a cramping pain that some women experience at the midpoint in their menstrual cycle when one of their ovaries releases an egg.

about the cramps because they went away after a few hours. The cramps got worse with each month, however, and one month they were so bad that Tanya's parents thought she might have appendicitis. They took their daughter to the emergency room because she was in great pain.

The doctors in the emergency room checked Tanya right away because they knew that appendicitis is not unusual in teenagers and must be treated as soon as possible. They gave her an ultrasound* test to get a clearer picture of the organs in her abdomen. The doctors found that Tanya did not have appendicitis; instead, she had some simple ovarian cysts that looked like bubbles on the ultrasound image of her ovaries. The doctors explained to Tanya and her parents that this type of cyst occurs when the follicle in the ovary that releases an egg each month ruptures. It was the bursting of the follicle that caused the sharp cramps that Tanya felt halfway between her periods. This type of pain is called mittelschmerz* from two German words that combined mean "middle pain." About 20 percent of women experience mittelschmerz during their childbearing years; it is usually only mildly uncomfortable, but once in a while it produces pain severe enough to send the woman to the emergency room.

Tanya was relieved to find out that her cramps did not indicate a serious health problem and that she could treat them at home with an over-the-counter pain reliever. She was surprised, though, to learn that teenagers and even young girls can develop ovarian cysts.

What Is an Ovarian Cyst?

An ovarian cyst is any collection of fluid larger than 0.8 inch that develops inside a thin wall of tissue in the ovary. Ovarian cysts can occur in young girls and older women after menopause*, although they are most common in women of childbearing age. Most ovarian cysts are harmless, do not produce any noticeable symptoms, and are related to the normal functions of a woman's body during the menstrual cycle*. Some cysts, however, are malignant* and need to be removed by surgery, whereas others may need to be removed because they are causing pain or bleeding even though they are benign*.

Functional ovarian cysts The majority of ovarian cysts are functional, which means that they result from the normal functioning of a woman's ovaries. This type of cyst is also called a simple cyst. To better understand how functional cysts develop, it is useful to review the process of ovulation*.

Women have two ovaries*, one on each side of the uterus*. One of the ovaries produces an egg each month that lies within a sac called a follicle. As the egg matures, the hormone estrogen signals the uterus to prepare for a possible pregnancy by thickening its lining, which is called the endometrium (en-doe-MEE-tree-um). If the egg is not fertilized, the extra tissue added to the lining of the uterus is shed from the body. The result is a normal menstrual period.

In most cases, the follicle that released the egg eventually shrinks without causing any symptoms. Functional cysts, however, can develop when the egg is not released normally or the follicle collects fluid or blood after the egg is released. Functional cysts usually look like air bubbles on the ovary when the doctor performs an ultrasound test. There are three basic types of functional cysts:

- **Follicular cysts.** Sometimes called Graafian (GRAY-fee-un) follicle cysts, this type of functional cyst develops when the follicle does not release the mature egg or when it collapses in on itself. Follicular cysts contain a clear fluid and can grow to become as large as 2.5 inches in diameter. The follicular cyst can burst, causing the pain of mittelschmerz, or it can remain in the ovary for several months and then gradually disappear.
- **Corpus luteum cyst.** The corpus luteum (KOR-pus LOO-tee-um) is the name given to the structure that develops in the ovary after a follicle has released its egg. It has two layers of cells and secretes two hormones* that are necessary to maintain a pregnancy if the egg is fertilized. If the egg is not fertilized, the corpus luteum stops producing hormones after about 14 days, breaks down, and gradually disappears. It can, however, also fill with blood or tissue fluid and grow to form a cyst. In most cases, corpus luteum cysts do not cause health problems. They can, however, grow to be as big as four inches in diameter and cause the ovary to twist inside the

* **menopause** (MEN-o-pawz) is the end of menstruation.

* **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.

* **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.

* **benign** (be-NINE) means a condition is not cancerous or serious and will probably improve, go away, or not get worse.

* **ovulation** (ov-yoo-LAY-shun) is the release of a mature egg from the ovary.

* **ovaries** (O-vuh-reez) are the sexual glands from which ova, or eggs, are released in women.

* **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

abdomen, causing sudden severe pain. Corpus luteum cysts can also fill with blood and burst during the second half of the menstrual cycle, releasing their blood inside the abdomen and causing severe pain.

- **Hemorrhagic** (*hem-uh-RAGE-ik*) *cyst*. Also called a blood cyst, this type of functional cyst develops when a blood vessel in the wall of a cyst breaks and leaks into the cyst. The bleeding may occur rapidly and stretch the wall of the cyst until it bursts, causing pain on one side of the body. The blood in a hemorrhagic cyst forms clots that can be seen on an ultrasound image. If the cyst bursts, the blood is released into the abdominal cavity.

Other types of benign ovarian cysts There are two other categories of ovarian cysts that are not related to the menstrual cycle but are still considered benign (noncancerous). The first type, dermoid (DER-moyd) cysts (also called ovarian teratomas) are strange-looking swellings that develop from a cell in the ovary that can give rise to other types of body tissues such as teeth, hair, fatty material, and bone. A dermoid cyst typically contains samples of these other tissues inside its wall. Almost all (98%) dermoid cysts are not cancerous; however, they can cause trouble if they become large enough to cause the ovary to twist and lose its blood supply or if they burst and spill their contents into the abdomen. Dermoid cysts may be as small as one-half inch or as large as 17 inches.

The second type endometrioid (en-do-MEET-ree-oid) cysts results from endometriosis (en-do-meet-ree-OH-sis), a condition that develops when a small patch of tissue from the endometrium—the tissue that lines the uterus—grows inside the ovaries instead of its normal location. The blood in the endometrioid cyst builds up inside the walls of the cyst and eventually turns brown, which is why these cysts are sometimes called chocolate cysts. Like other types of ovarian cysts, endometrioid cysts can grow to the point where they rupture and spill their contents onto other abdominal organs. They range in size from three-fourths of an inch to seven or eight inches.

Pathological ovarian cysts Pathological (path-oh-LAW-gih-kul) ovarian cysts are caused by some kind of disease process. There are two types of pathological cysts. The first type is a malignant cyst caused by cancer of the ovary. Cancerous ovarian cysts can cause nausea, vomiting, intestinal blockage, loss of appetite, and swelling of the abdomen as well as abdominal pain.

The second type of pathological ovarian cyst develops in a polycystic (pol-ee-SISS-tik)-appearing ovary. This condition is not the same as polycystic ovary syndrome even though the names are similar. The word *polycystic* means “many cysts” and refers to the appearance of the ovary on an ultrasound image. A polycystic-appearing ovary is about twice the size of a normal ovary (which is the size of a large olive) and has a number of small cysts that can be seen around the outside of the ovary. The cysts are

POLYCYSTIC OVARY SYNDROME

Polycystic ovary syndrome (PCOS) is an endocrine disorder that affects between 4 and 7 percent of women in the United States. It is the most common hormonal disorder in women of childbearing age. The most significant features of PCOS are the absence of ovulation and menstruation; acne; abnormal production of androgens (male hormones); growth of hair on the face, chest, and legs; and obesity. The disorder gets its name from the fact that most women with PCOS have polycystic ovaries. It is possible, however, for a woman with normal-appearing ovaries to have PCOS, just as a woman can have a polycystic-appearing ovary without having the disorder.

The cause of PCOS was not completely known as of 2009, although insulin resistance appeared to be a factor. Women with PCOS cannot have children unless they are treated, and they have an increased risk of type 2 diabetes, high blood pressure, heart disease, and cancer of the uterus. The condition is treated with medications to increase the patient's sensitivity to insulin, to restore ovulation, and to bring on regular menstrual periods.

* **endocrine** (EN-do-krin) refers to a group of glands, such as the thyroid, adrenal, and pituitary glands, and the hormones they produce. The endocrine glands secrete their hormones into the bloodstream, and the hormones travel to the cells that have receptors for them. Certain hormones have effects on mood and sometimes cause emotional swings.

usually one-half inch in size or smaller and may look like a string of pearls. This type of ovary can be found in some normal women and in some women with various endocrine* disorders. The main difference between a polycystic-appearing ovary and polycystic ovary syndrome (PCOS) is that a woman with PCOS will have other symptoms and abnormalities.

How Common Are Ovarian Cysts?

Ovarian cysts in general are common in American women; 95 percent are benign. They can be detected in almost all women of childbearing years on an ultrasound test, and in 14 to 17 percent of women after menopause. Most ovarian cysts are functional cysts. Another 10 percent are dermoid cysts. Cancerous ovarian cysts are diagnosed in about 22,000 women in the United States each year. Between 4 and 7 percent of women of childbearing age in the United States are diagnosed with polycystic ovary syndrome.

Different types of ovarian cysts are more common in different age groups, however. Ovarian cysts in women over 50 or in girls before puberty are more likely to be cancerous than those in women of childbearing age. Dermoid cysts are most common in women in their late twenties or early thirties. Women who take certain types of fertility drugs are more likely to develop corpus luteum cysts than those who do not.

Who Gets Ovarian Cysts?

Women from all races and ethnic backgrounds appear equally likely to develop functional ovarian cysts, although Caucasian women are more likely to develop cancerous cysts than women of other races. Some

* **hypothyroidism** (hi-po-THY-royd-ih-zum) is an impairment of the functioning of the thyroid gland that causes too little thyroid hormone to be produced by the body. Symptoms of hypothyroidism can include tiredness, paleness, dry skin, and in children, delayed growth and mental and sexual development.

* **infertility** (in-fer-TIH-lih-tee) is the inability of females to become pregnant or of males to cause pregnancy.

other risk factors for ovarian cysts have been identified; they include the following:

- A family history of ovarian cysts
- A large amount of fat on the upper body
- Hypothyroidism*
- Early menstruation; first period at age 11 or younger
- A history of irregular menstrual cycles
- Infertility*
- Being treated for breast cancer with a drug called tamoxifen
- A history of heavy smoking

One factor that appears to lower a woman's risk of ovarian cysts is taking birth control pills. The pills work to prevent pregnancy by preventing the production of eggs during ovulation.

How Do Women Know They Have Ovarian Cysts?

Most ovarian cysts, including early-stage cancerous cysts, do not cause any noticeable symptoms and are usually found in the course of an ultrasound test performed for other reasons. The most common single symptom that women report is pain in the lower abdomen. The pain is usually described as sharp or stabbing, sudden, and severe. Other symptoms that women may have with ovarian cysts are as follows:

- Irregular menstrual periods
- A feeling of pressure, bloating, or fullness in the abdomen
- Pain during sexual intercourse or vigorous exercise
- A need to urinate more frequently or difficulty in emptying the bladder
- Pain in the vagina or spots of blood from the vagina
- Pain during bowel movements
- Weight gain
- Nausea and vomiting
- Indigestion, heartburn or feeling full before the end of a meal
- Pain in the lower back or pelvis shortly before or after the end of the menstrual period
- Unusually heavy menstrual periods

How Serious Are Ovarian Cysts?

Most functional ovarian cysts are not a danger to health even though they sometimes cause mittelschmerz or cramping pain in the second half of the menstrual cycle. Functional cysts that continue to grow rather than shrinking after a few months may need to be removed to prevent torsion (twisting) of the ovary or to make sure that the cyst is not malignant. In

general, cysts that last beyond two to three menstrual cycles or grow larger than 2.5 to 5 inches are removed by surgery. The doctor may also recommend surgery if the cyst is causing severe pain.

Cancerous ovarian cysts are dangerous, partly because they can grow and develop for some time before causing any obvious symptoms. Although they occur in only 15 women per 100,000 in the United States each year, they cause 16,000 deaths. The five-year survival rate for women diagnosed with the most aggressive type of ovarian cancer is only 41 percent.

Women who are having any of the following symptoms with ovarian cysts should see their doctor at once:

- Weakness, dizziness, or fainting
- A fever that does not go away
- A mass in the abdomen that is large enough to be felt
- Extreme thirst or urination
- Sudden swelling of the abdomen
- Extreme abdominal pain
- Nausea and vomiting that does not stop
- Cold, moist skin, a sudden drop in blood pressure, or other symptoms of shock*
- Vaginal bleeding in a woman who has completed menopause

How Are Ovarian Cysts Diagnosed and Treated?

Diagnosis Some ovarian cysts are large enough to be felt when the doctor examines a patient's abdomen in the office or emergency room. Most, however, are too small to be felt during a physical examination but are identified through ultrasound imaging. To perform an ultrasound of the ovaries, the doctor places a thin wand into the vagina and points it in the direction of the uterus and ovaries. This type of ultrasound gives a clearer image of the cyst than an ultrasound performed through the abdomen. The doctor can tell whether the cyst is filled with fluid, is a solid mass, or is a mixture of fluid and solid tissue.

The doctor may also order magnetic resonance imaging* to confirm the results of the ultrasound or CT scans* to get a clearer picture of the extent of the cyst.

There are no laboratory tests that can detect ovarian cysts. The doctor may, however, order a urine test to rule out the possibility that the patient has an ectopic pregnancy*, and a blood test if the patient has a fever and may have an infection.

A postmenopausal woman with an ovarian cyst will be given a blood test to look for a tumor marker* called CA125, a substance in the blood whose level can be measured to evaluate whether a cyst in the ovary is benign or cancerous. It is, however, possible for conditions other than cancer to cause a rise in the level of CA125 in a woman's blood.

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **ectopic pregnancy** (ek-TAH-pik) is an abnormal pregnancy in which the fertilized egg develops outside the uterus, usually within one of the fallopian tubes.

* **tumor marker** (TOO-mer MARK-er) is a substance found in blood, urine, or body tissues whose level rises when a person has cancer. Tumor markers can be used to detect possible cancer.

* **laparoscopy** (lap-uh-ROS-kuh-pee) a type of surgery in which a small fiberoptic instrument is inserted through a very small incision to examine the inside of the abdomen or remove small amounts of tissue. It is also called minimally invasive surgery.

* **ibuprofen** (eye-bew-PRO-fin) is a nonsteroidal anti-inflammatory drug (NISAD) used to reduce fever and relieve pain or inflammation.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

Treatment Small benign ovarian cysts that are not causing any symptoms are usually treated first by watchful waiting. Because most functional cysts go away by themselves after a few months, the doctor usually recommends that a woman with a functional cyst return in one to three months for a follow-up ultrasound to see whether the cyst has changed in size. Women who are through menopause are also treated with watchful waiting if the cyst is smaller than an inch, is fluid-filled, and is not causing any other symptoms.

If ultrasound and other tests indicate that the cyst is very large, is growing, or may be cancerous, the doctor may perform a type of surgery called a laparoscopy* to remove the cyst or a part of it from the ovary for examination under a microscope.

If the cyst is very large, if it is found to be cancerous, or if the woman has completed menopause, the doctor will usually recommend abdominal surgery to remove one or both ovaries. If the cyst is cancerous and the woman is postmenopausal, the doctor may recommend surgical removal of the uterus as well as both ovaries to prevent the cancer from recurring or spreading.

In some cases the doctor may prescribe birth control pills to regulate the woman's menstrual cycle, to keep follicles from developing into functional cysts, and to stop or slow down the growth of existing functional cysts. Birth control pills also lower the risk of developing ovarian cancer in the future.

Self-Care at Home Women who have mittelschmerz or mild pain in the lower back or abdomen from ovarian cysts can take over-the-counter pain relievers such as ibuprofen* or acetaminophen*. The doctor may also prescribe pain relievers that contain codeine or oxycodone if the cramps are very bad. Warm baths and heating pads are helpful to many women, and some find that cutting back on coffee and other beverages containing caffeine helps to relieve cramps.

Can Ovarian Cysts Be Prevented?

As of 2009 there was no known way to prevent the development of ovarian cysts except for surgical removal of both ovaries. Regular medical checkups can, however, help in diagnosing ovarian cysts as soon as possible. Women should keep track of the frequency and heaviness of their periods and tell their doctors if they notice any changes in their usual pattern that last for more than two cycles.

▶ See also **Cyst**

Resources

Books and Articles

Orr, Tamra. *Ovarian Tumors and Cysts*. New York: Rosen, 2009.

Organizations

American College of Obstetricians and Gynecologists. 409 12th Street SW, P.O. Box 96920, Washington, DC, 20090-6920. Telephone: 202-638-5577. Web site: <http://www.acog.org>.

Society for Adolescent Medicine. 1916 Copper Oaks Circle, Blue Springs, MO, 64015. Telephone: 816-224-8010. Web site: <http://www.adolescenthealth.org>.

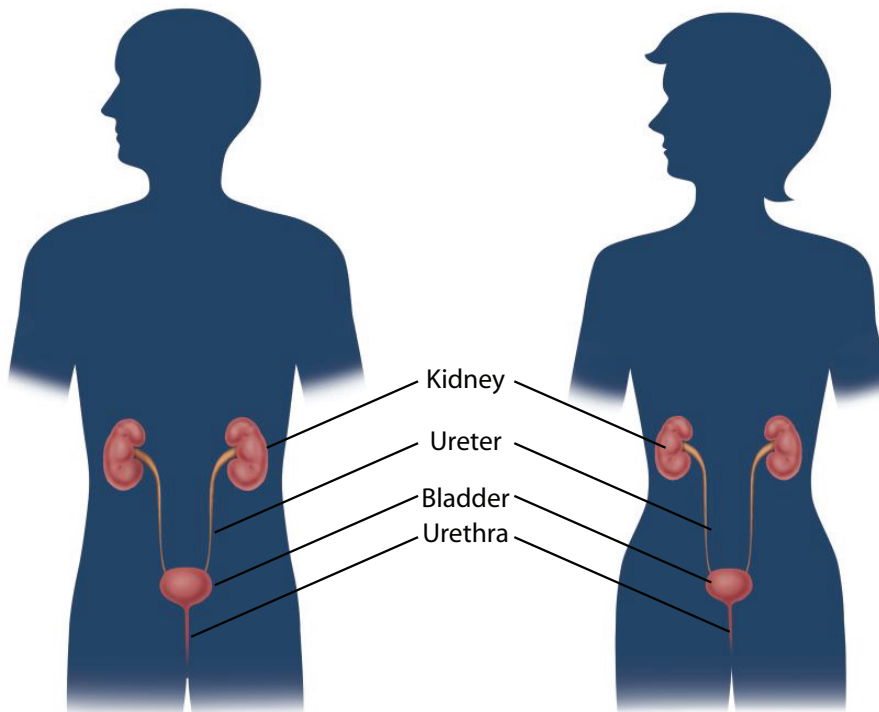
* **incontinence** (in-KON-ti-nens) is loss of control of urination or bowel movement.

Overactive Bladder

Overactive bladder causes an abrupt and hard to control need to urinate.

What Is Overactive Bladder?

An overactive bladder is caused by a sudden, involuntary contraction of the muscle in the wall of the urinary bladder. Overactive bladder causes an abrupt and hard to control need to urinate referred to as urinary urgency. Overactive bladder is also known as urge incontinence* and is a form of



◀ Anatomy of the kidneys and urinary tract. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

urinary incontinence (unintentional loss of urine). Overactive bladder is most common in older adults. It affects approximately one in 11 adults in the United States.

What Causes Overactive Bladder?

The bladder functions by filling with urine and then emptying. This process requires a complex interaction between the kidneys, nerve impulses, and muscular activity. When defective, various parts of this process can contribute to overactive bladder and urge incontinence.

How Does a Normal Bladder Function? The kidneys are responsible for filtering waste from the blood and producing urine. The urine then travels down a pair of tubes called the ureters from the kidneys to the bladder. The bladder fills with urine but holds the urine until it is time to void (release) it by going to the bathroom. During voiding, urine drains from the bladder through an opening (called the neck) and flows out of the body through a short tube called the urethra. In women, the urethral opening is located just above the opening to the vagina, whereas in men it is at the tip of the penis.

As the bladder fills with urine, it expands. When the bladder is approximately half full, nerve impulses are sent to the brain. The need to urinate normally occurs when the bladder is approximately three-fourths full. In order to release the urine it has been holding, the bladder relies on specialized muscle. During voiding, nerve signals coordinate the relaxation of the pelvic floor muscles and the urinary sphincter muscles (muscles surrounding the neck of the bladder and upper portion of the urethra). The relaxation of these muscles allows the urine to escape the bladder while muscles of the bladder contract, forcing urine out.

Abnormal bladder function Often overactive bladder symptoms occur because the muscles of the bladder involuntarily contract. The contraction of the bladder muscles creates urinary urgency. If the urinary sphincter remains constricted, it will prevent the bladder from leaking. However, if the urinary sphincter is overwhelmed by the bladder muscle contraction, involuntary urination occurs.

What Are the Symptoms of Overactive Bladder?

Symptoms associated with overactive bladder include frequent urination, usually at least eight times per day. Awakening to urinate at night usually occurs at least twice. There is a sense of urinary urgency, and an involuntary loss of urine immediately following the urgent need to urinate (urge incontinence). Some individuals may also have what is called mixed incontinence, when both urge incontinence and stress incontinence occur. Stress incontinence is an involuntary loss of urine in response to the pressure caused by physical stressors such as coughing or laughing, which increase the pressure within the abdomen and pelvis.

Although an individual with overactive bladder may be able to get to the bathroom in time when they experience urinary urgency, the frequency with which they must urinate both day and night, combined with the need to suddenly go to the bathroom, is disruptive at work and social activities, and affects their quality of life. For this reason, overactive bladder may cause significant social, psychological, occupational, and sexual problems.

What Risk Factors Make People Likely to Develop an Overactive Bladder?

Overactive bladder is not considered a normal part of aging. However, the risk of experiencing overactive bladder increases with age. As people get older they have increased risk of developing overactive bladder and are more likely to get diseases that cause problems with bladder function, such as enlarged prostate and diabetes. Neurological disorders such as Parkinson's disease*, stroke*, and multiple sclerosis* have been associated with overactive bladder. Lifestyle decisions that may reduce risk of overactive bladder include getting regular exercise, eating a high-fiber diet, and limiting caffeine and alcohol. Individuals who have an overactive bladder and whose lives are severely disrupted are at increased risk for depression.

How Is Overactive Bladder Diagnosed?

In the initial stages of an overactive bladder diagnosis, other medical issues that may be causing symptoms need to be ruled out. Medical history and a physical exam focusing on the abdomen and genitals are necessary. A urine test may be performed in order to rule out urinary tract infection. Once other, more common causes of urinary urgency have been ruled out, three specialized tests may be performed.

Urodynamic tests assess bladder function, including the ability to empty completely. This aspect of bladder function is assessed by measuring the urine left in the bladder after voiding is complete. Failure of the bladder to empty completely may cause symptoms similar to overactive bladder.

Cystometry is performed to measure the pressure inside the bladder and assess bladder function. In this test, two catheters* are used. The first enters the bladder and fills the bladder with water. The second catheter is attached to a pressure-measuring sensor and placed near the bladder in the vagina or rectum. Cystometry can identify involuntary muscle contractions, indicate the level of pressure that causes urge incontinence, and measure the pressure required for the bladder to empty.

Electromyography examines the muscles of the bladder to assess its ability to coordinate impulses in the muscles of the bladder with impulses in the urinary sphincter. If these muscles are not coordinated, the process of normal urination is affected. Also cystoscopy can be performed, which involves running a tiny lens through the urethra to check for abnormalities such as tumors in the bladder.

* **Parkinson's disease** is a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

* **multiple sclerosis** (skluh-RO-sis), or MS, is an inflammatory disease of the nervous system that disrupts communication between the brain and other parts of the body. MS can result in paralysis, loss of vision, and other symptoms.

* **catheters** (KAH-thuh-ters) are small plastic tubes placed through a body opening into an organ (such as the bladder) or through the skin directly into a blood vessel. They are used to give fluids to or drain fluids from a person.

How Is Overactive Bladder Treated?

Pelvic muscle rehabilitation is one treatment used to relieve the symptoms of overactive bladder. This treatment improves pelvic muscle tone and prevents involuntary leakage of urine. Pelvic muscle rehabilitation includes doing Kegel exercises, which are sets of voluntary muscle contractions of the pelvic muscles and urinary sphincter, designed to improve their strength and help prevent urinary incontinence. Electrical stimulation of the muscles of the pelvic floor may also be performed in conjunction with Kegel exercises. Behavioral therapies such as scheduled bathroom appointments every two to three hours may help some people with incontinence. Caffeine and alcohol may be avoided because they increase the frequency of urination. Double voiding is a technique that involves emptying the bladder, waiting a few minutes, and then attempting to fully empty the bladder a second time. This technique may help people who have difficulty emptying their bladder completely during urination. At home occasional catheterization may also improve bladder emptying and increase dryness. Patients may learn how to periodically insert a catheter into their bladder to empty it. Maintaining a healthy weight is also important for overactive bladder patients. Being overweight increases incidents of incontinence. Medications that relax the bladder are used to alleviate symptoms of overactive bladder and reduce episodes of urge incontinence. These drugs include tolterodine, oxybutynin, an oxybutynin skin patch, trospium, solifenacin, and darifenacin. Common side effects include dry eyes and dry mouth.

Surgery to treat overactive bladder is only used on severe cases that do not respond to other treatments. Surgery may be performed to improve the storage ability of the bladder and reduce pressure. One type of surgical intervention is nerve stimulation of specific nerves involved in bladder function. Stimulation of the nerves of the bladder is analogous to stimulation of the heart by a pacemaker. A thin nerve stimulation wire attached to a small battery may be inserted under the skin.

Resources

Books and Articles

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Newman, Diane K., and Alan J. Wein. *Overcoming Overactive Bladder: Your Complete Self-Care Guide*. Oakland, CA: New Harbinger, 2004.

Organization

American Urological Association. 1000 Corporate Boulevard, Linthicum, MD, 21090. Toll free: 866-RING-AUA. Web site: <http://www.auafoundation.org/auafhome.asp>.

P

Pain

Pain is a signal from the body that something is wrong.

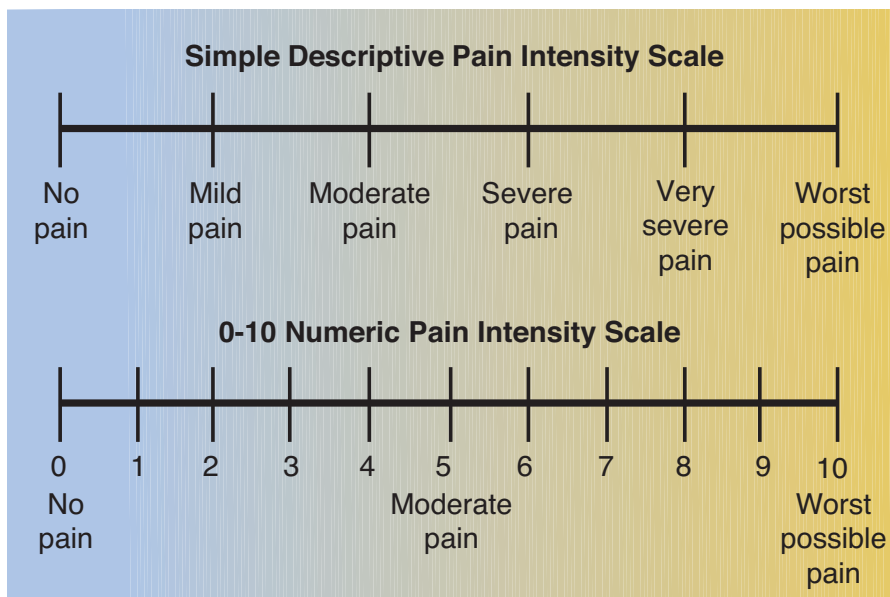
Sarah's Story

Sarah woke up Monday morning with pain in her throat. She did not mention it to her mother before heading for school, and the pain continued to worsen during the day. By evening Sarah could barely swallow, and when her mother looked into her mouth, she saw that Sarah's tonsils were red and inflamed.

The pain did not go away, and on Thursday morning, her mother took Sarah to the doctor. After taking a history and examining Sarah's throat, the doctor used a swab to collect a culture*. The culture indicated that Sarah had strep throat (a contagious infection caused by bacteria called Group A beta-hemolytic *Streptococcus pyogenes*), and the doctor prescribed a course of antibiotics as treatment. After a few days on the antibiotics, the pain went away, and after 10 days, Sarah's strep throat was healed.

* **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

Pain Intensity Scales



Medical professionals use pain intensity scales to help determine the level of pain a person is suffering. *Public Domain.*

* **nervous system** is a network of specialized tissue made of nerve cells, or neurons, that processes messages to and from different parts of the human body.

* **neurotransmitter** (NUR-o-tranz-mit-er) is a chemical substance that transmits nerve impulses, or messages, throughout the brain and nervous system and is involved in the control of thought, movement, and other body functions.

Without the pain that accompanied her sore throat, Sarah and her mother might not have realized that Sarah had an infection that, if left untreated, could have made her seriously ill.

What Is Pain?

Pain is one of the body's signals that something is wrong. In Sarah's case, the pain of a sore throat was the harbinger of a strep infection. Pain is an unpleasant, uncomfortable feeling conducted from the site of an injury by the nervous system* to the brain. Pain serves several functions: as a warning of an injury; as a means of preventing further injury; and as a cause of reduced activity to allow healing to proceed.

In the brain, the pain messages first enter the thalamus, a part of the brain that diverts nerve impulses to the proper areas of the brain. Pain signals are routed to three areas of the brain: the frontal cortex, the thinking and reasoning part of the brain; the somatosensory cortex, the part of the brain that handles physical sensations; and the limbic system, the part of the brain that controls the emotions.

The body releases natural chemicals that can intensify the perception of pain, such as prostaglandins, compounds that have many functions in the body, including to sensitize the nerve cells in the spinal cord to pain. The analgesic (pain-killing) aspirin blocks the receptors on the cells that are keyed to receive prostaglandins and thus interfere with its effect, relieving pain. Endorphin, another neurotransmitter*, blocks the perception of pain naturally, and because the brain may release a high level of endorphin during an exciting or stressful situation, a person who is injured in such a situation—such as a traffic accident—may not even be aware of being injured until later.

Each person experiences pain in a unique way. How pain is interpreted and handled is affected by a variety of factors, such as age, gender, emotional state, previous experiences of pain, and attitude. Upbringing and social or cultural background can also affect a person's experience of pain, such as the famous British "stiff upper lip" expectation that a person would not show a reaction to pain.

What Are the Two Main Types of Pain?

The human body can experience acute pain, which strikes quickly and leaves quickly (usually within six weeks), such as after a fall, or chronic pain, which can also strike quickly but lingers, sometimes for years.

An example of acute pain is the pain of a sprained ankle. After the stretching of the ankle's ligaments, the pain receptors in the area signal the brain. The brain responds by not putting weight on the injured joint so as not to cause additional damage.

Acute pain can often be successfully treated with over-the-counter pain medications called analgesics. Some analgesics not only relieve pain but also reduce inflammation.

However, intense pain can be the sign of a life-threatening condition. A feeling of pressure, fullness, squeezing, or pain in the center of the chest

or pain that is radiating down one or both arms or into the jaw may signal a myocardial infarction (heart attack). Someone experiencing such symptoms should seek medical help immediately.

A doctor will ask the patient to describe the location of the pain and indicate its severity, perhaps by using a scale from 0 to 10 (0 being no pain, 10 being worst), words (such as no pain, mild, moderate, and severe), or faces that by their expressions show the extent of the pain. The doctor may order tests or procedures, such as x-rays, MRIs*, or laboratory tests, to determine if the pain is the result of an injury, such as fractured bone, or an infection or a heart attack. Once the underlying cause is treated, pain usually disappears.

Chronic pain may come and go or be a constant lingering ache, but it occurs over a period of six months or more. For people who suffer from migraine headache, the pain comes on suddenly and can be incapacitating. On the other hand, people with fibromyalgia* experience a constant pain throughout the body. Approximately 76 million Americans live with chronic pain, and 58 percent of chronic-pain sufferers report experiencing anxiety or depression. Chronic pain affects people's quality of life.

The most common types of chronic pain are lower back pain, migraine headaches, neck pain, and facial pain. Arthritis*, fibromyalgia, and cancer all cause chronic pain, as can diabetes* and shingles (a painful contagious rash). Chronic pain can result from an initial injury, such as a back injury suffered during car accident, but for an unknown reason the central nervous system continues to send pain messages after the injury heals.

How Is Pain Treated?

Pain can be relieved by medications called analgesics. There are two main groups of analgesics that are available without prescription: nonsteroidal anti-inflammatory drugs (NSAIDs) and acetaminophen*. Although they are available over the counter (OTC), both groups must be taken with caution; excessive doses of acetaminophen can cause liver damage, and NSAIDs can damage the stomach.

Stronger pain relievers, such as narcotics, are available only with a prescription because they can cause physical and psychological dependence. They may be administered by mouth or intravenously.

The pain of childbirth is acute but can be relieved in a number of ways. A woman in labor may opt for an epidural or a spinal block, in which a local anesthetic is injected into the lower part of the body to block pain signals. A woman may control pain with behavioral techniques such as relaxation exercises and controlled, rhythmic breathing.

Like acute pain, chronic pain can be treated with pain relievers. In some cases, such as fibromyalgia, antidepressant medications* can be helpful. Exercise and alternative therapies such as acupuncture (a technique to relieve pain by inserting and manipulating fine needles in the skin) can also help to relieve chronic pain. Research continues to explore ways to relieve the suffering of people who experience chronic pain.

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **fibromyalgia** (fi-bro-my-AL-ja) is a group of disorders that are characterized by aching, tender, and stiff muscles.

* **arthritis** (ar-THRY-tis) refers to any of several disorders characterized by inflammation of the joints.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **antidepressant medications** are used for the treatment and prevention of depression.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

* **enzymes** (EN-zimes) are proteins that help speed up a chemical reaction in a cell or organism.

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Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: www.aafp.org.

American Chronic Pain Association. P.O. Box 850, Rocklin, CA, 95677. Toll free: 800-533-3231. Web site: <http://www.theacpa.org>.

Pancreatic Cancer

Pancreatic (pan-kree-AT-ik) cancer is a condition in which the cells in the pancreas (PAN-kree-us), a digestive gland located behind the stomach, divide without control or order, forming tumors that frequently spread to other parts of the body. The disease is usually fatal.

What Is Pancreatic Cancer?

The pancreas is a six-inch-long gland in the abdomen* that is surrounded by the stomach, intestine, and other digestive organs. It is shaped like a long, flattened pear, wide at one end and narrow at the other.

This gland produces fluids that contain digestive enzymes* (EN-zymes), proteins that help break down food for use in the body. These fluids travel through a series of ducts, or tubes, into a main pancreatic duct that joins the common bile duct coming from the liver and gallbladder. Along with

the bile, which helps the body digest fat, the pancreatic juices empty into the small intestine.

Besides secreting enzymes, the pancreas has islet (EYE-let) cells that manufacture and release hormones directly into the blood. These hormones help the body store or use the energy that comes from food. Insulin and glucagons are created this way, and these hormones help control the amount of sugar in the blood.

Cancer usually begins in the juice-carrying ducts, but in rare cases it may start in the islet cells. A tumor* forms and eventually grows into the surrounding organs. Cancer cells may also break away from the tumor and spread to other parts of the body, such as the lymph nodes*, liver, lungs, and bones.

Finding cancer early is the key to treating it successfully, but with pancreatic cancer, a patient typically does not notice the symptoms until the cancer has spread to other parts of the body. By then, it is usually too late for treatment to be successful.

What Are the Symptoms of Pancreatic Cancer?

People with cancer of the pancreas eventually develop pain in the upper abdomen that sometimes spreads to the back and may become worse after eating or lying down. They also may experience nausea*, loss of appetite, weight loss, and weakness. If the tumor blocks the common bile duct so that bile cannot pass into the small intestine, they develop jaundice (JAWN-dis), a condition in which the skin and whites of the eyes turn yellow. Islet-cell cancer can cause the pancreas to make too much insulin or other hormones. As a result, the person may feel weak or dizzy and experience chills, muscle spasms, or diarrhea*.

How Is Cancer of the Pancreas Diagnosed?

When doctors suspect pancreatic cancer, they perform x-rays and other imaging tests that produce pictures of the pancreas and the areas surrounding it. These tests can help doctors rule out other, less serious conditions that may cause the same symptoms. While these visual tests are helpful in diagnosing pancreatic cancer, the only way to know for sure is to do a biopsy (BY-op-see), the removal of a tissue sample that is then viewed under a microscope. Surgeons can obtain this tissue in different ways. They can get it with a needle that is inserted through the abdomen into the pancreas or through a thin, flexible tube passed down the throat and into the stomach region.

How Is Pancreatic Cancer Treated?

Pancreatic cancer has the highest mortality rate of all cancers: between 95 and 99 percent. The best chance for survival occurs when the tumor is confined to the pancreas and the immediate surrounding area. More commonly, treating the disease aims at lessening the pain and improving the person's quality of life.

* **tumor** (TOO-mor) usually refers to an abnormal growth of body tissue that has no known cause or physiologic purpose and is not an inflammation.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **nausea** (NAW-zha) refers to a feeling of being sick to one's stomach or needing to vomit.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

- * **radiation therapy** is a treatment that uses high-energy radiation from x-rays and other sources to kill cancer cells and shrink cancerous growths.
- * **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

In either case, the most common forms of treatment are surgery, radiation therapy*, and chemotherapy* (kee-mo-THER-a-pee), or a combination of them. Surgery involves removing part or all of the pancreas in a procedure called pancreatectomy (pan-kree-a-TEK-to-mee). Radiation therapy uses high-energy rays to damage cancer cells and stop them from growing and dividing. Chemotherapy is the use of anticancer drugs that are fed into a vein or given in pill form.

Who Develops Cancer of the Pancreas and Why?

As with most other types of cancer, pancreatic cancer is usually diagnosed in middle-aged and older people. It rarely occurs in people younger than 40 years of age, and most people who develop it are around 70 years of age. Cancer of the pancreas is the fourth most common kind of cancer, affecting about 37,000 Americans every year.

Doctors are not sure what causes this type of cancer. Research shows that people are more likely to develop it if they smoke cigarettes or they have diabetes*. Some studies suggest that a fatty diet that is low in fruits and vegetables contributes to pancreatic cancer, whereas others indicate that people who are exposed to certain harsh chemicals in their jobs are at higher risk. Heredity is another possible factor: About 10 percent of people who have pancreatic cancer have a family history of the disease. In the early 2000s research was under way to help pinpoint specific causes of pancreatic cancer, particularly in those people who have none of the risk factors.

▶ See also **Cancer: Overview**

Resources

Books and Articles

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O'Reilly, Eileen, and Joanne Frankel Kelvin. *100 Questions & Answers about Pancreatic Cancer*. Sudbury, MA: Jones and Bartlett, 2003.

Organizations

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-227-2345. Web site: http://www.cancer.org/docroot/CRI/CRI_2x.asp?sitearea=&dt=34.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://cancernet.nci.nih.gov/cancertopics/types/pancreatic>.

Pancreatitis

Pancreatitis (pan-kree-a-TY-tis) is a painful inflammation of the pancreas.*

What Is Pancreatitis?

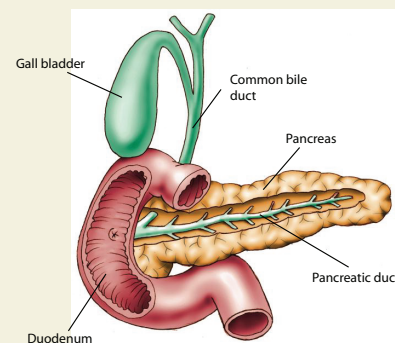
The pancreas (PAN-kree-us) is part of the digestive system. It is a gland that is about six inches long and shaped like a flattened pear. It lies next to the stomach with its wider end near the duodenum (doo-o-DEE-num), the first part of the small intestine. The pancreas produces insulin and glucagon (GLOO-ka-gon), which are chemical messengers called hormones*, which control the use of sugar in the body. The pancreas is also one of the organs in the digestive system that helps to break down food. The pancreas does this by secreting enzymes* that allow the body to digest proteins, sugars, and fats. These digestive juices from the pancreas travel into a tube, called the pancreatic duct. Other digestive juices, known as bile, also enter the pancreatic duct. Bile comes from the gall bladder, which is a small muscular sac that stores juices produced by another organ, the liver. Another tube, called the common bile duct, leads from the bladder to the pancreatic duct. From the pancreatic duct, this combination of digestive juices empties from the pancreatic duct into the small intestine, where it can then start digesting food.

Normally, the powerful digestive enzymes of the pancreas are inactive until they reach the small intestine. When the pancreas becomes inflamed, however, its enzymes leak out, become activated, and begin to digest the tissues they contact, so they begin to eat away at the pancreas and surrounding tissues. The resulting damage can cause swelling of tissues and blood vessels.

There are two forms of pancreatitis: acute and chronic. Acute* pancreatitis occurs when the pancreas suddenly becomes inflamed and destruction of the pancreas with attendant biochemical and functional abnormalities occur. Chronic* pancreatitis is persistent inflammation of the pancreas or a combination of persistent inflammation with repeated attacks of acute pancreatitis. Over time, the damage caused by chronic pancreatitis can lead to malabsorption (when the body cannot absorb the nutrients and calories it needs). People who have advanced cases may also develop diabetes*. This occurs because pancreatitis can damage the cells in the pancreas that produce insulin and glucagon.

Insulin and glucagon work opposite to one another. Glucagon tells the liver to turn a chemical called glycogen into another, called glucose. Glucose is a form of sugar that the liver then releases into the bloodstream. Insulin, by contrast, tells the liver to turn the glucose into glycogen, and the glycogen is then stored in the liver. Together, these two hormones regulate blood sugar. This regulation is important because blood sugar levels that are too high or too low can cause numerous health problems, including death.

Because advanced chronic pancreatitis can affect both insulin and glucagon production, doctors must be very careful in treating this condition.



▲ Anatomy of the pancreas, gallbladder, and duodenum. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

- * **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.
- * **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **enzymes** (EN-zimes) are proteins that help speed up a chemical reaction in a cell or organism.
- * **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.
- * **chronic** (KRAH-nik) lasting a long time or recurring frequently.
- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **gallstones** (GAWL-stonz) are hard masses that form in the gallbladder or bile duct.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

For example, people who have diabetes usually have high blood sugar, and doctors may order an infusion of insulin to treat it. If a patient's glucagon production is low, however, the additional insulin can lead to an overly decreased blood-sugar level (called hypoglycemia), which can be fatal.

What Causes Pancreatitis?

Pancreatitis has many causes, but most cases of acute pancreatitis result from alcohol abuse or gallstones*. A patient usually feels severe pain in the upper abdomen* that may last for hours or for a few days. The abdomen may be swollen and tender. Other symptoms may include nausea, vomiting, fever, and an increased pulse rate.

How Is Pancreatitis Diagnosed?

In addition to pain, patients with chronic pancreatitis usually show signs of long-term damage such as malabsorption or diabetes. Because acute pancreatitis causes an increase in certain levels of digestive enzymes in the blood, a blood test may confirm a diagnosis of the condition. Sometimes, a doctor may order x-rays or CT scans* to make the diagnosis.

How Is Pancreatitis Treated?

Treatment for pancreatitis depends on the type, cause, and severity of the condition. Although acute pancreatitis usually gets better on its own, a patient may spend time in the hospital during the attack. If the patient has gallstones, surgery to remove them may be needed.

Patients with chronic pancreatitis will begin a strict diet that limits fat and protein, because the damaged pancreas can no longer digest these substances properly. Patients sometimes receive replacement enzymes to help digest their food, and a doctor may prescribe medication to relieve pain. Because alcohol is often the cause of both acute and chronic pancreatitis, the best way to prevent the disease is to avoid drinking alcohol.

With treatment, the outlook for chronic pancreatitis often is good, but patients must stop drinking alcohol. Other less common causes of pancreatitis, such as infections, cancer*, and reactions to medicines or chemicals, require a proper diagnosis in order to be treated the best way possible.

▶ See also **Alcoholism • Diabetes • Gallstones**

Resources

Organizations

American Gastroenterological Association. 4930 Del Ray Avenue, Bethesda, MD, 20814. Telephone: 301-654-2055. Web site: <http://www.gastro.org/wmspage.cfm?parm1=855>.

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/pancreatitis>.

Panic Disorder

Panic (PA-nik) is a sudden surge of overwhelming fear that causes both psychological (sy-ko-LAH-je-kal) and physical symptoms. Panic disorder is a condition that leads to repeated attacks of panic that can strike often and without warning.

Karla's Story

Karla was riding her bicycle to school when a speeding car ran a stop sign. The driver slammed on the brakes, but the car kept skidding toward Karla with a sickening squeal. As Karla watched the car bearing down on her, she felt her heart racing, she broke into a sweat, and could not catch her breath, and everything seemed to be moving in slow motion. For a moment before the car finally came to a stop, Karla feared she was going to die.

What Are Panic Attacks and Panic Disorder?

Karla was feeling panic, a sudden surge of overwhelming terror that causes both psychological symptoms, such as feeling that things are unreal or fearing that death is approaching, and physical symptoms, such as a racing heart, sweating, trembling, shortness of breath, chest pain, upset stomach, and dizziness. These feelings are the body's natural response to danger or stress. For some people, though, the feelings seem to arise from nowhere. They can occur in seemingly harmless situations, such as while taking a quiet walk or sitting in class. Panic attacks are bursts of intense fear or discomfort that happen, often for no obvious reason. They are part of many anxiety (ang-ZY-e-tee) disorders, in which needless fear becomes so intense and long-lasting that it causes problems at home, in school, at play, or elsewhere.

Panic disorder is a particular type of anxiety disorder in which people have panic attacks that strike often and usually without warning. The attacks are so unpleasant that many people live in constant dread of the next one. People may develop phobias (FO-bee-as), intense, unrealistic fears of certain objects or situations, about things linked to past panic attacks. For example, a boy who has had a panic attack during basketball practice might develop a phobia of the gym. As the problem gets worse, people may start to avoid situations where they believe they might have another panic attack. This avoidance may even turn into agoraphobia (a-gor-a-FO-be e-a), a condition

* **genetics** (juh-NEH-tiks) is the branch of science that deals with heredity and the ways in which genes control the development and maintenance of organisms.

* **identical twins** are twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.

* **fraternal** twins are born at the same time but develop from two separate fertilized eggs. Unlike identical twins, who develop from only one fertilized egg that splits into two and who look exactly alike, fraternal twins may not look the same at all or be the same gender. Identical twins have the same genes, but fraternal twins are no more likely to share genes than non-twin siblings.

* **nervous system** is a network of specialized tissue made of nerve cells, or neurons, that processes messages to and from different parts of the human body.

that makes people find it hard to go beyond familiar places or even leave their homes. People with agoraphobia are terrified of having a panic attack in a situation where it would be hard to escape or get help.

How Common Is Panic Disorder?

About one in every 63 adults in the United States will have panic disorder at some point in his or her life. The problem usually begins during the late teen or early adult years, but children and older adults can have panic disorder, too. Women are affected twice as often as men. People with panic disorder often have other conditions as well, such as other anxiety disorders or depression.

What Causes Panic Disorder?

Genetics There are probably several causes of panic disorder. Genetics* may play a role in some cases, because panic disorder and other forms of anxiety can run in families. Also, research has shown that identical twins* are more likely to have panic disorder than fraternal* twins.

Physical factors People with panic disorder may not be able to use the natural substances made by the body to reduce feelings of anxiety. Such people may have flaws in nerve cell structures in the nervous system* that bind to these substances.

Psychological factors Other research suggests that it takes very little to set off the body's danger alarm in people with panic disorder. These people may have learned to overreact to normal body changes, giving rise to frequent false alarms. Some scientists speculate that the faulty learning may be the result of repeated stress. Once people have learned to react this way, a stressful event may trigger full-blown panic disorder.

THE MYTHOLOGICAL ROOTS OF PANIC

The word "panic" comes from the Greek term "panikos," which means "of Pan." Pan, the son of Hermes, was the Greek god of nature, of shepherds and their flocks (both goats and sheep), and of music. He was not an especially handsome Greek god, having the upper body of a man and the hindquarters and horns of a goat. Nonetheless, within the woods where he made his home, Pan was known for chasing the ladies. The beautiful nymph Syrinx, in an effort to escape him, was changed into a stand of reeds. Pan plucked one of the reeds and made a musical instrument called a panpipe. When lonely travelers wandered through the wild woods at night, it was said that they heard the pipes of Pan in the wind whistling through the trees and were struck with dread and deep fear. This fear of Pan came to be known as panic.

What Are the Symptoms of a Panic Attack?

Panic disorder starts with panic attacks that can seem to come without a reason. People can be struck suddenly by intense feelings of fear and vulnerability or of losing control. These symptoms usually last several seconds, but they may go on for several minutes or longer. Confused by the unexpected rush of feelings, people may worry that they are going crazy or suffering from a disease. Even when the most intense symptoms of panic have stopped, anxiety and nervousness may last for a while.

Symptoms of a panic attack may include the following:

- pounding or racing heart
- sweating
- trembling
- shortness of breath
- a choking feeling
- chest pain
- upset stomach
- dizziness
- faintness
- feeling as if things are unreal
- fear of losing control
- fear of dying
- numbness or tingling

Initial panic attacks may occur when people are under great stress, such as when they are trying to do too much or when they have just lost a loved one through moving away, divorce, or death. A panic attack may also follow surgery or a serious accident or illness. In addition, overuse of caffeine or abuse of cocaine and certain other drugs may trigger panic attacks. Whatever the situation, though, first panic attacks usually take people completely by surprise, which is one reason they are so terrifying and so clearly remembered.

What Are the Symptoms of Panic Disorder?

Some people have a single panic attack or occasional attacks, but they never have a problem serious enough to affect their lives. For others, however, panic attacks can continue and cause much misery. People with panic disorder have attacks so often that they start to live in constant fear of the next one. This “fear of fear” can become so intense and last so long that it greatly interferes with people’s lives. Panic disorder tends to get worse over time if it is not properly treated.

How Is Panic Disorder Treated?

Early treatment helps keep panic disorder from reaching the stage where people experience severe problems in everyday life. With proper care, 70 to 90 percent of people with panic disorder can feel much better.

Calming Down

Three strategies for coping with a panic attack are:

- Focusing on the fact that the feelings are frightening but not dangerous
- Rating one’s fear from 0 to 10 and noticing how it begins to fall from the highest level after just a few seconds or minutes
- Distracting oneself by counting backward from 100 by threes or by snapping a rubber band on one’s wrist. Distracting oneself from the panic allows the feelings to disappear on their own after a few seconds or minutes, whereas focusing on the panicky feelings intensifies them.

* **thyroid gland** (THY-roid GLAND) is located in the lower part of the front of the neck. The thyroid produces hormones that regulate the body's metabolism (me-TAB-o-LIZ-um), the processes the body uses to produce energy, to grow, and to maintain body tissues.

* **epilepsy** (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.

Before treatment starts, a medical checkup can determine if there are other possible causes for the person's physical symptoms, such as an over-active thyroid gland*, certain types of epilepsy*, or problems with the rhythm of the heartbeat.

Medications Certain medications can prevent or lessen the severity of panic attacks. When people find that their panic attacks are less frequent or less severe, they may worry less about future attacks, and they may be able to face situations they have been avoiding. There are several different kinds of medications doctors may use to treat panic disorder, depending on the person's age and condition.

Therapy A treatment that often works well for panic disorder is cognitive-behavioral (COG-ni-tiv-bee-HAY-vyor-al) therapy, which helps people change specific unwanted behaviors and faulty thinking patterns. People are taught that statements such as "I am going to have a panic attack" can be replaced with statements such as "This is only uneasiness. It will pass." They also may learn to use slow, deep breathing to help ward off the rapid, shallow breathing that many people experience during panic attacks. In another technique, the therapist may have people intentionally bring on some of the sensations of a panic attack. For example, people may exercise to raise the heart rate. Then the therapist can teach them how to cope better with these physical sensations. For example, instead of thinking, "I am having a heart attack," a person may be taught to think, "It is only my heart beating fast. I can handle it."

In this way, cognitive-behavioral therapy focuses on helping people learn to relax when they feel panic. People are taught to understand the thought processes behind their panicky feelings and the way the body physically reacts to stress. Then the therapist can help individuals find ways to respond better when they feel the symptoms of a panic attack.

▶ See also **Agoraphobia • Anxiety and Anxiety Disorders • Fears and Phobias**

Resources

Books and Articles

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Anxiety Disorders Association of America. 8730 Georgia Avenue, Suite 600, Silver Spring, MD, 20910. Telephone: 240-485-1001. Web site: <http://www.adaa.org>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov/health/topics/panic-disorder/index.shtml>.

Paralysis

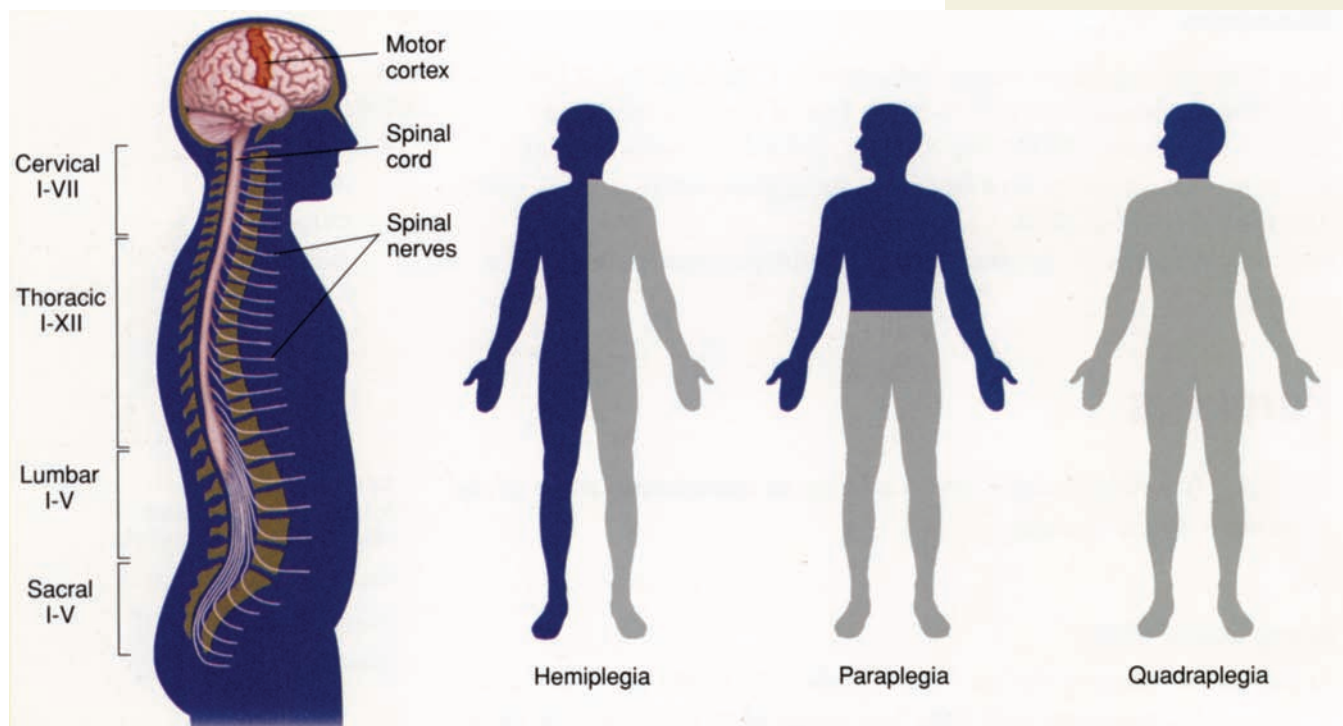
Paralysis (pa-RAL-i-sis) is the inability to consciously control the movement of the muscles.

Sang Lan's Story

As she was warming up for her routine at the July 1998 Goodwill Games, 17-year-old Chinese gymnast Sang Lan prepared for a vault, a move she had performed thousands of times. But Sang flung herself too forcefully into the vault and landed on her head instead of her feet. The impact snapped the sixth and seventh vertebrae (VER-te-bray) in her neck, damaging her spinal cord and leaving her unable to move from the chest

Left to right: Spinal cord showing regions (cervical, thoracic, lumbar, etc.) and nerves; hemiplegia; paraplegia; and quadriplegia. The gray shading indicates how much of the body is paralyzed.

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.





▲
Water provides both resistance and buoyancy, which can help patients with neuromuscular diseases and paralysis exercise more effectively. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **brain stem** is the part of the brain that connects to the spinal cord. The brain stem controls the basic functions of life, such as breathing and blood pressure.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

down. Sang's disability is probably permanent. This type of injury is one of the causes of the condition called paralysis.

What Is Paralysis?

Muscle is a special kind of tissue that enables bodies to move. It is under the control of the nervous system, which processes messages to and from all parts of the body. To understand paralysis, it is important to understand certain terms. Motor neurons are those nerve cells that stimulate the muscles that are under conscious control, such as those for walking, swallowing, breathing, talking. The usual pathway through which nervous signals are sent involves transmission of impulses from the upper motor neurons of the brain to the lower motor neurons of the brain stem* and the spinal cord and then onto the actual muscles. Paralysis occurs when either the upper or the lower motor neurons are irrevocably damaged through either disease or injury, and the individual loses the ability to move the muscles voluntarily.

Paralysis of the muscles of the face, arm, and leg on one side of the body is called hemiplegia ("hemi" means "half") and usually results from damage to the opposite side of the brain, which occurs because the upper motor neurons cross from one side of the brain to the other within the brain stem. Damage to the nerves of the spinal cord affects different parts of the body, depending on the amount of damage and where it occurred. Paralysis of both lower limbs is called paraplegia, and paralysis of both arms and both legs is called quadriplegia. Paralysis may be temporary or permanent, depending on the disease or injury. Because paralysis can affect any muscle in the body, a person may lose not only the ability to move but also the ability to talk or to breathe unaided. Spastic paralysis refers to a form of paralysis which often occurs due to upper motor neuron disease or injury. In spastic paralysis, the muscles are continuously contracted and tight. The individual may experience twitches and muscle spasms. Flaccid paralysis refers to a form of paralysis that often occurs due to lower motor neuron disease or injury. In flaccid paralysis, the muscles get no input from the central nervous system*, and they remain floppy, loose, and limp.

How Does a Person Become Paralyzed?

Physical injury (e.g., sports or car accidents) poisoning, infection, blocked blood vessels, and tumors can all cause paralysis. Defects in the developing brain of the fetus* or brain injury during birth can cause a paralytic condition known as cerebral palsy. In diseases such as multiple sclerosis, inflammation scars the nerves, interrupting communication between the brain and the muscles. Sometimes the muscle tissue itself is affected. In muscular dystrophy, deterioration of the muscle tissue of the arms and legs causes increasing weakness.

Guillain-Barré (gee-YAN ba-RAY) syndrome is an autoimmune disorder in which the body's own cells attack the insulation and core of the

nerve fibers, beginning in the hands and feet. In myasthenia gravis (my-es-THEE-nee-a GRA-vis), another autoimmune disorder, a chemical malfunction disrupts the communication needed for muscles to contract.

In rare cases, no physical cause for paralysis can be found. Psychologists call this condition a conversion disorder; that is, a person converts his or her psychological anxiety into physical symptoms of paralysis, but nerve and muscle function are still intact.

Signs and Symptoms

The signs and symptoms of paralysis vary. When the spinal cord is crushed, as in Sang Lan's injury, a person is immediately paralyzed and loses feeling in the affected limbs. When damage to the muscles or central nervous system is caused by a progressive disease or disorder, such as muscular dystrophy or multiple sclerosis, symptoms are gradual and often start with muscle fatigue and weakness. With poliomyelitis (PO-le-o-my-e-LY-tis) and stroke, paralysis comes on suddenly, with little or no warning.

Diagnosis

Information about symptoms and their onset helps the doctor pinpoint the cause of paralysis. With certain genetic* diseases that are inherited, such as muscular dystrophy, family medical history provides important clues. A careful physical examination with attention to presence or absence of voluntary movement and/or reflexes and characteristics of muscle tone can quickly, accurately, and cheaply establish the general location of the lesion or injury. Confirmation of the diagnosis usually requires other testing, including electromyography, and computerized tomography* CAT or MRI* scans.

Is Paralysis Treatable?

Aside from poliomyelitis (which can be prevented by vaccination*) and brain and spinal cord injuries (which in some cases can be prevented by using appropriate safety measures), it is usually not possible to prevent the conditions that cause paralysis, and most of the time there is no specific treatment. Steroid medications are sometimes given at the time of spinal cord injury to reduce inflammation in an attempt to limit the amount of damage to the spinal nerves. For people with paralysis who must use wheelchairs, treatment emphasizes exercises and special care to avoid infections and pressure sores. Patients with myasthenia gravis may be offered a drug that helps their muscles contract. Most people with Guillain-Barré syndrome recover on their own. Conversion disorder can be difficult to treat; the underlying psychological problem must be addressed.

Living with Paralysis

Many people with paralysis have normal life spans, even when the condition is the result of progressive disease. People who are confined to wheelchairs can still drive, swim, fly planes, and even ski. But being paralyzed requires major adjustments to daily living, because the muscles a person usually relies on to do certain actions no longer work. For example, for

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

“Like a Mind in a Jar”

Jean-Dominique Bauby (1952–1997), editor of the magazine *Elle*, was 43 and had a wife and two young children when he suffered a stroke that left him with a condition called locked-in syndrome. Bauby was able to think, but he could not speak or move a single muscle in his body except for his left eye. He began to communicate by blinking his eye in a kind of code that a friend painstakingly transcribed letter by letter, first into words and then into sentences. The sentences became a book titled *The Diving Bell and the Butterfly*. The book was an instant bestseller in France and later inspired readers worldwide.

people with severe paralysis, ordinary body functions such as urinating and having bowel movements may be difficult tasks. In extreme cases, a person may not even be able to breathe without assistance. Help is available to cope with most cases of paralysis, and people with this condition can often hold jobs, raise families, and participate in various activities.

Will There Ever Be a Cure?

In the mid-1990s, no one would have imagined that badly injured nerves could heal. But in the 21st century, people may be able to regain the function they have lost through injury to their motor nerves. For example, experiments with rats and cats have shown that it is possible to repair damaged nerves and that severed spinal cord tissue can be made to grow back. Of course, many questions need to be answered before these approaches can be applied to humans.

Stem cells are generic or archetypal cells that can differentiate into any number of specific kinds of cells, given the right chemical environment. A great deal of hope rests on the theory that stem cell technology may induce stem cells to differentiate into cells that could be transplanted in order to repair injuries to the spinal cord, or to upper or lower motor neurons.

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National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824, Web site: <http://www.ninds.nih.gov>.

National Spinal Cord Injury Association. 1 Church Street #600, Rockville, MD, 20850. Toll free: 800-962-9629. Web site: <http://www.spinalcord.org>.

Paranoia See *Delusions, Delusional Disorders, and Paranoia*.

Paraplegia See *Paralysis*.

Parasitic Diseases: Overview

Parasitic diseases are caused by infection with parasites such as protozoa (one-celled animals), worms, or insects. These diseases are widespread in Africa, Southeast Asia, and Central and South America, especially among children. They include malaria and schistosomiasis, the world's most common serious parasitic infectious diseases.*

What Are Parasitic Diseases?

Most of the world's nearly 7 billion people are infected with parasites, which are primitive animals that live in or on the bodies of humans, animals, or insects. Often the parasites do little damage, and people may be unaware that they have them. In any given year, however, more than 1 billion people, many of them children, fall sick with parasitic diseases, and millions of them die.

Where Do Parasitic Illnesses Occur?

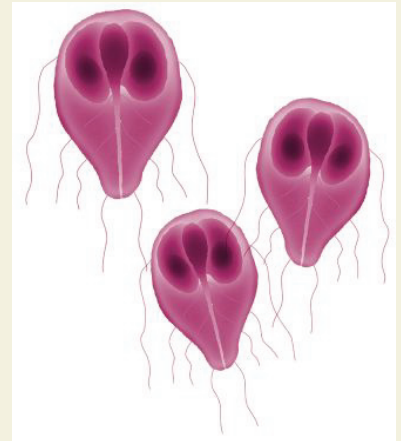
Parasites live everywhere, but they thrive in warm, moist environments. So they are most common in sub-Saharan Africa, the Indian subcontinent, Southeast Asia, and Central and South America. Some regions and some nations in these parts of the world are too poor to take measures that could prevent many parasitic infections—such as building water and sewage treatment plants, controlling mosquito populations, and providing adequate medical care. Furthermore, in many of these places, parasitic diseases make so many people weak, ill, and unable to work that they slow economic development and help keep regions impoverished.

Travelers from industrialized nations may pick up parasitic infections in tropical areas where they visit. In addition, parasites can infect people who live in industrialized nations if they eat food that was produced in tropical areas. Examples of such parasites are cyclospora and cryptosporidia (both protozoans).

Some parasites are found worldwide, even in cooler climates and in wealthier nations, including the United States. These include pinworms, whipworms, and such protozoa as *Giardia lamblia* (which causes intestinal problems), several *Babesia* species (which spread via ticks and cause fever and chills), *Trichomonas vaginalis* (which infects the genitals of men and women), and *Cryptosporidium parvum* (which has caused outbreaks of diarrheal illness in some cities of the United States).

What Are the Most Common Parasitic Diseases?

The intestinal roundworm *Ascaris lumbricoides* causes ascariasis, estimated to infect more than 1 billion people, although it often does little damage. Malaria (a disease caused by a protozoan, transmitted to humans



▲ The *Giardia lamblia* protozoan that causes giardiasis. Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

* **malaria** (mah-LAIR-e-uh) is a disease spread to humans by the bite of an infected mosquito.



▲
A skin rash on the upper arm caused by the burrowing of hookworm larvae. *St. Bartholomew's Hospital/Photo Researchers, Inc.*

Ectoparasites

“Ecto-” means “outer.” Ectoparasites live on the outer surface of humans. They include lice and the mites that cause scabies (SKAY-beez).

by mosquitoes) has a much greater impact. According to the Centers for Disease Control (CDC), the malaria-causing agent is responsible for 300 million to 500 million illnesses per year worldwide and more than 1 million deaths. About half of those deaths occur in children under five years of age. *Schistosoma* blood flukes cause schistosomiasis (shis-to-so-MY-a-sis), which results in 120 million illnesses, 20 million of them severe, according to the CDC.

Other parasitic diseases are estimated to afflict 1 million or more persons per year are filariasis, amebiasis, Chagas' disease, leishmaniasis, and African sleeping sickness (trypanosomiasis).

How Do Parasitic Diseases Spread?

In many cases, people get parasitic infections as a result of bathing in, swimming in, or drinking water that contains parasites; by eating food that has not been cooked thoroughly; or by coming into contact with untreated sewage, which can happen when human waste is used to fertilize fields. It also can happen when people who handle food do not wash their hands thoroughly after using the bathroom.

Many impoverished nations are undergoing rapid urbanization, meaning that many people are crowded together into fast-growing cities that may lack sewage treatment facilities. Raw (untreated) sewage may be dumped into rivers whose water is also used for drinking, bathing, washing, and cooking. Parasitic diseases spread easily in such conditions.

Insects and animals spread some parasitic diseases. Mosquitoes, for instance, spread the protozoan that causes malaria. Tsetse flies spread the protozoan that causes African trypanosomiasis (tri-pan-o-so-MY-a-sis), also called African sleeping sickness. Domestic animals spread beef and pork tapeworms.

What Happens When People Get Parasitic Diseases?

Symptoms The symptoms of parasitic diseases vary widely depending on the parasite. Parasitic infections may cause symptoms including (but not limited to) the following:

- fever
- listlessness
- joint and muscle aches and pains
- intestinal problems including diarrhea, constipation, gas and bloating, and other gastrointestinal symptoms
- skin conditions including hives, rash, swelling, and sores
- weight gain or loss

Diagnosis Parasitic diseases can be difficult to diagnose because evidence of the presence of many parasites does not show up in the routine blood tests that doctors perform. In addition, people with parasites are

prone to getting bacterial infections as well, which may give doctors the impression that the bacteria alone are the cause of the illness.

Certain blood tests, however, can help with diagnosis. In addition, medical professionals can sometimes see parasites if they examine samples of stool or blood under a microscope.

Treatment There are a variety of medications that can kill most parasites, although not all parasites can be treated with medication. Because different parasites respond best to different medications, individuals should consult a medical professional to assure proper treatment.

How Can Parasitic Diseases Be Prevented?

Public authorities that build sewage and water treatment systems play a major part in preventing these diseases. Disease prevention is also achieved by controlling insect populations that spread some parasitic diseases and by teaching people always to wash their hands thoroughly after using the bathroom and before handling food. To control many parasitic infections effectively, a combination of medications and sanitary improvements are necessary.

▶ See also **Ascariasis • Babesiosis • Chagas' Disease • Cyclosporiasis and Cryptosporidiosis • Elephantiasis • Lice • Malaria • Toxoplasmosis • Worms: Overview**

Resources

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Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 888-INFO-FDA. Web site: <http://www.cfsan.fda.gov/~mow/intro.html>.

World Health Organization. Avenue Appia 20, 1211 Geneva 27, Switzerland. Web site: <http://www.who.int/ctd/html/intest/html>.

Parkinson's Disease

Parkinson's disease is a disorder of the central nervous system that causes shaking, rigid muscles, slow movements, and poor balance. The disease is progressive, meaning it tends to get worse over time.

Sleeping Sickness

African trypanosomiasis (tri-pan-o-so-MY-a-sis) is also called African sleeping sickness. Protozoa (single-cell animals) of the genus *Trypanosoma* cause the disease. African trypanosomiasis, in which the disease-causing agent is transmitted by the bite of an infected tsetse (TZEET-ze) fly, occurs only in Africa. Treatment for African trypanosomiasis is composed of drug regimens administered under a doctor's care over a period of weeks. Left untreated, death eventually occurs.



▲ Actor Michael J. Fox waits for his turn to testify before the Senate Appropriations Subcommittee on September 28, 1999, in Washington, DC. The committee heard testimony from Fox and others suffering from Parkinson's disease. *AP Images.*

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

Michael J. Fox's Story

Actor Michael J. Fox first noticed the twitch in his left little finger in 1991 while filming the movie *Doc Hollywood*. He remembers looking at the shaking finger and thinking, "Geez, what's that?"

Within six months, Fox's whole left hand started to twitch uncontrollably, and parts of his body started to feel stiff. Fox was concerned, so he visited a doctor.

Fox was only 30 years old and appeared to be in excellent health. His roles often required physical stunts that he performed with ease. He never expected to find out that his shaking hand and rigid muscles meant he had Parkinson's disease, a condition that is more common among people over 50 years of age.

What Is Parkinson's Disease?

Parkinson's disease is a movement disorder. It results from chemical imbalances in a small area deep within the middle of the brain that controls muscle movements, coordination, and balance.

For many people, their first symptoms are an involuntary twitching of a finger or hand, perhaps with a motion like rolling a small ball between the fingers. Doctors call this type of twitching "pill-rolling." Often, other people barely notice the motion.

Slowly over months and years, the twitching gets worse. Although it often starts in a limb, the tremors can affect the neck, face, and head. Sometimes, it affects only one part or side of the body.

Muscles also become rigid and do not respond normally, because the brain is unable to send the proper messages through the central nervous system* to get the body to act the way a person wants. At times, the person seems to freeze in the middle of an action, such as reaching for a book or walking.

The person starts to shuffle the feet and walk slowly. The arms do not swing back and forth normally. It can become difficult to sit or walk without rolling forward and sometimes falling. As talking becomes difficult, the person speaks slowly and in a monotone.

Eventually, the symptoms become so severe the person needs help with simple activities of living, such as walking and eating. The person's ability to think also can be affected late in the disease.

Not all people develop all the symptoms. Sometimes the disease progresses quickly, from the slight tremors to incapacity within a few years. Often and especially with treatment, however, a person can live well for many years.

The disease affects more than 1.5 million Americans. About 10 percent of the cases involve people younger than age 40, like Fox. Most men and women who get the disease, however, first show signs of it when they are between 50 and 75 years of age.

The disease is named for a British doctor, James Parkinson, who first described the disease's symptoms in 1817. He called it "Shaking Palsy." In the 1960s scientists began to understand how the chemical changes in the

brain caused the symptoms. Eventually, research led to medications and other treatments to help control the disease.

What Imbalance in the Brain Causes Parkinson's Disease?

People with Parkinson's lack enough of the chemical dopamine* in their brain. Dopamine (DO-pa-meen) is a neurotransmitter, a chemical that helps nerve cells send messages to each other. Dopamine receives assistance in sending these messages from other chemicals.

For some reason, the production of dopamine and the other chemicals is disturbed in the brains of people with Parkinson's. When that happens, the messages cannot transmit as well between one nerve cell and the next. Shaking, rigid muscles and other problems result.

What Causes Parkinson's Disease?

As of the early 2000s, no one knew exactly what causes the chemical imbalances. Scientists suspected a number of causes that might, in some cases, trigger the disease. Possible causes include a head injury (especially like those received during a boxing match), some medicines given for other serious conditions, abuse of certain drugs, exposure to toxic levels of carbon monoxide and other pollutants, and small strokes in the brain. Parkinson's disease is not contagious and, therefore, cannot pass from one person to another, like a cold can.

Parkinson's does run in some families, which has led researchers to look for a gene* that might trigger the disease. They studied a large number of Parkinson's cases among two large European families that appeared to share a defective gene, but as of 2009 the scientists had not been able to find the same abnormal gene in many others with the disease. In addition, researchers were interested in a particular area of the brain called the substantia nigra. When this part of the brain is not working properly because its nerve cells have died off, Parkinson's results. By learning more about the substantia nigra, they hoped to be able to fight the disease.

How Is Parkinson's Disease Diagnosed?

Parkinson's is a difficult disease to diagnose. No single test can determine if a person has it. Instead, doctors often rule out other causes of the shaking, such as a brain tumor or other brain disorder to arrive at their diagnosis.

How Is Parkinson's Disease Treated?

Hope is available for people with Parkinson's, because several prescription drugs can help. For most people, doctors prescribe a combination of drugs that help the brain make dopamine, the chemical needed to help nerve cells communicate in the brain. Other medications act like dopamine in the brain, improving the ability of the brain to control movements.

The drugs do not cure the disease, but they do treat its symptoms. People are able to perform many of the same activities they did before the

* **dopamine** (DOE-puh-meen) is a neurotransmitter in the brain that is involved in the brain structures that control motor activity (movement).

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

Did You Know?

Actor Michael J. Fox is not the only famous person with Parkinson's disease who has continued to maintain an active life. Janet Reno, the U.S. attorney general during the Clinton administration, and boxer Muhammad Ali have the disease.

Ali created a dramatic moment at the 1996 Olympics when he carried the torch in Atlanta. In 1998, Ali joined others in promoting more research that involves people of African, Hispanic, and Asian ancestry.

WHO WAS JAMES PARKINSON?

Parkinson's disease was first identified and named *paralysis agitans* (pa-RAL-i-sis AJ-i-tans) by the British physician James Parkinson (1755–1824). His classic description of its symptoms appeared in "Essay on the Shaking Palsy." Other physicians, as ancient as Galen (138–201 C.E.) and as many years later as Parkinson's contemporary Gerard van Swieten (1700–1772), had noted tremors like those characteristic of Parkinson's, but Parkinson's observations of the disorder were among the earliest to interpret those symptoms as a well-defined clinical syndrome. Not long after Parkinson's essay was published, the French neurologist Jean-Martin Charcot (1825–1893) began using the term "Parkinson's disease" to describe the condition.

disease developed, which is why Michael J. Fox has been able to continue taking some acting roles.

Besides drug treatment, doctors sometimes recommend brain surgery to destroy tiny areas of the brain that are malfunctioning. Fox had this surgery. The elimination of these cells can improve the trembling in some people with Parkinson's.

Experimental treatments were available in the early 2000s. These included transplanting brain tissue from human fetuses into the part of the brain where the dopamine is in short supply. Early results showed that this surgery might benefit some people, but the technique was controversial because the fetal tissue often becomes available as the result of an abortion or infertility treatments. Researchers experimented with animal cells and cells they grew in the laboratory in attempts to achieve the same results as using fetal cells. Many were especially interested in stem cells, which are unspecialized cells that can develop into any kind of cell, including nerve cells, and may be important in treating and perhaps one day curing Parkinson's disease.

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National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Toll free: 800-352-9424. Web site: http://www.ninds.nih.gov/disorders/parkinsons_disease/parkinsons_disease.htm.

Parrot Fever See *Chlamydial Infections*.

Pedophilia

The term “pedophilia” (ped-uh-FIL-ee-uh) is derived from the Greek words for “child” and “love.” Pedophilia is a sexual perversion in which an adult prefers sexual encounters with children. Such a person is known as a pedophile. The term “pedophile” has medical and legal meanings. Medically, a pedophile is an adult who experiences sexual urges towards prepubescent children; this person may or may not engage in the act of child sexual abuse. In law enforcement, the term usually refers to someone accused or convicted of sexual abuse involving a prepubescent child or a minor (below the age of legal consent).

Two Victims of Sexual Abuse

Twelve-year-old Valerie was at a family reunion where she met many relatives whom she had not seen in a long time. She realized she was not likely to remember aunts and uncles whom she met when she was very young. When she was walking alone down a narrow corridor, an uncle whom she hardly knew approached her. “Valerie,” he said. “Look how you have grown. Give me a hug!” She hugged him, but she was surprised that he did not let go when she thought he would. Next she felt him touching her low below her hips.

She yelled, “Stop it!” Then she ran to her parents. The uncle had drunk too much alcohol. When he sobered up, he was sorry for his actions. Although there were legal consequences for his actions, he would not be considered a pedophile by psychiatrists. This incident made him realize that he needed help with his alcoholism. He was even grateful that Valerie reported him.

Ten-year-old Cindy needed a babysitter when her parents went out. She liked to have teenaged Conrad babysit because he always made her chocolate

* **psychoactive** (sy-ko-AK-tiv) affecting a person's mood, behavior, perceptions, or consciousness.

sundaes, which her parents did not like her to have. "This is our little secret," he would say. Another little secret was a game called "Lifeguard," which Conrad made up. They played it in their underwear pretending they were at the beach. Cindy never told her parents about the game because Conrad told her it was all right, and she could see that her parents trusted Conrad. Because she kept the sundaes a secret, it was easier to keep the game a secret. One day her parents came home early and saw them playing the game. They called the police on Conrad and Cindy had to tell many law enforcement people all of the details about the game. Her parents assured her that she should not feel ashamed. They took special care to spend more time with her. When Conrad was arrested, many other young girls came forward to say he had abused them also, some more than he had Cindy.

What Is Pedophilia?

Pedophilia is the deviant (abnormal) sexual preference for prepubescent children by an adult over the age of 16. According to the guidelines established by the American Psychiatric Association (APA), the offender has to be at least five years older than the victim. The preference may or may not be exclusive, which means the offender may also enjoy adult sexual relationships. The APA guidelines do not recognize as a pedophile an adolescent who is sexually involved with a younger adolescent in a long-term relationship. Also, an isolated event, which is not part of a pattern of behavior, is not considered pedophilia. This distinction includes an adult who acts sexually toward a child while under the influence of alcohol or other psychoactive* drugs. The APA also avoids classifying as pedophiles those persons who may have the predisposition for pedophilia but who are not likely to act out by initiating a sexual act with a child.

How Common Is Pedophilia?

Rates of pedophilia in the general population are undetermined. Numbers of reported sex acts against children necessarily differ from any estimate of how many people are predisposed to pedophilia. An estimate given in *Time* magazine (2002) was as low as 4 percent of the population; whereas Gordon Hall of the University of Oregon found up to 25 percent of the population has an inclination. Of course, these sources relied on different methods for evaluating someone as a pedophile. Also, being aroused by pedophilic stimuli does not indicate necessarily the urge to commit sexual abuse against children.

Who Becomes a Pedophile?

Some data regarding the nature of pedophiles comes from those who have been incarcerated for their sexual offense. Using this population introduces variables into the research. For this reason, findings tend to be disputed. Identifying who is most likely to be a pedophile is difficult to establish with any certainty. As of 2009, the causes of pedophilia were not fully understood. In the past, it was widely believed that most male pedophiles

were victims of childhood sexual abuse themselves; however, subsequent research found this to be true in only a small percentage of cases.

Most pedophiles are men; however, there are female pedophiles, and they differ in many ways from the males. Kathryn Jennings at the University of Toronto conducted a study of female pedophiles. She found that over half of the women studied were forced into the act by a male partner or spouse. Many of these women reported being victims of abuse themselves when they were young. Also, most male pedophiles tend to rely on certain excuses for their behavior, such as claiming their desire is uncontrollable or that children are sexual beings. However, Jennings found that the women did not try to justify their actions by these kinds of explanations.

Some research was underway in 2009 to determine predisposing factors in pedophilia. Other research sought to describe common factors in neurological, cognitive, and behavioral traits of pedophiles; some results suggested that lower IQ, school failure, and childhood head injuries resulting in loss of consciousness were common traits. Research sponsored by the Canadian Institutes for Health Research found evidence for a link between low IQ and pedophilia. The researchers divided data into three groups of offenders: non-sexual, sexual against adults, and sexual against children. The measured intelligence of the pedophiles was significantly lower than the IQ of other offenders. The researchers suggested that something in the offenders' development contributed to both the low IQ and the pedophilia. These findings may be relevant only to the incarcerated pedophile. Moreover, they do not explain pedophiles among groups that tend to have normal or above average IQs.

Pedophiles commonly exhibit sociopathic tendencies, impaired interpersonal functioning, increased introversion, and cognitive distortions. Studies have shown that treating offenders with selective serotonin reuptake inhibitor (SSRI) has had some success on reducing recidivism (relapse into criminal activity), which suggests that pedophilia is related to a disturbance in the neural system relating to impulse control. This therapy is often used in treating impulsive shopping, aggression, and anger. A study reported by the APA found similarities in measured personality traits among pedophiles. These personality traits correlated defiance of authority and sexual deviance. However, there are many people with these same personality measures who are not pedophiles.

Many pedophiles have a history of substance abuse. While intoxication may facilitate the pedophile's acting on sexual urges against children, it is not the cause of pedophilia.

How Is Pedophilia Diagnosed and Treated?

If a psychiatrist is trying to diagnose someone as a pedophile, most likely that person has already committed an offense against a child. Any prescribed treatment would be negotiated in relation to court action by which the person is bound. However, individuals who suspect they have pedophilic impulses could turn to a psychiatrist for a diagnosis.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

* **behavior therapy** is a type of counseling that works to help people change their actions.

Diagnosis The main way to diagnose the condition of pedophilia is through following the guidelines of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)*. These guidelines specify that individuals must be at least 16 years old before they can be considered a pedophile. The child who stimulates sexual desire has to be at least five years younger than the person, and the child has to be prepubescent, meaning not yet experiencing puberty*. The guidelines also define what constitutes a sexual reaction to children. These reactions or feelings have to have some manifestation such as intense fantasies that arouse the person sexually, sexual urges that seem to be uncontrollable, or definite sexual behaviors involving a child. These feelings have to be recurrent and continuing over a period of at least six months. Another key component of the diagnosis is that these feelings have led to actual behavioral or affective changes; the person has acted on these feelings or has allowed these feelings to deteriorate his lifestyle. Thus, persons for whom such feelings do not interfere with their daily life do not classify as pedophiles. The *DSM-IV* emphasizes a diagnosis has to take into consideration long-term behavior, personal distress, or interpersonal difficulty.

Treatment As of 2009 there were no reliable methods to cure pedophilia. Treatment is generally performed in collaboration with law enforcement in order to prevent further occurrence of child sexual abuse. Incarceration and/or public monitoring are common methods for preventing pedophiles from abusing children again.

Several therapies that combine behavior therapy* with medication have shown some success in deterring repeat offenses. Most drugs used in treating pedophiles suppress testosterone in men, with the goal of reducing the pedophile's sexual urges. Another method in drug treatment involves drugs that actually increase the secretion of testosterone so that the supply is dissipated. Thus, the level is never high enough to allow a sexual drive.

Can Pedophilia Be Prevented?

There are many therapists who believe that someone with pedophilic tendencies might volunteer for diagnosis and treatment if the social stigma was not so severe. A campaign to bring awareness of the types of support available might help prevent a young person from developing and acting on these deviant urges. Unfortunately, the available help was limited, and the methods were not fully validated as of 2009.

The most important aim when dealing with pedophilia is preventing harm to children. Parents have to be aware of the many elaborate ways that pedophiles use to get access to children and to obtain their trust. Children who are too young to understand how people can disguise their true intentions can be fooled in ways that their parents may not suspect. Parents may think that they have educated their children to be wary of strangers, but the pedophiles can be very creative in their deceit. Once abuse has happened, most pedophiles will use either direct threats or complex persuasive techniques to keep the child from reporting sexual abuse.

The Internet provides a pedophile with various ways to meet and tempt young children. The pedophile pretends online to be a young person who is sincerely interested in the child. Children who assume they are chatting online with a peer may open up about personal issues, including clues that the pedophile can use to find the child in real life. Parents need to be aware of the contacts their children have online. Parents should be aware of and use whatever solutions are available to them for controlling Internet use by their children.

▶ See also **Sexual Disorders**

Resources

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Organization

Psychology Today. 115 East 23rd Street, 9th Floor, New York, NY, 10010, Web site: <http://www.psychologytoday.com/conditions/pedophilia.html>.

- * **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.
- * **ovaries** (O-vuh-reez) are the sexual glands from which ova, or eggs, are released in women.
- * **fallopian tubes** (fa-LO-pee-an tubes) are the two slender tubes that connect the ovaries and the uterus in females. They carry the ova, or eggs, from the ovaries to the uterus.

Pelvic Inflammatory Disease (PID)

Pelvic inflammatory disease (PID) is an infection of the female reproductive system, including the cervix, uterus*, ovaries*, and especially the fallopian tubes*. PID usually is the result of an untreated or poorly treated sexually transmitted bacterial infection. It can cause scarring and reduce or eliminate a woman's ability to get pregnant.*

Illustration by Corey Light. Reproduced by permission of Gale, a part of Cengage Learning.

- * **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.
- * **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.

Pelvic inflammatory disease (PID) risk factors

Age: the rate of infection in women drops as they get older. Risk is highest for sexually active women under 25 years of age.

Ethnicity: the rate of infection is higher in nonwhite groups.

Socioeconomic status: the rate of infection is higher in women of lower socioeconomic status.

IUD: the rate of infection is higher with the use of IUDs, and frequent douching.

Barrier contraception: consistent use of barrier contraceptives protects against PID, although they may not protect against other STDs, such as HPV.

Lifestyle: the rate of infection is higher in women who abuse drugs and alcohol, have had intercourse for the first time at an early age, and have had a higher number of sexual partners.

STDs: the rate of infection is higher in women who have had sexually transmitted diseases.

Carrie and Reg's Story

Two years after Carrie and Reg got married, they decided to start a family. Carrie began looking at the ads for strollers and baby clothes. But after a year, she had not gotten pregnant. She was sure she did not have a medical problem. After another six months of trying, Carrie and Reg decided to see a doctor who specializes in fertility problems.

The doctor asked Carrie if she had ever had pelvic inflammatory disease (PID). She said no, she had not even heard of it. But in a series of tests, her body told a different story. Carrie's fallopian tubes (the place where egg meets sperm in conception) had been scarred by PID. After trying laser surgery to remove the scar tissue, the blocked passageways were opened, and Carrie finally got pregnant.

When healthy young women have difficulty getting pregnant, damage from PID is one of the many possible causes. In most cases, the women do not know they had the disease and never got treated. Quick treatment of PID can reduce the chances that it will cause infertility.

What Causes Pelvic Inflammatory Disease?

Most often, women get PID as a result of having a sexually transmitted bacterial* infection that was not treated, often because it was not noticed. The bacteria *Chlamydia trachomatis* and *Neisseria gonorrhoeae* are the most common bacteria involved in PID. The infections they cause are called a chlamydial (kla-MID-e-al) infection and gonorrhea (gon-o-REE-a). PID can involve more than one type of bacteria. In many cases, doctors do not identify the bacteria involved.

Most often, bacteria enter the vagina* during sexual activity and then move up into the cervix, uterus, and other parts of the reproductive system where they rapidly reproduce. PID also can develop after a woman gives birth or has an abortion in unsanitary conditions. In rare cases, certain medical procedures done on reproductive organs, such as injecting dye for special x-rays, can lead to PID.

What Effect Does Pelvic Inflammatory Disease Have?

To understand the effect of PID, one has to understand the basic facts about conception. The ovary releases an egg into one of a woman's two fallopian tubes, where it meets with the sperm*. The newly formed embryo* travels through the tube to the uterus, an expandable sac where it attaches to the wall and grows into a fetus*.

In PID, bacteria infect the cervix and then travel upward and infect the fallopian tubes, a condition called salpingitis (sal-pin-JY-tis). Doctors sometimes use that name as a synonym for PID; however, PID can also involve the uterus and the ovaries. In severe cases, a collection of pus can form in the ovaries and fallopian tubes, (a tubo-ovarian abscess), or the infection can spread to the membrane* around the reproductive organs, a condition called pelvic peritonitis (per-i-to-NY-tis).

The body usually fights off the infection, but in the course of fighting the infection, tissues can be damaged and scar tissue may form. Scar tissue can block the delicate fallopian tubes. That means the egg and sperm may not be able to meet, or, if they do, the fertilized embryo may not be able to reach the uterus.

Of women who have PID one time, about 10 percent become infertile. Each repeat episode of PID doubles the chance of becoming infertile. In 2007 the Centers for Disease Control and Prevention estimated that about 100,000 American women become unable to conceive children each year as a result of PID. Prompt treatment within three days of symptoms can help prevent infertility and other complications.

Women who have had PID are also more likely than other women to have an ectopic (ek-TOP-ik) pregnancy. That means the embryo starts growing outside the uterus, usually in the fallopian tubes. Such a pregnancy cannot produce a baby and, if it is not ended, poses a very serious risk to the woman because the growing embryo will rupture the fallopian tubes and cause life-threatening hemorrhage*.

Who Is at Risk for Acquiring Pelvic Inflammatory Disease?

About one million American women have a case of PID each year of which about 200,000 are hospitalized due to complications of their infection. PID is rare among women who do not engage in sex. Sexually active teenagers are at the highest risk by far, followed by women in their early twenties. The risk increases if a woman has many sexual partners, has sex with a man who has many sexual partners, or has sexual intercourse very frequently even with a single partner. Frequent douching (inserting fluid into the vagina supposedly to clean it) also increases the risk of PID. Women who use an intrauterine device (IUD) for birth control have a slightly increased risk of developing PID for a short time after the IUD has been inserted.

- * **sperm** are the tiny, tadpole-like cells males produce in their testicles. Sperm can unite with a female's egg to result eventually in conception.
- * **embryo** (EM-bree-o), in humans, is the developing organism from the end of the second week after fertilization to the end of the eighth week.
- * **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.
- * **membrane** (MEM-brain) is a thin layer of tissue that covers a surface, lines a cavity, or divides a space or organ.
- * **hemorrhage** (HEH-muh-rij) is uncontrolled or abnormal bleeding.

The United States and the World

- In the United States, it is estimated that more than one million women get PID each year. Almost all U.S. cases are caused by a sexually transmitted disease.
- With its complications of infertility and ectopic pregnancy, PID is estimated to cost the U.S. economy more than \$4 billion a year.
- In developing nations of Africa and Asia, PID is far more common, with many infections caused by childbirth or abortions occurring in unsanitary settings.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **ectopic pregnancy** (ek-TAH-pik) is an abnormal pregnancy in which the fertilized egg develops outside the uterus, usually within one of the fallopian tubes.

* **syphilis** (SIH-fih-lis) is a sexually transmitted disease that, if untreated, can lead to serious life-long problems throughout the body, including blindness and paralysis.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome) infection.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

What Are the Symptoms of Pelvic Inflammatory Disease?

About 60 percent of all cases of PID have symptoms so mild that they go unnoticed. At the other extreme, symptoms can be quite severe. Noticeable symptoms are not specific to PID. They include the following:

- Pain in the lower abdomen* or pelvis
- Sharp pain when the doctor performs a pelvic examination
- Fever of over 100 degrees Fahrenheit (38 degrees Celsius)
- Discharge of pus or irregular bleeding from the vagina
- Pain during urination or intercourse

Sometimes, long after an untreated PID infection occurs, women have chronic* (persistent) pain in the pelvis, which is sometimes called chronic PID.

How Is Pelvic Inflammatory Disease Diagnosed?

PID can be difficult to diagnose. Many conditions cause similar symptoms, and no one test can tell for sure if a woman has PID. Because it is so important to treat PID promptly, doctors usually start treatment if the symptoms even suggest PID.

To try to confirm the diagnosis, doctors can administer blood tests and take pelvic cultures to look for general evidence of infection. They test for chlamydial infection and gonorrhea, and they do a pregnancy test to determine whether the symptoms are being caused by an ectopic pregnancy*. All women with PID also should be tested for syphilis* and offered the opportunity to be tested for HIV*.

Ultrasound*, a painless procedure that uses sound waves to create an image of the organs, can help doctors look for a tubo-ovarian abscess.

The most definitive test for PID is laparoscopy (la-pa-ROS-ko-pee), a surgical procedure in which a narrow device is inserted through a small incision into the abdomen so the doctor can look inside the belly. Laparoscopy usually is done only if treatment is not working or if the doctor suspects the woman may have another condition, such as appendicitis*(a-pen-di-SY-tis), that requires emergency surgery.

How Is Pelvic Inflammatory Disease Treated?

Since it is difficult to determine exactly which bacteria are causing PID, combinations of two or three different antibiotics (an-ty-by-OT-iks) that fight a wide range of bacteria are given for at least two weeks, usually in pills to be taken at home. If a woman is pregnant or particularly ill, she usually is hospitalized for at least a few days and given antibiotics intravenously*.

If a woman has an abscess, it may need to be drained through a tube or catheter* inserted into the abdomen. If an abscess ruptures, or breaks open, immediate surgery is necessary.

If a woman has PID, any man who had sex with her in the previous two months should be treated for possible chlamydial infection

and gonorrhea. Even if he has no symptoms, chances are high that he is infected and could reinfect the woman or other partners.

How Can Pelvic Inflammatory Disease Be Prevented?

Like chlamydial infections and gonorrhea, PID most surely is prevented by not having sex. A sexually active woman is most protected if she has sex only with one faithful partner, that is, a partner who has sex only with her. Short of that, a woman should limit her sexual partners. Latex condoms worn by the man during sexual activity can prevent PID if they are used correctly at all times.

A woman should seek immediate treatment if she suspects that she, or a sexual partner, has a sexually transmitted disease. Because these diseases often cause no symptoms, health officials recommend that all sexually active young women, especially teenagers, get tested routinely for chlamydial infections and gonorrhea. When chlamydial infection screening of young women was tried as an experiment, it reduced the number of cases of PID.

▶ See also **Bacterial Infections • Chlamydial Infections • Gonorrhea • Infection • Sexually Transmitted Diseases (STDs)**

Resources

Books and Articles

O'Donnell, Judith A. *Pelvic Inflammatory Disease*. Philadelphia, PA: Chelsea House, 2005.

Wilson, Michael R. *Pelvic Inflammatory Disease*. New York: Rosen, 2009.

Organizations

American College of Obstetricians and Gynecologists. 409 12th Street SW, P.O. Box 96920, Washington, DC, 20090-6920. Telephone: 202-638-5577. Web site: http://www.acog.org/publications/patient_education/bp077.cfm.

Centers for Disease Control and Prevention National Prevention Information Network. P.O. Box 6003, Rockville, MD, 20849-6003. Toll free: 800-232-4636. Web site: <http://www.cdc.gov/std/PID/STDFact-PID.htm>.

Peptic Ulcer

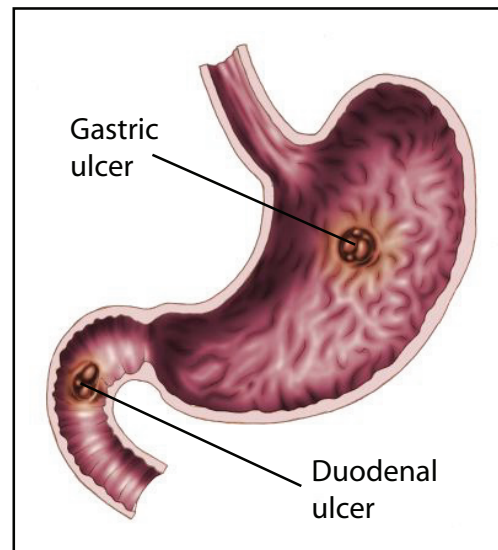
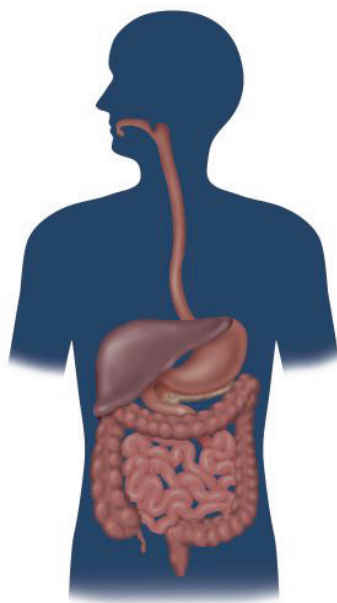
A peptic ulcer is a painful sore that forms in the stomach or the duodenum (doo-o-DEE-num), the first part of the small intestine. Peptic ulcers found in the stomach are sometimes called gastric or stomach ulcers. Those found in the duodenum are sometimes called duodenal ulcers.

* **appendicitis** (ah-pen-dih-SY-tis) is an inflammation of the appendix, the narrow, finger-shaped organ that branches off the part of the large intestine in the lower right side of the abdomen.

* **intravenously** (in-tra-VEE-nus-lee) means given or injected directly through a vein.

* **catheter** (KAH-thuh-ter) is a small plastic tube placed through a body opening into an organ (such as the bladder) or through the skin directly into a blood vessel. It is used to give fluids to or drain fluids from a person.

Peptic ulcers may occur in the stomach (gastric ulcers) or in the first part of the small intestine (duodenal ulcers). Many peptic ulcers are the result of infection with *H. pylori* bacteria. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



* **enzyme** (EN-zime) is a protein that helps speed up a chemical reaction in cells or organisms.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

What Is a Peptic Ulcer?

Digestive juices in the stomach contain hydrochloric acid, a very strong acid that is produced by parietal cells and secreted into the stomach. This acid helps to kill bacteria and viruses found in food and water and, along with the enzyme* pepsin, begins the process of digestion, or break down of food so that it can be absorbed into the bloodstream and used by the body. The inside of the stomach and duodenum are lined with a heavy layer of mucus. This mucus protects the stomach tissue from being destroyed by stomach acid. Peptic ulcers develop when there is damage to the mucus lining. Stomach acid then erodes (eats away at), the stomach tissue and/or duodenal. This condition causes inflammation* and can result in a peptic ulcer.

Who Gets Peptic Ulcers?

Peptic ulcers are common in adults, but rare in children and teenagers. Duodenal ulcers are most likely to develop in people between 30 and 50 years of age, whereas most stomach ulcers occur in people over age 60. People living in the United States have about a 10 percent chance of developing a peptic ulcer in their lifetime. In 2008, about 4.5 million Americans had peptic ulcers. Peptic ulcers cause about 1 million hospitalizations and 6,000 deaths each year.

Why Do People Get Peptic Ulcers?

Peptic ulcers form because the mucus in the stomach and duodenum is unable to protect the tissue underneath it from destruction by stomach acid. Several conditions can upset the balance between mucus and stomach acid and make it likely that an ulcer will form.

Helicobacter pylori *Helicobacter pylori* (hel-i-ko-BAK-ter pi-LOR-ee) is a spiral-shaped bacterium that has adapted to living in the very acidic

environment of the stomach. In order to survive, *H. pylori* burrows into the mucus lining the stomach. Once it gets into the mucus, it uses an enzyme to cause a chemical reaction that produces bicarbonate and ammonia. Both of these are strong bases that neutralize any stomach acid that reaches the bacterium. The immune system responds to the presence of *H. pylori*. Eventually the mucous lining is weakened and stomach acid can eat away at the tissue underneath, forming an ulcer or open sore.

In the United States, about 10 percent of children under age 12 are infected with *H. pylori*. This number increases with age until about half of all Americans over age 60 have the infection. The rate of infection is much higher in the developing world. Scientists are not exactly sure how the infection is passed from person to person, although they think that it is transmitted through contact with feces* from infected people or through drinking contaminated water. Some researchers also believe that *H. pylori* can be transmitted through kissing an infected person.

As of 2009, researchers do not fully understand the relationship between *H. pylori*, gastric inflammation, and peptic ulcers. For example, about 90 percent of people who have peptic ulcers are infected with *H. pylori*, but only a small number of those who are infected develop an ulcer, and 10 percent of people with ulcers do not have *H. pylori* infections. Also, antibiotic treatment to rid the body of *H. pylori* does not, by itself, cure most ulcers.

Nonsteroidal anti-inflammatory drugs Nonsteroidal anti-inflammatory drugs (NSAIDs) are medications used to reduce inflammation and treat the pain it causes. Familiar NSAIDs are aspirin, ibuprofen (Advil, Motrin), and naproxen (Aleve). Long-term use of NSAIDs, for example to treat arthritis, can cause the mucous lining to weaken and allow an ulcer to form.

Other causes Certain lifestyle choices also make it more likely that a person will develop a peptic ulcer. These include heavy alcohol use, cigarette smoking, and heavy caffeine consumption.

People who experience severe injuries, burns, or who undergo major surgery are more likely to develop an ulcer. Some researchers also believe that extreme anxiety and emotional distress can promote ulcer formation.

What Are the Symptoms of Peptic Ulcer?

The most common symptom of a peptic ulcer is a gnawing or burning pain in the stomach. This pain comes and goes over a period of days or weeks, most often when the stomach is empty, for example, three or four hours after a meal or in the middle of the night. Eating may help relieve the pain. Other possible symptoms include weight loss, poor appetite, bloating, burping, nausea, and vomiting.

How Are Ulcers Diagnosed?

If a person has lasting abdominal pain or other symptoms of peptic ulcer disease, there are several methods a doctor can use to make a diagnosis.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

* **gastrointestinal** (gas-tro-in-TESS-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **antagonist** (an-TAG-oh-nist) a chemical that acts within the body to reduce or oppose the effects of another chemical.

One of the most common ways to check for ulcers is with endoscopy (en-DOS-ko-pee). For this procedure, a person is given medication to relax and numb the throat. Then a doctor gently inserts an endoscope (a thin, flexible tube with a camera and light on the end) down the throat, through the esophagus, and into the stomach and intestines. The camera on the end of the endoscope allows the doctor to view the digestive system and take pictures of it. In addition, the doctor can perform a biopsy, removing a small amount of tissue for study under a microscope.

Although it is less helpful than endoscopy, another test that may be used to check for ulcers is an upper gastrointestinal* (GI) series. This is a set of x-rays of the gastrointestinal system. A person taking the test first drinks a white, chalky liquid called barium to help highlight the ulcer and makes it visible on the x-ray.

A person suspected of having *H. pylori* infection may undergo a breath test. During a breath test, a person drinks a liquid containing a carbon marker known as carbon-13 (^{13}C). The person then provides a breath sample by blowing up a balloon or blowing bubbles. The sample is checked for the presence of the ^{13}C marker. If the person has *H. pylori* infection, there will be traces of ^{13}C present in the carbon dioxide gas molecules of the person's breath. A person's blood also can be checked for the presence of antibodies* to *H. pylori*, indicating infection. However, the presence of the antibody in the blood does not indicate current infection and may be due to prior infection. Another diagnostic measure is to take a culture* of the *H. pylori*. This is the most accurate means of detection.

How Are Peptic Ulcers Treated?

People with peptic ulcers and infected with *H. pylori* are treated for 10 to 14 days with what is called triple therapy. This consists of a combination of two or three antibiotic medicines that kill *H. pylori* bacteria and a drug that reduces acid production in the stomach. But the mainstay of peptic ulcer treatment is the reduction or abolition of gastric acid secretion. Two classes of drugs reduce acid production: histamine type 2 receptor antagonists* and proton pump inhibitors. Alternatively, patients may take an antacid that neutralizes the acid. Some of these drugs are available over-the-counter, meaning without a prescription. In addition, patients are encouraged to make lifestyle changes such as limiting alcohol and caffeine consumption and quitting smoking.

If left untreated, ulcers can lead to serious complications. In some cases, the ulcer can make a hole all the way through the stomach or duodenum wall. In other cases, the ulcer or acid breaks a blood vessel and causes serious internal bleeding. Peptic ulceration may obstruct the passage of stomach contents into the duodenum. It is important to get medical help promptly for the following symptoms, which may signal a peptic ulcer or other serious problem:

- Sharp, sudden, or long-lasting stomach pain
- Bloody or black stools (bowel movements)
- Bloody vomit or vomit that looks like coffee grounds

Can Ulcers Be Prevented?

Ulcers that developed in response to medications such as NSAIDs or stressful situations such as severe burns and other conditions that are often associated with peptic ulcerations can be prevented by taking drugs known as prophylactic H2 blockers or proton pump inhibitors.

▶ See also **Bacterial Infections • Heartburn (Dyspepsia) • Helicobacter Pylori Infection • Pancreatic Cancer • Stomach Cancer**

Resources

Organizations

American College of Gastroenterology. P.O. Box 342260, Bethesda, MD, 20827-2260. Telephone: 301-263-9000. Web site: <http://www.acg.gi.org/patients/gihealth/peptic.asp>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ulcer/keytocure.htm>.

National Digestive Diseases Information Clearinghouse, National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health. 2 Information Way, Bethesda, MD, 20892, Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/hpylori>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/pepticulcer.html>.

Pericarditis See *Myocarditis/Pericarditis*.

Periodontitis See *Gum Disease*.

Peritonitis

Peritonitis (per-i-to-NY-tis) is an inflammation of the peritoneum (per-i-to-NEE-um), which is the lining of the abdominal (ab-DOM-i-nal) cavity. Peritonitis typically results from a hole or slit in one of the hollow organs of the abdomen, which include the stomach, small intestine, colon, and gallbladder. This hole can allow the contents of the organ, often including billions of bacteria to escape into the abdominal cavity. Peritonitis can be life-threatening.*

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **ulcer** is an open sore on the skin or the lining of a hollow body organ, such as the stomach or intestine. It may or may not be painful.

* **Crohn's disease** (KRONZ) an often inherited, chronic inflammatory disease that typically affects the small and/or large intestine but which can affect any part of the digestive system. The disease causes crater-like ulcers or sores in the inner surface of the bowel. Mild cases may be treated with medication; serious cases may be treated with surgery.

* **colitis, ulcerative** (ko-LIE-tis, UL-sir-ah-tiv) a common form of inflammatory bowel disease that causes inflammation with sore spots or breaks in the inner lining of the large intestine (colon). Symptoms include cramping, bleeding from the rectum, and diarrhea.

* **gallbladder** is a small pear-shaped organ on the right side of the abdomen that stores bile, a liquid that helps the body digest fat.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **cirrhosis** (sir-O-sis) is a condition that affects the liver, involving long-term inflammation and scarring, which can lead to problems with liver function.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

What Is Peritonitis?

Peritonitis (per-i-to-NY-tis) is an inflammation of the peritoneum, the thin, slippery, abdominal lining that covers the organs in the abdomen. While peritonitis may not sound serious, it is very dangerous if it is not identified and treated right away. Anyone with symptoms of peritonitis needs emergency medical attention immediately.

Usually, the cause of peritonitis is a perforation (per-fo-RAY-shun), or a hole, in the stomach, intestines, appendix, or one of the other organs covered by the lining. The perforation can come from a disease process such as stomach or intestinal ulcer*, Crohn's disease*, or ulcerative colitis, ulcerative* gallbladder* disease, a knife or gunshot wound to the abdomen, or from a cut during surgery. When such a perforation occurs, bacteria* can quickly invade the abdominal cavity. For example, a puncture in the colon (the part of the intestine that stores feces before it leaves the body) can send billions and even trillions of bacteria and bacterium-like cells flooding into the abdomen. The peritoneum mounts a defense against the onslaught, and peritonitis results.

People can also get peritonitis from complications of a wide variety of other illnesses, including the following.

- Burst appendix
- Diverticulitis (dy-ver-tik-yoo-LY-tis), the inflammation and possible rupture of pouches that form on the colon
- Perforated ulcer
- Cholecystitis (ko-li-sis-TIE-tis), which typically results when a gallstone blocks and inflames the bile duct and can lead to rupture of the gallbladder
- Pelvic inflammatory disease

In all of these cases, bacteria can inflame the peritoneum. People with cirrhosis* (si-RO-sis) of the liver* sometimes get spontaneous bacterial peritonitis, which means that they have no rupture or obvious source for the infection.

What Happens When People Get Peritonitis?

Symptoms The symptoms of peritonitis range from mild to excruciating pain in the stomach area, and while the pain may start in one area, it often extends throughout the abdomen within a matter of hours. Movement and/or touching the abdomen typically make the pain worse. A person with peritonitis usually loses his or her appetite and may quickly become nauseated. Some may begin vomiting. Peritonitis often causes a muscle spasm in the abdominal wall, making the abdomen* feel hard and immobile, as if it were a wooden board. The stomach may also become distended (puffed out).

Diagnosis A doctor often can diagnose peritonitis through a physical examination of the patient. Doing so may include gently touching the abdomen both to determine the level of pain and tenderness (typically very

severe) and to check for hardness (called rigidity)). To confirm the diagnosis, the doctor may also order blood tests, abdominal x-rays, or CT scans*.

Treatment The treatment of peritonitis usually includes surgery and antibiotics*. Surgery repairs any ruptured organ that caused the inflammation, and also washes and drains the infectious fluids from the abdominal cavity. Antibiotics treat the bacterial infection. Most people who get peritonitis recover fully after treatment. Without prompt treatment, however, peritonitis can be fatal, so people who have symptoms of peritonitis should receive immediate medical attention.

▶ See also **Appendicitis • Bacterial Infections • Cirrhosis of the Liver • Diverticulitis/Diverticulosis • Infection • Pelvic Inflammatory Disease (PID) • Sepsis**

Resources

Organizations

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/001335.htm>.

University of Maryland Medical Center. 22 S. Greene Street, Baltimore, MD, 21201-1595. Telephone: 410-328-8667. Web site: <http://www.umm.edu/altmed/articles/peritonitis-000127.htm>.

Personality and Personality Disorders

The term “personality” refers collectively to all traits or characteristics that determine how people usually think and feel about themselves, relate to others, and react to the world around them. A personality disorder may be present when a person’s usual way of relating to others, thinking about the world, and reacting to events causes him or her to have problems that interfere with important areas of life, including relationships with other people.

Three Neighbors

Renée is a warmhearted, energetic woman who knows everyone in the neighborhood. She is always ready to lend a hand or a tool from her well-stocked garage. She loves to organize neighborhood activities. Renée hosts backyard cookouts, plans the yearly spring cleanup and planting of the neighborhood park, and serves mugs of hot chocolate when neighbors shovel snow from the walks in winter. People say that Renée is friendly, outgoing, and enthusiastic.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

* **psychologists** (sy-KOL-o-jists) are mental health professionals who treat mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth. Psychologists also study the brain, behavior, emotions, and learning.

Pradeep, her next-door neighbor, has a quiet nature and prefers to keep to himself. Pradeep is always on time and well organized. He keeps to a set routine every day. He walks his dog at 6:30 a.m., has coffee and reads the morning paper at 7:00, and then heads off to work at 7:30. At 5:30 every weekday evening, he pulls into his driveway again. Early on Saturdays he shops for groceries for himself and for Mrs. Dunn, a neighbor who cares for her elderly mother. People say that Pradeep is shy, reliable, and thoughtful.

Rudy, who lives at the end of the block, annoys everyone with his grouchy mood and self-centered attitude. He scowls at the neighborhood kids who walk past his house, warning them not to step on his lawn and scolding them to keep the noise down as they get off the school bus on his corner. People say Rudy is selfish, impatient, and bad tempered.

What Is Personality?

The brief descriptions of these three neighbors highlight some of the ways they are different from one another. They capture a few of the main characteristics of each person. These characteristics are what psychologists* (sy-KOL-o-jists) call personality traits.

Personality traits shape or label the ways people usually think and feel about themselves (such as insecure, self-centered, or humble), how they relate to others (such as suspicious, critical, or friendly), and how they react to events (such as accepting, encouraged, or short-tempered). Personality is a person's own special blend of these traits. Although each person has a unique personality, there are some groups of personality traits that produce common personality styles.

Some normal and common personality styles have been described with terms such as self-confident, dramatic, sensitive, leisurely, adventurous, solitary, and aggressive. Personality style influences how someone thinks, feels, and behaves in most situations. Well-adjusted people tend to be able to adapt to situations that call for a way of thinking or reacting that is different from their usual personality style.

Some individuals have a personality style that causes them to have serious problems in most areas of their lives. Such individuals are often set in their ways and inflexible. They tend to be unable to adjust to the demands of a situation that calls for a different way of responding. Such a problematic personality style may qualify as a personality disorder. There are 10 different personality disorders that mental health professionals may diagnose. A personality disorder has a harmful effect on most aspects of the person's life, leading to long-term difficulties in relationships with other people.

What Are Personality Disorders?

Personality, or personality style, describes someone's usual pattern of thinking, feeling, and behaving. Personality style is made up of a number of personality traits or characteristics. A personality disorder is a problematic personality style that negatively affects most areas of a person's life.

Personality disorders are generally diagnosed only in adults, but they reflect difficult personality styles that have been present since adolescence or young adulthood. Personality disorders can only be diagnosed in those under 18 years of age when the features have been present for a least one year and appear to be pervasive, persistent, and unlikely to be part of a particular developmental phase. Antisocial personality disorder cannot be diagnosed in someone under 18 years of age (similar symptoms in someone under age 18 labeled as conduct disorder).

Personality disorders can cause lifelong psychological problems and difficulty in relating to others.

There are 10 different personality disorders that mental health experts may diagnose. Each has its own set of characteristics, and each causes problems of a certain nature. The 10 personality disorders fall into three groups, called clusters, based on similarities in the personality traits of the disorders in each group.

One cluster includes personality disorders that feature unusual points of view or odd or eccentric behavior of various sorts. In this cluster are the following disorders:

- **Paranoid:** People with paranoid (PAIR-a-noyd) personality disorder distrust other people and may become overly suspicious, believing that other people's actions are always meant to harm them. Someone with paranoid personality disorder may find it difficult to form friendships and may be overly guarded, argumentative, or cold toward others.
- **Schizoid:** Individuals with schizoid (SKIT-zoyd) personality disorder are typically loners and do not often show emotion. Such people do not make friends easily and do not even care to spend time with their families. A person with this disorder usually chooses a solitary job and activities and has very little, if any, social life.
- **Schizotypal:** People who have schizotypal (skit-zo-TIE-pal) disorder can be fearful and distrustful of others. They are usually unable to make friends outside their own families. They also can have strange beliefs and superstitions. They tend to dress oddly or act in a peculiar way that does not seem to fit in with those around them.

Another cluster includes personality disorders that feature personality styles that are overly dramatic, overly emotional, overly reactive, or unpredictable. In this cluster are the following disorders:

- **Antisocial:** Individuals with antisocial personality disorder are typically in trouble with the law and have no respect for the rights of other people. Such people frequently lie and cheat, and they try to take advantage of others for their own profit or enjoyment. They can be irritable and often get into fights or even attack others. They also may be quite reckless and put themselves or others in danger, and they frequently do not understand or care that they have done something wrong or hurt another person.

- **Borderline:** Individuals with borderline personality disorder have difficulty being in relationships. People with this disorder fear that they will be abandoned, and the fear can become so strong that it makes them try to hurt or even kill themselves. Their relationships are often overly intense, and they may be extremely demanding of the time and attention of anyone who is close to them. They may abruptly end relationships and can quickly and drastically change their views about their friends if they think their friends have let them down.
- **Histrionic:** Histrionic (his-tree-AH-nik) personality disorder makes people want to be the center of attention. To draw attention, people with this disorder can be highly dramatic, often making up exaggerated stories about themselves. They flirt to attract people, and they may dress and act in a showy or overly sexy way. They may publicly exaggerate their emotions, perhaps through temper tantrums or fits of crying. People with this disorder can be too trusting of other people and too easily influenced by them.
- **Narcissistic:** People who have narcissistic (nar-se-SIS-tik) personality disorder are overly self-concerned. They often exaggerate their talents and accomplishments. They think of themselves as superior to others, and they tend to imagine themselves as very wealthy or powerful or beautiful or intelligent. Because they feel that they are unique, they also need other people to admire them and to treat them as special. They usually do not care much about the feelings or needs of other people. In fact, they often take advantage of other people to get what they want.

A third cluster includes difficult personalities that feature anxious, fearful, or extremely cautious behavior. In this cluster are the following disorders:

▶ The ancient Greek myth of Narcissus tells the story of a young man who fell in love with his own reflection. Entranced by his image reflected in the water, he threw himself into the pool and drowned. The term “narcissistic,” or conceited and self-centered, derives from this myth. (*Echo and Narcissus*, oil on canvas, by John William Waterhouse). ©Walker Art Gallery, National Museums Liverpool/The Bridgeman Art Library International.



- **Avoidant:** People with avoidant personality disorder fear criticism and disapproval, and for this reason they tend to steer clear of jobs or activities where they must work together with other people. They do not make new friends easily, and they typically are quiet and shy because they fear that other people will embarrass and make fun of them. They often feel out of place in social situations.
- **Dependent:** Individuals who have dependent personality disorder have a difficult time making even small, everyday decisions, for example, about what to wear. People with this disorder often rely on others to take care of them and make all their choices in life. When they are alone, they feel helpless, and they typically look around for someone to care for and support them.
- **Obsessive-Compulsive:** People with obsessive-compulsive (ob-SES-iv-kom-PUL-siv) personality disorder have a deep need for order and control. They pay close attention to rules, lists, and schedules, and they can be very hard on themselves when they do not meet their own high standards of perfection. Some may be incredibly neat and orderly, but others may tend to be pack rats, hoarding money or even saving worthless or unnecessary objects just in case they might need them one day. (Obsessive-compulsive personality disorder is not the same as obsessive-compulsive disorder.)

* **inborn** means present from birth, or inherited.

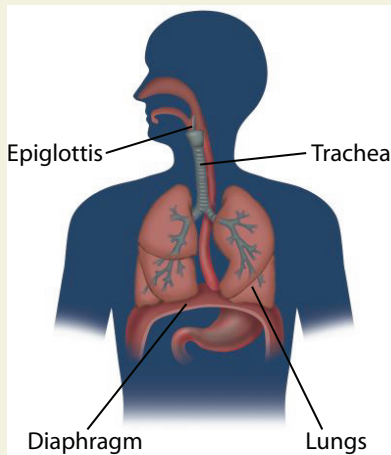
How Are Personality Disorders Diagnosed?

Personality disorders are difficult to diagnose because many, if not all, of these sorts of traits are also found in normal personalities. A personality disorder is diagnosed only when a personality trait, or a set of traits, is present to such an extreme that it causes an individual to have problems almost every day in almost all interactions.

Several of the personality disorders have traits that overlap, making it difficult to distinguish them. Evaluating personality styles can be subjective, and different people may have different ideas about each personality style. Even experts may not agree about whether a certain trait in an individual is extreme or simply a variation of normal. Also, when some people have problems as a result of trauma or other difficult events in their lives, they may appear to have problems affecting most parts of their lives. Generally, however, these problems are temporary. Researchers have continued to work on finding new ways of classifying and diagnosing personality disorders that will be more reliable and accurate.

What Causes Personality Disorders?

Because each personality disorder is different, there are separate theories about how each one may develop. There is still much to learn about the factors involved in each of these disorders. Most theories focus on a combination of inborn* traits and early experiences that influence and shape how someone begins to think, feel, and act. Research has shown that being



▲
Pertussis can cause quick short coughs due to spasms of the glottis as the air leaves the lungs. This makes the distinctive “whooping” sound associated with the disease. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

a victim of child abuse or neglect increases the risk of that individual's developing a personality disorder in adulthood.

How Are Personality Disorders Treated?

Because personality disorders can be so deeply ingrained and so long-standing, they are among the most difficult conditions to treat. People with personality disorders often resist change. Although some treatment methods can be effective, change may be slow. Treatment for personality disorders usually involves long-term talk therapy aimed at helping people understand how their particular pattern causes them trouble and then learning new ways to approach and solve specific problems. Medications are sometimes used to help treat problems that may be associated with the personality disorder, such as depression or anxiety.

▶ See also **Antisocial Personality Disorder**

Resources

Books and Articles

Dobbert, Duane L. *Understanding Personality Disorders: An Introduction*. Westport, CT: Praeger, 2007.

Organizations

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.psych.org>.

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905, Web site: <http://www.mayoclinic.com/health/personality-disorders/DS00562>.

Mulhauser Consulting. 55 De Tracey Park, Newton Abbot, TQ13 9QT, UK, Web site: <http://counsellingresource.com/distress/personality-disorders/foundation/index.html>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/personalitydisorders.html>.

Pertussis (Whooping Cough)

Pertussis (per-TUH-sis), also called whooping cough, is a bacterial infection of the respiratory tract that causes severe coughing.*

What Is Pertussis?

Pertussis is a respiratory disease found only in humans that is caused by the bacterium *Bordetella pertussis*. The first account of the infection was recorded in the sixteenth century, but it was not until the early twentieth century that *B. pertussis* was identified as the cause.

The infection causes a violent series of coughing fits usually ending in a high-pitched intake of breath that sounds like a “whoop,” giving the disease its other name, whooping cough. These coughing fits can be so severe that patients may vomit, lose consciousness, break a rib, or turn blue from lack of oxygen.

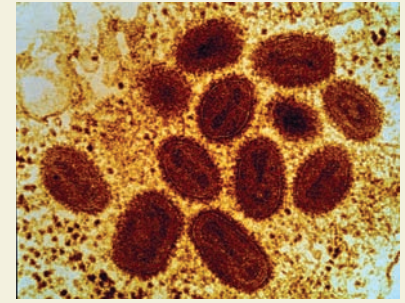
Do Many People Contract Pertussis?

Pertussis occurs throughout the world in all age groups, with at least 50 million cases and 300,000 deaths reported each year. In the early twentieth century, it was a common childhood disease and a leading cause of infant death. With the widespread use of a vaccine* starting in the mid-1940s, infection rates in children in the United States declined by 99 percent until the 1980s when they began to rise again. In 2005 there were 25,616 cases of whooping cough reported in the United States. However, experts at the Centers for Disease Control and Prevention assumed that only 5 to 10 percent of cases were being recognized and reported.

The increase in whooping cough cases is thought to be attributable to two main factors. Because previously deadly childhood diseases have been controlled by immunization, some parents feel less urgency to vaccinate their children. The vaccination* rate for children ages 19 to 35 months in the United States in 2006 was only 85 percent, and many states give liberal exemptions to parents who do not wish their children to be vaccinated. In addition, vaccination, or even having the pertussis, does not provide lifelong immunity*. Unless teens and adults have booster shots to renew their immunity, they can develop the disease and pass it on to children who have not been immunized or who are too young to have completed the required series of vaccinations.

How do People Get Pertussis?

Pertussis is an extremely contagious infection. The bacteria can spread through the air in drops of fluid released from the mouth and nose of a coughing or sneezing person who is infected. Inhaling those airborne drops can lead to disease, as can direct contact with the drops, such as touching them and transferring bacteria from a hand to the mouth or nose. Pertussis is different from most other contagious respiratory illnesses because children generally do not infect adults. Instead, adults usually have a mild case of the disease first and unknowingly pass the bacteria to their children, who develop a more serious form of the illness. Up to 90 percent of susceptible (non-immune) people living in the same house with someone who has whooping cough become infected as well.



Bordetella pertussis bacteria seen under a microscope. ©Peter Arnold/Alamy.

* **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

* **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.

- * **incubation** (ing-kyoo-BAY-shun) is the period of time between infection by a germ and when symptoms first appear. Depending on the germ, this period can be from hours to months.
- * **toxins** are substances that cause harm to the body.
- * **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.
- * **lymphocytes** (LIM-fo-sites) are white blood cells, which play a part in the body's immune system, particularly the production of antibodies and other substances to fight infection.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

What Happens When People Have Pertussis?

Following exposure to the bacteria, an incubation* period begins and generally lasts 7 to 10 days but occasionally stretches to as long as a month. During this time, the bacteria settle in the lungs where they produce toxins* that cause inflammation and make it difficult to clear out the mucus* that forms in the respiratory tract.

After the incubation period, there are three distinct stages of pertussis infection: the catarrhal (kah-TAR-hul), paroxysmal (PAIR-ok-siz-mul), and convalescent (kon-vuh-LEH-sent) stages. In the catarrhal stage, the first symptoms of the disease appear and often are mistaken for those of a common cold or the flu. They include runny nose, sneezing, mild fever, and a cough that gradually worsens. This stage typically lasts one to two weeks.

In the paroxysmal stage, the characteristic symptoms of whooping cough become obvious. The occasional cough develops into sudden violent attacks, or paroxysms, of rapid coughing ending with the whooping noise. Spasms of coughing are due to the buildup of mucus in the respiratory tract and occur frequently at night. Babies under six months of age may not have the strength to make the whooping sound that older children do, and the characteristic whoop may be absent in adults. It is difficult to breathe during these fits, and many patients turn blue from lack of oxygen. The severe coughing also can lead to vomiting and extreme tiredness. Between these bouts, patients look normal. The paroxysmal stage generally lasts from one to six weeks but can linger for up to 10 weeks.

In the final, convalescent stage, coughing slowly subsides over two to three weeks.

How Is Pertussis Diagnosed?

In some cases, the doctor can make the diagnosis of whooping cough based solely on hearing the cough. However, other infections (specifically with chlamydia pneumoniae) can produce a syndrome with a cough very much like the whoop in classic whooping cough, so careful examination of the offending bacteria is necessary. A definitive diagnosis requires an examination of fluid from the nose or throat. Samples of this fluid are checked for bacteria. Blood tests can look for the increased number of lymphocytes* commonly seen with this disease and for antibodies* to the bacterium. Experts suspect that many cases of adult whooping cough go undiagnosed.

How Is Pertussis Treated?

Doctors commonly prescribe a two-week course of antibiotics to keep the disease from spreading to other people. Antibiotics can also be prescribed for other people living in the same household with the patient to prevent these people from contracting the infection. However, antibiotics can do little to improve the illness if they are not prescribed until after the characteristic whooping cough symptoms appear. Cough medicines do not

ease the cough significantly, but using a cool-mist vaporizer and avoiding irritants such as smoke or fumes can help.

Children 18 months of age and younger who contract whooping cough need to be watched carefully because they may choke or stop breathing during a coughing spasm. Infants younger than six months of age usually are hospitalized and given oxygen and intravenous* fluids, and their mouth and nose may need to be suctioned to keep their breathing passages clear of mucus.

Whooping cough usually lasts between six weeks and two months, but it can take even longer for a patient to recover completely. The coughing spasms may continue on and off for several months.

Complications

Complications of whooping cough include bacterial infections such as ear infections or pneumonia*; dehydration* due to poor fluid intake and vomiting after coughing; broken blood vessels in the eyes, nose, and brain from forceful coughing; problems associated with lack of oxygen such as seizures* or, rarely, brain damage and, particularly among young infants, death. Adults may cough hard enough to break a rib.

Can Pertussis Be Prevented?

Vaccination (vak-sih-NAY-shun) is the best way to prevent pertussis in children. The vaccine for pertussis is given in a combined vaccine, including those for diphtheria* and tetanus*. The DTaP vaccine (made with acellular pertussis, which contains only parts of the pertussis bacterium and does not cause as many side effects as the vaccine made with the whole bacterium) is given in five doses: at two, four, and six months, between 15 and 18 months, and between four and six years of age. At least three doses are required to stimulate immunity, and four or all five doses are preferred.

Teens and adults who have completed the childhood series of vaccinations for pertussis can receive a booster shot to renew their immunity. This is especially important for people who work with young children and those who travel to parts of the world where pertussis is common. Adults can also reduce their chances of spreading the disease by practicing good hygiene, such as regularly washing their hands; not sharing food, silverware, or drinking glasses; and covering their mouth when they sneeze or cough.

▶ See also **Croup • Diphtheria • Pneumonia • Vaccination**

Resources

Books and Articles

Laskey, Elizabeth. *Whooping Cough*. Chicago: Heinemann Library, 2003.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **diphtheria** (dif-THEER-ē-uh) is an infection of the lining of the upper respiratory tract (the nose and throat). It is a disease that can cause breathing difficulty and other complications, including death.

* **tetanus** (TET-nus) is a serious bacterial infection that affects the body's central nervous system.

Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://wwwn.cdc.gov/travel/yellowBookCh4-Pertussis.aspx>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/whoopingcough.html>.

Pervasive Developmental Disorders, Overview

Pervasive (per-VAY-siv) developmental disorders are various conditions in which the brain fails to develop normally, resulting in serious problems with communication, social interaction, and behavioral development.

What are Pervasive Developmental Disorders?

Pervasive developmental disorders (PDDs) are conditions that prevent children from developing normal communication and normal social abilities. Parents may note symptoms of PDDs as early as infancy, and signs of these conditions begin to appear in the earliest years of childhood. Some forms of PDD are milder and other forms are more severe. Most children with these conditions have very limited interests and activities, and some engage in unusual behavior, such as rocking, flapping their hands, or even behavior that causes self-injury.

PDDs include autism (AW-tizm), Asperger's (AS-per-gerz) syndrome, Rett's syndrome, and childhood disintegrative disorder. The term "pervasive developmental disorder" refers to the whole group of conditions, but it sometimes is used to refer to milder forms of autism. The word "pervasive" means that the condition affects all aspects of something. It is used to describe these conditions because these conditions affect all aspects of a person's life.

What Are the Types of Pervasive Developmental Disorders?

Autism is a brain disorder that affects children within the first three years of life. Sometimes these children appear to develop normally for a time in early infancy. The word "autism" comes from the Greek word meaning "self." It was chosen for the disorder due to the characteristic self-absorption of people who have this problem. Indeed, children with autism appear to live in a world of their own, often seeming not even to notice members of their own family around them. They seldom make eye contact with other people or share the interests of others.

Children with autism are socially isolated. Their social problems are made worse by the fact that their language skills usually do not develop normally. Some children may never learn to talk. Others may talk, but they use language inappropriately, perhaps simply repeating the words of others or reversing the meanings of “I” and “you.” They may persist in certain behavior, such as hand-flapping or body-rocking, for no apparent purpose.

Asperger’s syndrome is generally thought to be a milder form of pervasive developmental disorder, and it shares with autism the features of social isolation and lack of responsiveness to other people. The difference between Asperger’s syndrome and what is called “classic” autism is that a child with Asperger’s syndrome has the intellectual function and language skills of a normal child of the same age. In fact, children with this syndrome often have excellent vocabularies but do not use their language skills for appropriate conversation. Socially, they often lack good give-and-take interactions. They may memorize and then recite timetables or lists (for example, facts from almanacs) or have intense and highly focused interests (for example, on mechanical devices). A child with Asperger’s syndrome may know the names and numbers of every Amtrak engine or be an expert on the town’s fire stations. Also, their social interactions often revolve around their overly focused interests (“Which fire station is near your house?” may be a way to say “Hello”).

Rett’s syndrome is a severe genetic* developmental condition that affects only girls. At first, the child develops normally, usually during the first and second year. She may even begin to walk and talk. Then she starts to lose these skills and may show signs of a stiff-legged walk. Losing the ability to use words to communicate, she may also lose interest in making friends. A typical physical sign of Rett’s syndrome is that the child’s head stops growing at the normal rate.

Childhood disintegrative disorder has signs that are in many ways similar to those of autism. An important difference is that in childhood disintegrative disorder a child may develop normally for two to 10 years. Then the child may begin to lose some combination of social or communicative skills, bowel or bladder control, or motor skills (physical coordination).

What Causes Pervasive Developmental Disorders?

Rett’s syndrome is caused primarily by a faulty gene. The causes of most cases of autism, Asperger’s syndrome, and childhood disintegrative disorder were not known as of 2009. Because autism and Asperger’s syndrome tend to run in families, it was believed that they were at least partly caused by faulty genes. Some authorities have speculated that childhood disintegrative disorder may be the result of damage to the developing brain, but as of the early 2000s, it was not known how this damage occurs.

How Are Pervasive Developmental Disorders Diagnosed and Treated?

In order to diagnose a developmental disorder, a doctor or psychologist first asks the child’s parents questions about the child’s early development

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **hyperactivity** (hy-per-ak-TI-vi-tee) is overly active behavior, which makes it hard for a person to sit still.

and then carefully observes the child to identify possible signs of impairment in social activities, behavior, and communication.

There are no cures for pervasive developmental disorders, but many children improve over time. Early intervention is essential to developing social and language skills. Therefore, prompt and proper diagnosis is important, so that well-planned special training and education can begin. Children are taught how to overcome the effects of certain impairments and how to build on the skills they have. Medication may be used to treat special problems, such as seizures* or hyperactivity*. One key to treatment is the development of a communication system that can help children with their social skills. One communication system that has proven to be effective uses picture exchanges. For example, if a child wants a drink, he hands the teacher a picture (symbol) of a drink. Pictures are gradually added together (picture of orange + picture of drink) and paired with words. Often, words then begin to replace the picture exchange system.

Often, children with these disorders can learn to attend to their basic needs such as self-feeding, dressing, and personal care. Many individuals with milder developmental problems learn to use language effectively and learn to relate well enough to gain some degree of independence (have a job, live in a group home) as adults. Some people with autism and Asperger's syndrome make rapid developmental progress in school and eventually may live by themselves.

Many individuals with PDDs, however, never learn to relate socially, never develop a communication system to express their needs, and never rid themselves of unusual behaviors such as rocking or hand-flapping.

▶ See also **Asperger's Syndrome • Autism • Childhood Disintegrative Disorder (Heller's Syndrome) • Rett Syndrome**

Resources

Books and Articles

Attwood, Tony. *The Complete Guide to Asperger's Syndrome*. London: Jessica Kingsley, 2008.

Judd, Sandra J., ed. *Autism and Pervasive Developmental Disorders Sourcebook*. Detroit, MI: Omnigraphics, 2007.

Organizations

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov/health/publications/autism/complete-publication.shtml>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824, Web site: <http://www.ninds.nih.gov/disorders/pdd/pdd.htm>.

Pharyngitis See *Sore Throat/Strep Throat*.

Phenylketonuria (PKU)

Phenylketonuria (fen-il-kee-to-NU-ree-a), or PKU, is an inherited metabolic disease in which the body cannot change one essential amino acid, phenylalanine (fen-il-AL-a-noon), into another needed amino acid, tyrosine (TY-ro-seen). Untreated, PKU often results in severe mental retardation, but if it is detected at birth and these children are put on a special diet, they can lead normal lives.

Children with a Strange Smell

In 1934 a mother with two children with mental retardation went to a Norwegian medical doctor, Asbjørn Følling (1888–1973). Følling became interested in the children's condition when the mother described the children's odd musty odor. The children, four and six years of age, had severe mental retardation. The younger child could not speak or walk and still wore diapers. The older child could speak only a few words and had problems walking.

Følling examined the children's urine and found no protein or glucose in it, but he was puzzled when their urine turned a deep green, instead of staying brownish, after he added the chemical compound ferric chloride to it. Følling expanded his study to other children whose urine produced the same kind of reaction and concluded that the unusual quality of the urine seemed to be connected with mental retardation. Thus, he discovered PKU, which he concluded was a genetic error in the children's metabolism*.

What Causes Phenylketonuria?

PKU is a disruption in normal metabolism. Normally, an enzyme* in the body called phenylalanine hydroxylase (fen-il-AL-a-noon hy-DROK-si-lase) changes the essential amino acids* phenylalanine to another needed amino acid called tyrosine (TY-ro-seen). If phenylalanine hydroxylase is missing, as it is in PKU, phenylalanine builds up in the blood and passes out of the body in urine.



▲ A package of artificial sweetener alerts people with PKU that the product contains phenylalanine. ©Leonard Lessin/ Peter Arnold, Inc.

- * **metabolism** (meh-TAB-o-liz-um) is the process in the body that converts foods into the energy necessary for body functions.
- * **enzyme** (EN-zime) is a protein that helps speed up a chemical reaction in cells or organisms.
- * **amino acids** (α-MEE-no acids) are the chief building blocks of proteins. In humans, certain amino acids are required to sustain life.

* **eczema** (EG-ze-mah) an inflammatory skin condition characterized by redness, itchiness, and oozing blisters that become crusty and hard.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **hyperactivity** (hy-per-ak-TI-vi-tee) is overly active behavior, which makes it hard for a person to sit still.

* **formula** is a prepared, nutritious drink or a dry drink mix designed specifically for infants.

PKU affects on average 1 out of every 10,000 to 15,000 babies in the United States. Because PKU is an inherited disorder, there is considerable variation among different ethnic and racial groups. The condition is found less often in people of African descent (1 in every 50,000 babies) and in Ashkenazic Jews.

What Are the Signs and Symptoms of Phenylketonuria?

Infants with PKU usually have lighter skin, hair, and eyes than the rest of their families, but symptoms do not appear until they are about three to six months old. These may include the following:

- An eczema*-like rash
- Seizures*
- Hyperactivity*
- An unpleasant musty or mousy body odor (caused by phenylacetic acid in the urine and sweat)
- Intellectual disability

How Is Phenylketonuria Diagnosed?

Almost all babies born in hospitals in the United States are screened for PKU within 48 hours of birth with a blood test that measures their levels of phenylalanine. In families with a history of PKU, the disease can usually be diagnosed in the fetus during pregnancy. A pregnant woman who has untreated PKU herself has a much greater chance of having a baby with (often severe) birth defects.

Living with Phenylketonuria

Jennifer is a happy 12-year-old with fair skin, blue eyes, and a very normal life except for her diet. Jennifer has PKU, which was diagnosed at birth through hospital screening. She cannot go out for pizza, drink diet sodas, or eat many of the common foods that most people take for granted.

Infants with PKU must begin treatment within days of being born to prevent their becoming mentally retarded. They must eat a special diet that restricts their intake of phenylalanine and provides the tyrosine that the body cannot make. Babies drink special formula* that is low in phenylalanine. People with PKU cannot have high-protein foods such as meat, poultry, fish, milk, eggs, and cheese or products containing the artificial sweetener aspartame (also known by the brand name NutraSweet). They can eat low-protein foods such as fruits, vegetables, and certain cereals.

Not adhering to the diet may cause serious problems such as a drop in IQ and problems with learning and behavior. Experts are not sure whether and at what age it is safe to stop treatment. Most recommend that people with PKU stay on the special diet for life.

Once destined to become mentally retarded, people like Jennifer can avoid mental retardation and lead independent, vibrant lives. However,

left undiagnosed and untreated, those with PKU generally develop severe mental retardation and are unable to live independent lives. PKU, therefore, is an example of an inherited (genetic) condition whose damage can be prevented by early detection and adherence to a low-protein, low phenylalanine PKU diet from birth throughout life.

▶ See also **Genetic Diseases • Intellectual Disability • Metabolic Disease**

Resources

Books and Articles

Fields, Denise, and Ari Brown. *Toddler 411: Clear Answers & Smart Advice for your Toddler*. Boulder, CO: Windsor Peak Press, 2006.

Organizations

Children's PKU Network. 3790 Via De La Valle, Suite 120, Del Mar, CA, 92014. Toll free: 800-377-6677. Web site: <http://www.pkunetwork.org>.

National PKU News. 6869 Woodlawn Avenue NE, Suite 116, Seattle, WA, 98115-5469. Telephone: 206-525-8140. Web site: <http://www.pkunews.org>.

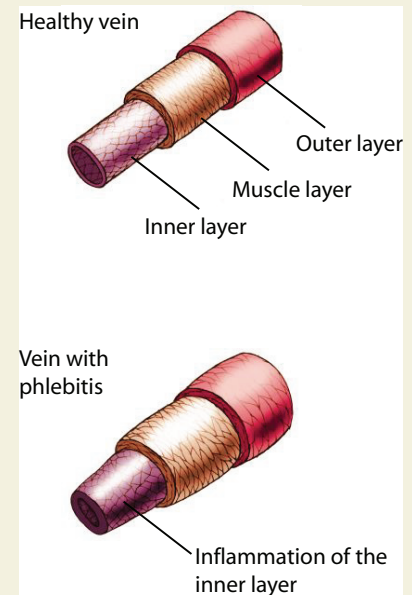
Patient Power. 9220 SE Sixty-Eighth Street, Mercer Island, WA, 98040-5135, Web site: <http://www.patientpower.info/specialeditionpku.asp?ac=AW3-PKU-5&gclid=CLOdgaOryJUCFQxzHgodJWzajQ>.

Phlebitis and Venous Thrombosis

Phlebitis (fle-BY-tis) is a general term that refers to the inflammation of a vein. Phlebitis is usually treatable and not dangerous by itself. However, if the inflammation leads to or is accompanied by the formation of a blood clot, or thrombus, the condition is known as venous thrombosis, or thrombophlebitis, and is a more serious health problem. With venous thrombosis, the blood clot that has formed may block or partially block the flow of blood in the vein. If the clot or a portion of the clot breaks free of the vein, it is then called an embolus. The embolus then travels in the bloodstream away from the site where it was formed and may lodge in another part of the body, such as the pulmonary artery (leading into the lungs) or one of its branches. This is a life-threatening condition known as pulmonary embolism (PUL-mo-na-ree EM-bo-lizm).*

Terry's Tale

Terry decided to visit her doctor after she experienced slight pain in an area of her lower left leg and then discovered a streak of redness in the area. The



Healthy vein (top) and vein with phlebitis (bottom). *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **blood clot** is a thickening of the blood into a jelly-like substance that helps stop bleeding. Clotting of the blood within a blood vessel can lead to blockage of blood flow.

* **pulmonary** refers to the lungs.

* **embolism** is a blockage in a blood vessel caused by a blood clot, air bubble, fatty tissue, or other substance that traveled through the bloodstream from another part of the body.

* **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **menopause** (MEN-o-pawz) is the end of menstruation.

area was also swollen. The doctor examined the sore spot and then asked her if the pain was worse early in the morning when she swung her leg over the side of the bed. She said it was. He also asked if she spent much time sitting. She said that as a receptionist at a busy office, she might go hours without getting up from her desk. The doctor considered all of the information and told Terry that she had superficial phlebitis. He explained that if she followed his recommendations, she would be back to normal in a week or two. He also told her that he was glad she came into the office, because superficial phlebitis can sometimes lead to more serious health problems.

What Are Phlebitis and Venous Thrombosis?

The heart beats about 100,000 times per day, driving blood through the arteries of the body and back to the heart through the veins. Sometimes, however, the blood in veins does not flow well. It moves slowly or pools in the veins, like water forming a puddle. The pooling of blood causes the walls of the vein to stretch and become inflamed, and it sometimes causes clotting. Clots are gelled, or thickened, clumps blood that usually have a beneficial function, such as when they help to seal a wound and stop its bleeding. The inflammation of a vein is called phlebitis, and when the affected vein is close to the body's surface, it is known as superficial phlebitis. Superficial phlebitis is often painful but rarely serious. Deep vein thrombosis is the formation of a blood clot in a deep vein. It affects the large blood vessels deep in the leg. Deep vein thrombosis is potentially life-threatening. An embolus can travel in the bloodstream and enter the heart. It can then block the pulmonary* artery, the large artery that carries blood from the heart into the lungs, causing a pulmonary embolism*. This may cause death if not treated rapidly and effectively.

What Causes Phlebitis and Venous Thrombosis?

Phlebitis and venous thrombosis can occur for many reasons. A sedentary lifestyle is a risk factor. Prolonged inactivity or sitting for many hours on long car or plane rides causes pooling of blood in the legs and may cause a vein to become irritated and inflamed. An injury to the legs, a tumor, and some surgeries can inflame or otherwise damage veins and result in a slowed blood flow. People who are confined to bed, either after an operative or in general, are prone to pooling of blood in the leg veins, and some medical conditions increase the clotting potential of blood. Pregnant women are also at greater than normal risk, as are women who take estrogen (ES-trojen), a primary female sex hormone* in the form of oral contraceptives or as part of hormone replacement therapy during menopause*. Smoking is another major risk factor, along with having varicose veins.

What Are the Symptoms of Phlebitis and Venous Thrombosis?

Phlebitis usually occurs in the legs. Venous thrombosis typically affects the lower legs, the pelvis, or the thigh. However, both phlebitis and venous thrombosis can occur elsewhere in the body. The symptoms for superficial

phlebitis and for deep vein thrombosis overlap somewhat. The symptoms of superficial phlebitis include swelling, a red streak in the affected area, and pain that may become worse when walking or when first getting out of bed. Symptoms of deep vein thrombosis include swelling of the leg or arm, which may happen suddenly; leg pain that may develop suddenly or worsen when one stands up or walks; a warm feeling at the affected site that sometimes extends over larger areas; and an enlargement of superficial veins in the area, which may appear reddish-blue.

In the case of pulmonary embolism, symptoms can include heavy sweating; rapid breathing and rapid heart rate; coughing often accompanied by sharp chest pains; back pain; shortness of breath, and fainting or lightheadedness.

How Are Phlebitis and Venous Thrombosis Diagnosed?

Doctors can often diagnose phlebitis simply by asking the patient a few questions and conducting a physical examination. For venous thrombosis, doctors use tests to detect the presence of clots in the veins. One test, venography, is a way of viewing veins that entails injecting dye into a leg vein and taking an x-ray of the veins, a venogram. Doctors can also use ultrasound* to generate an image of the leg that is vaguely similar to an x-ray image. Other techniques used to diagnose venous thrombosis include magnetic resonance imaging* (MRI) and computerized tomography* (CT), which generate cross-sectional images of organs, structures, and/or blood vessels, and clots.

According to the Coalition to Prevent Deep Vein Thrombosis, deep vein thrombosis affects nearly 2 million Americans per year, and up to 600,000 of them are hospitalized annually. Of those who develop a pulmonary embolism, up to 300,000 die per year.

How Are Phlebitis and Venous Thrombosis Treated?

The danger of phlebitis is that it can lead to venous thrombosis. If clots are absent, doctors treat patients with heat packs and anti-inflammatory drugs, such as ibuprofen*, and have the person raise the affected leg to encourage better blood flow. If clots are present, doctors may prescribe blood-thinning drugs such as heparin or warfarin to dissolve the clots or to prevent the blood from clotting as easily. Such medication may prevent a clot from growing larger and may lower the likelihood that the clot will break free and cause an embolism. Clot-dissolving drugs may be injected into the affected vein. In rare cases, a doctor may recommend that a vein be opened and the clot surgically removed.

For people at high risk for developing clots, doctors often recommend preventive measures such as the use of drugs that slow or impede the clotting of blood and special compression stockings that help to keep blood from pooling in the deep veins of the legs.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **ibuprofen** (eye-bew-PRO-fin) is a nonsteroidal anti-inflammatory drug (NISAD) used to reduce fever and relieve pain or inflammation.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

* **intestines** are the muscular tubes that food passes through during digestion after it exits the stomach.

Can Superficial Phlebitis and Thrombosis Be Prevented?

The best prevention is to stay active. Smoking and obesity* increase the risk of superficial phlebitis and thrombosis, so avoiding tobacco and maintaining a healthy weight are both good preventative measures.

▶ See also **Vascular Diseases**

Resources

Books and Articles

James, Andra H., Thomas L. Ortel, and Victor F. Tapson. *100 Questions & Answers about Deep Vein Thrombosis and Pulmonary Embolism*. Sudbury, MA: Jones and Bartlett, 2008.

Organizations

New York University Langone Medical Center. 550 First Avenue, New York, NY, 10016. Telephone: 212-263-7300. Web site: <http://www.med.nyu.edu/patientcare/library/article.html?ChunkIID=197673>.

University of Iowa Hospitals and Clinics. 200 Hawkins Drive, Iowa City, IA, 52242, Web site: <http://www.uihealthcare.com/topics/bloodandcirculatory/bloo4215.html>.

Phobias See *Fears and Phobias*.

PID See *Pelvic Inflammatory Disease (PID)*.

Pimples See *Acne*.

Pink Eye See *Conjunctivitis*.

Pinworm Infestation (Enterobiasis)

In cases of pinworm infestation, or enterobiasis (en-tuh-roh-BY-uh-sis), a species of small worm lives and reproduces in the human intestines. The infestation causes anal itching. Children often inadvertently spread it to schoolmates or family members.*

What Is Pinworm Infestation?

Human pinworms, *Enterobius vermicularis* (*en-tuh-ROH-be-us ver-MIH-kyoo-lar-is*), are a species of roundworm* that are usually less than one centimeter in length and resemble light-colored pieces of thread. People become infested when they swallow tiny pinworm eggs, usually after touching something that was handled by a person who is already infected. The eggs travel to the small intestine* and hatch into larvae*. Pinworm larvae then travel from the small intestine to the large intestine, where they attach to the intestinal wall. About two to six weeks after a person swallows the eggs, adult female pinworms migrate from the large intestine to the rectum, where they exit from the anus to lay numerous eggs on nearby skin. The adult pinworms then return to the large intestine, where they usually die, but the new eggs remain on the skin, where they can survive for two to three weeks.

Is Pinworm Infestation Contagious?

Pinworm infestation is highly contagious. The egg-laying causes itching, which prompts the infested person to scratch the area. By doing so, however, the person can inadvertently get some of the microscopic eggs on the fingers. If the person then touches the mouth, he or she can transfer the eggs to the lips. At that point, the individual can swallow the eggs, starting the life cycle again. In addition, the infected person may transfer the eggs to clothing, bedding, towels, toilets, and other objects in the environment. When another person picks up the clothes, makes the bed, or handles anything else that is contaminated, that person may get the eggs on his or her fingers. By touching the mouth, this person, too, can swallow the eggs to start a new infestation.

How Common Is Pinworm Infestation?

According to the Centers for Disease Control and Prevention, about 40 million people in the United States have pinworms, making it the most common worm infestation in the country. Young children have the greatest chance of becoming infested, because they often put their hands in their mouths. The parasites spread easily in preschools, schools, and childcare settings. Pinworms are also common in people living in crowded conditions. When one person in a household becomes infested, other family members often wind up with the worms as well.

What Are the Signs and Symptoms of Infestation?

Many people with pinworms have no symptoms at all. In others, symptoms are generally mild. The most common symptom is itching around the anus. The sensation becomes strongest at night, when the female worms are active on the skin. This condition may lead to restless sleep or even trouble sleeping. Children with infestations may become irritable from lack of peaceful sleep, and they occasionally lose their appetites. If a



▲ Pinworms are about one-third of an inch long and live in the human intestine. Female pinworms deposit eggs on the skin surrounding a person's anus. The eggs can then be spread to other family members through contact with sheets or clothing. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

- * **roundworm** is one of several types of cylinder-shaped worms that live in people. Roundworms are also known as nematodes (NEE-muh-todes).
- * **small intestine** is the part of the intestines—the system of muscular tubes that food passes through during digestion—that directly receives the food when it passes through the stomach.
- * **larvae** (LAR-vee) are the immature forms of an insect or worm that hatches from an egg.

* **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.

child constantly scratches around the anus, the skin there can become raw and infected. In girls, adult worms sometimes enter the vagina* instead of returning to the anus, which may cause vaginal itching.

How Is Pinworm Infestation Diagnosed?

In some cases, a parent can see the worms at night around the anus or in the bed sheets, but usually a doctor makes the diagnosis by using the tape test. The doctor (or a parent) places adhesive tape on the skin in the anal area, usually in the morning since egg laying occurs overnight. This is done before the person takes a shower or has a bowel movement, because both activities can dislodge the eggs and worms. When the tape is removed and viewed under a microscope at a medical office, medical professionals can see eggs or worms stuck to the tape. If the doctor sees no eggs or worms but still suspects pinworms, he or she may want to repeat the test one or more times. The doctor might also examine scrapings from under the fingernails, where pinworm eggs can become stuck after the patient scratches the anal area.

What Is the Treatment?

Once an infestation is confirmed, the doctor generally prescribes medication to get rid of the worms. The patient takes the first dose, often in the form of a chewable pill, right away and usually a second dose two weeks later. Because pinworms can be highly contagious, doctors sometimes recommend that all people who live in the same house with the infested person take the medicine as well. Reinfection is common, and a patient may have to repeat the treatment.

Are There Complications of Pinworm Infestation?

Complications of pinworm infestation are uncommon and generally minor, such as the development of a bacterial infection that results from scratching the anal area.

What Are the Preventive Measures?

Practicing good personal hygiene is the best way to avoid infestation. Individuals should wash their hands after using the bathroom and before eating and should avoid scratching the anal area and biting the nails. To limit the spread of pinworms, people with the parasites are advised to change into clean underwear every day and frequently change their night-clothes. Taking a bath or shower after waking up in the morning can help get rid of pinworm eggs, and keeping fingernails trimmed short can prevent eggs from lodging there and later being deposited somewhere else. Doctors advise that after each course of treatment for pinworms, sheets and sleeping clothes be washed, to lower the risk of reinfestation.

▶ See also **Ascariasis • Trichinosis • Worms: Overview**

Resources

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://familydoctor.org/online/famdocen/home/children/parents/common/stomach/139.html>.

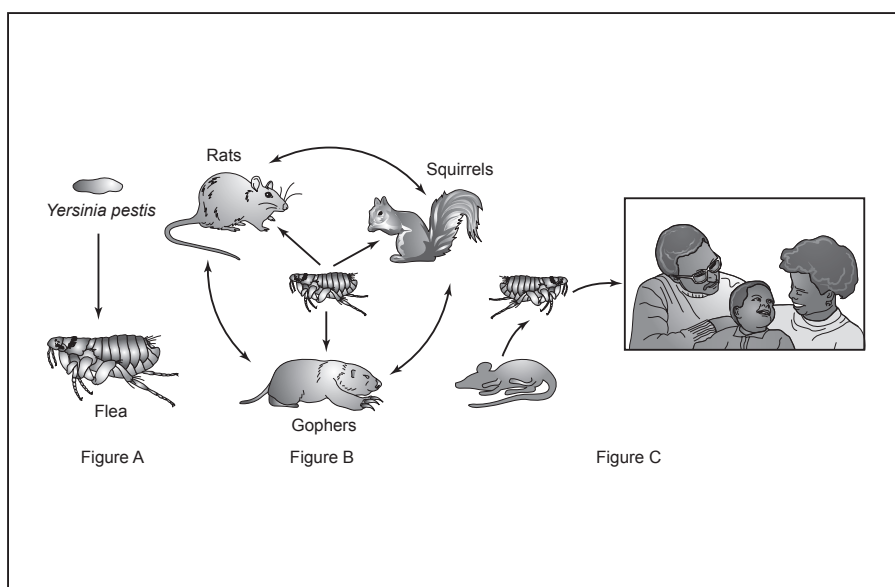
Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/parasites/pinworm/default.htm>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-6612. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/pinworm>.

PKU See *Phenylketonuria (PKU)*.

Plague

Plague (PLAYG) is a potentially serious bacterial infection that is spread to humans by infected rodents and their fleas.



Plague is a serious infectious disease transmitted by the bites of rat fleas. There are three major forms of plague: bubonic, pneumonic, and septicemic. Fleas carry the bacterium *Yersinia pestis* (A). When a flea bites an infected rodent (B), it becomes a vector and then passes the plague bacteria on when it bites a human (C). *Illustration by Electronic Illustrators Group. Reproduced by permission.*

Bioweapons

Plague bacteria are considered to be one of several deadly organisms that could be used in biological warfare. It is feared that the bacteria could be aerosolized (AIR-o-suh-lized), or processed into tiny particles that could be released into the air.

A plague vaccine was available to the general public but was discontinued by its manufacturers in 1999. Even if the vaccine were made available in the early 2000s, it would not be able to prevent the pneumonic form of plague, which is resistant to treatment as well.

The plague has been used as a weapon before. In 1346 the Tartar army tried to capture the port city of Caffa on the Black Sea in the Crimea. The army catapulted the bodies of plague victims over the city wall; an epidemic of plague ensued and the city surrendered.

* **lymphatic system** (lim-FAH-tik) is a system that contains lymph nodes and a network of channels that carry fluid and cells of the immune system through the body.

What Is Plague?

Plague is a disease caused by the bacterium *Yersinia pestis* (yer-SIN-e-uh PES-tis). It has been in existence for at least 2,000 years and in the 21st century is still found in Africa, Asia, South America, and North America.

There are three types of plague. Pneumonic (nu-MOH-nik) involves the lungs; bubonic (byoo-BAH-nik), the most common form, involves the body's lymphatic system*; and septicemic (sep-tih-SEE-mik) involves the bloodstream and spreads throughout the body. Septicemic plague can occur by itself or along with pneumonic or bubonic plague.

Wild rats and fleas often are associated with plague because they were the primary carriers of the disease during the most devastating outbreaks. Other types of rodents (and their fleas) can carry plague as well, such as prairie dogs, chipmunks, wood rats, and ground squirrels.

How Common Is Plague?

The World Health Organization (WHO) reports 1,000 to 3,000 cases of plague worldwide annually. In the United States, 10 to 20 cases are reported every year, usually in rural areas in the southwestern states, particularly New Mexico and Arizona. The last outbreak in the United States was in 1924 and 1925 in Los Angeles. Plague has not occurred in Europe since World War II.

How Is Plague Spread?

Plague is transmitted in several ways. The most common of these is from animal to human through the bite of infected fleas. Fleas living on infected animals ingest the animals' blood and the bacteria in it. They then spread the disease to other animals and humans through their bite, which can

THE BLACK DEATH

The first pandemic (a worldwide outbreak of disease) of plague chronicled by historians occurred between 542 and 546 C.E., during the reign of the emperor Justinian the Great (482/483–565). The plague followed trade routes to other countries, and the Roman army itself carried plague during war campaigns throughout Asia Minor, Western Europe, Italy, and Africa. Outbreaks continued for the next 300 years before the disease finally subsided.

An equally devastating second pandemic erupted nearly 800 years later, as plague once again traveled across trade routes and infected populations throughout Europe. Known as the Black Death, this fourteenth-century outbreak killed more than one-third of Europe's population.

During these two pandemics, the cause of plague (rats and, more importantly, their infected fleas) was unknown. The spread of disease went unexplained, and many people feared it was a punishment sent by God.

result in the bubonic or septicemic form of plague. Bacteria also can enter the body through an open cut or wound after direct contact with infected people or animals.

In addition, humans and animals (such as cats) with plague can spread the disease by releasing tiny drops containing the bacteria from their mouth and nose, which happens in humans when a person coughs, sneezes, or talks. As these drops enter the air, the smaller ones can float for up to one hour, whereas the larger drops settle on nearby objects. A sneeze or cough can send thousands of infected particles into the air. If inhaled, these drops can cause the pneumonic form of plague. This way of spreading the disease requires relatively close contact with an infected person or animal.

What Are the Signs and Symptoms of Plague?

Symptoms typically appear two to six days after infection. Sudden fever, chills, and headache, followed by swollen, painful, hot-to-the-touch lymph nodes*, known as buboes (BYOO-boze), are the hallmarks of bubonic plague. Lymph nodes in the groin are most commonly affected. If left untreated, the infection eventually spreads to the bloodstream, causing sepsis*, pneumonia*, or meningitis*.

In septicemic plague, the bacteria multiply in the blood, causing symptoms such as fever, chills, weakness, abdominal* pain, nausea (NAW-zee-uh), and vomiting. As the infection progresses, the blood pressure drops and the blood is unable to clot* normally. The skin looks bruised from uncontrolled bleeding, which is why historically the disease was called the Black Death.

The pneumonic form of plague takes hold rapidly, with symptoms such as fever, cough, chills, chest pain, bloody sputum*, and headache. It can progress to respiratory failure* and shock* within two to four days.

How Do Doctors Diagnose and Treat Plague?

Determining whether a person was in close contact with animals that can carry plague or has traveled to an area where the plague is known to occur can be key in making the diagnosis. Bubonic plague can be identified by the characteristic swollen lymph nodes. A blood culture* and a lymph node biopsy* may be done, as well as a culture of a sputum sample to look for *Yersinia pestis* bacteria.

Getting timely treatment for plague is critical. Without treatment, bubonic plague is fatal in 50 to 60 percent of cases. Septicemic plague and pneumonic plague are fatal in almost all cases if not treated within 24 to 48 hours.

Suspected plague patients are isolated and hospitalized, where they are treated with antibiotics, intravenous* (IV) fluids, and oxygen. Anyone who has come in close contact with someone diagnosed with plague is treated with antibiotics to prevent them from contracting the infection. All suspected cases of plague must be reported to state and local health departments. Treatment and full recovery from plague can take several

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **sepsis** is a potentially serious spreading of infection, usually bacterial, through the bloodstream and body.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

* **clot** is the process by which the body forms a thickened mass of blood cells and protein to stop bleeding.

* **sputum** (SPYOO-tum) is a substance that contains mucus and other matter coughed out from the lungs, bronchi, and trachea.

* **respiratory failure** is a condition in which breathing and oxygen delivery to the body are dangerously altered. This may result from infection, nerve or muscle damage, poisoning, or other causes.

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

- * **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.
- * **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- * **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.
- * **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.
- * **membrane** (MEM-brain) is a thin layer of tissue that covers a surface, lines a cavity, or divides a space or organ.

weeks or longer. Complications of plague include damage to vital organs due to lack of blood flow associated with sepsis, brain damage from lack of oxygen, lung damage, and death.

How Can People Prevent Becoming Infected?

Some people are at a higher risk for developing plague than others, such as lab technicians who handle the bacterium or blood samples taken from people who are infected, people who work in areas where plague occurs, and people who work with animals that carry the disease.

A person's risk of developing plague can be lowered by limiting contact with wild animals that might carry the disease, removing potential food sources and shelter for rodents near the home, treating pet dogs and cats weekly for fleas, and using insecticides to kill fleas around the home during outbreaks of plague in wild animals. Rat management in rural and urban areas also can minimize the potential for disease.

Antibiotics sometimes are prescribed to prevent infection if a person has been exposed to plague.

▶ See also **Bioterrorism • Pneumonia • Sepsis • Travel-related Infections • Zoonoses**

Resources

Books and Articles

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Peters, Stephanie True. *The Black Death*. New York: Benchmark Books, 2005.

Whiting, Jim. *Bubonic Plague*. Hockessin, DE: Mitchell Lane, 2007.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dvbid/plague/index.htm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/plague.html>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/topics/plague/en>.

Pleurisy

Pleurisy (PLOOR-i-see) is an inflammation of the membrane* that covers the lungs and lines the chest cavity. The lining is called the pleura (PLOOR-a).*

What Is Pleurisy?

In pleurisy, the membrane covering the lungs and lining the chest cavity becomes inflamed, and excess fluids may build up in the space. When people who have pleurisy breathe in or cough, the inflammation causes pain, which is a result of friction from the inflamed pleura. The pain is a sharp, stabbing pain that begins suddenly. There are a number of different causes of pleurisy.

What Are the Symptoms of Pleurisy?

A sharp, knifelike pain when breathing in or coughing is the primary symptom of pleurisy. People who have pleurisy tend to breathe more frequently with smaller breaths to avoid pain. Ultimately, these small breaths can lead to pneumonia*.

What Causes Pleurisy?

Pleurisy may result from a number of causes. It can develop from infections, including viral, bacterial, mycobacterial, fungal, or parasitic. It also can be a result of traumatic injury from an accident or from chest surgery or radiation treatments. Sometimes, pleurisy is a complication of another disease, such as lung cancer*, sickle-cell anemia*, or connective tissue diseases such as rheumatoid arthritis*, or systemic lupus erythematosus*. Blood clots that travel to the lung (pulmonary emboli) can result in pleurisy, as can exposure to toxic substances such as asbestos. The result in all of these cases is inflammation of the pleura that causes pain when a person coughs or breathes, as well as a fluid accumulation (called a pleural effusion) between the layers of tissue that line the lung and the chest wall.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **cancer** is any tumorous (TOO-mor-us) condition the natural (untreated) course of which is often fatal.

* **sickle-cell anemia** also called sickle-cell disease, is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.

* **rheumatoid arthritis** (ROO-mah-toyd ar-THRY-tis) is a chronic disease characterized by painful swelling, stiffness, and deformity of the joints.

* **systemic lupus erythematosus** (sis-TEM-ik LOO-pus eri-them-a-TO-sus), sometimes just called lupus, is a chronic inflammatory disease that can affect the skin, joints, kidneys, nervous system, membranes lining body cavities, and other organs.

BLUE ROSES

In the play *The Glass Menagerie* by Tennessee Williams (1911–1983), Laura tells her mother how a boy in her high school called her “Blue Roses.”

“Why did he call you such a name as that?” asks her mother, Amanda.

Laura explains that when she came back to school after she had an attack of “pleurosis,” the young man, Jim, asked her what had been the matter with her. She told him she had had pleurosis, and he mistook the word for “blue roses.” Thereafter, whenever Jim saw Laura, he would greet her with “Hello, Blue Roses!”

Unfortunately, it is easier to contract pleurisy than it is to find blue roses. In the play, though, Laura does recover from her pleurosis. Her problems are of a different nature. The title of the play refers to Laura’s collection of glass animals.

How Is Pleurisy Diagnosed and Treated?

Physicians may diagnose pleurisy when they hear a “friction rub” when the patient breathes deeply. Doctors can use several different laboratory tests to help diagnose the condition. Fluid from pleural effusion can be removed with a needle and sent to the laboratory for analysis. Medicines can be given to help with the pain and inflammation. However, the underlying cause of pleurisy, such as bacterial pneumonia or tuberculosis (too-ber-ku-LO-sis), must be treated. If the pleural effusion is large, the fluid may need to be drained via a needle, or a chest tube may need to be inserted in order to evacuate (remove) the abnormal accumulation of fluid and improve breathing.

▶ See also **Bacterial Infections • Pneumonia • Tuberculosis**

Resources

Books and Articles

Mason, Robert J., V. Courtney Broaddus, John F. Murray, et al. *Murray & Nadel's Textbook of Respiratory Medicine*, 4th ed. Philadelphia, PA: Saunders, 2005.

Organizations

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905, Web site: <http://www.mayoclinic.com/health/pleurisy/DS00244>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: http://www.nhlbi.nih.gov/health/dci/Diseases/pleurisy/pleurisy_whatare.html.

PMS (Premenstrual Syndrome) See *Menstruation and Menstrual Disorders*.

Pneumoconiosis

Pneumoconiosis (noo-mo-ko-nee-O-sis) refers to a group of diseases of the lungs caused by long-term breathing of dust, especially certain mineral dusts. Forms of pneumoconiosis include black lung disease (coal worker's pneumoconiosis), silicosis, and asbestosis. The disease typically results from working in a mine for many years, but factory work and other occupations can expose people to the ill effects of breathing dusts. The term “pneumoconiosis” comes from the Greek pneumon, meaning lung, and konis, meaning dust.

THE WAR AGAINST BLACK LUNG

The prevalence of black lung disease did not begin to decrease until it became clear that the cause was excessively high levels of coal dust in mines. Largely due to the efforts of coal miners' unions, occupational safety conditions improved.

In 1969 the Mine Health and Safety Act set standards in the United States for maximum allowable levels of coal dust in mines. The act also provided compensation for miners who developed black lung disease. Death rates from pneumoconiosis declined after the act was passed.

* **emphysema** (em-fuh-ZEE-mah) is a lung disease in which the tiny air sacs in the lungs become permanently damaged and are unable to maintain the normal exchange of oxygen and other respiratory gases with the blood, often causing breathing difficulty.

What Causes Pneumoconiosis?

Only microscopic-size dust particles, about 1/5,000 of an inch across or smaller, are able to reach the tiniest air sacs (the alveoli) in the lungs. Once there, they cannot be removed. They accumulate to cause a scarring and thickening of the lungs called fibrosis (fy-BRO-sis). Eventually, the lungs begin to lose their ability to supply oxygen to the body.

Black lung disease is caused by breathing coal dust, usually in mines. Silicosis results from inhaling silica dust from sand and rock, primarily in mines, quarries, and in occupations such as sandblasting. Asbestosis comes from breathing tiny asbestos fibers in mining, building construction, and other industries. Less commonly, other kinds of dust are continuously inhaled in work-related situations and cause pneumoconiosis. Inhalation of large volumes of dust also caused lung damage to rescue workers after the destruction of the World Trade Center Towers on September 11, 2001, a condition sometimes referred to as Ground Zero Lung.

What Happens When People Have Pneumoconiosis?

Symptoms Because pneumoconiosis usually takes 20 or 30 years to develop, workers often do not notice symptoms until they are over 50. The main symptoms are coughing and difficulty in breathing, which gradually increases. Complications include emphysema* (em-fe-SEE-ma) and increased risk of tuberculosis. Asbestosis patients are more likely to develop lung cancer, especially if they smoke cigarettes. Damaged lungs make the heart work harder, and heart problems can accompany severe cases of pneumoconiosis.

Diagnosis Diagnosis is made by physical examination and through a medical history that tells the doctor which dusts patients have been exposed to. The doctor may also take chest x-rays and pulmonary (lung) function tests.

* **oxygen** (OK-si-jen) is an odorless, colorless gas essential for the human body. It is taken in through the lungs and delivered to the body by the bloodstream.

Treatment There is no cure for pneumoconiosis, because the dust cannot be removed from the lungs. Even if it could, the damage done to the lungs from years of inflammatory reaction to the dust could not be undone. Except in a mild form called simple pneumoconiosis, the disease is progressively disabling. The only treatment is to avoid smoking and further exposure to dust and to treat complications.

Prevention Pneumoconiosis can be prevented by enforcing maximum allowable dust levels in mines and at other work sites and by using protective masks. Regular medical examinations, including chest x-rays for people at risk, can detect pneumoconiosis during its earlier stages, before it becomes disabling.

▶ See also **Environmental Diseases • Lung Cancer • Tuberculosis**

Resources

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Mason, Robert J., V. Courtney Broaddus, John F. Murray, et al. *Murray & Nadel's Textbook of Respiratory Medicine*, 4th ed. Philadelphia, PA: Saunders, 2005.

Organization

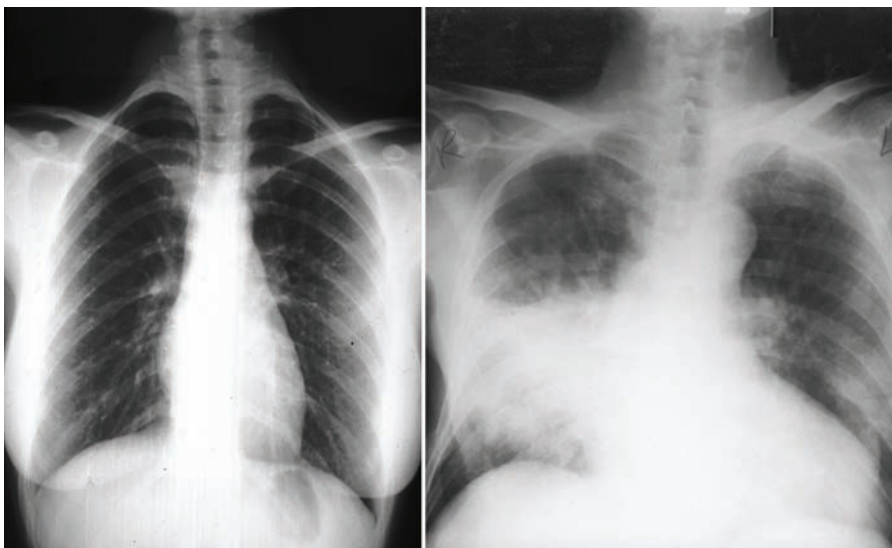
National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/000130.htm>.

Pneumonia

Pneumonia (noo-MOH-nyah) is an inflammation of the lungs. It is a common illness usually caused by infection with a bacterium, virus, or fungus. It is often mild, especially in young people. Pneumonia may also cause serious illness, especially in people who are old or already have health problems, and it remains a major cause of death.

What Is Pneumonia?

When a person breathes, air enters the lungs and travels through millions of tiny sacs. In these sacs, known as alveoli (al-VEE-oh-lye), oxygen* is transferred to the blood, which carries it to all parts of the body.



Clear, healthy lungs (left); inflamed lung tissue of pneumonia (right). *Custom Medical Stock Photo, Inc. Reproduced by permission.*



When someone has pneumonia, the lung tissue becomes inflamed and the alveoli fill with mucus* and other debris, making it difficult for oxygen to be transferred. Breathing is difficult and the lungs have to work harder to take in oxygen and to exhale carbon dioxide, a dangerous waste product in the blood. Eventually, the cells of the body may not get enough oxygen, and carbon dioxide may build up in the body.

Normally, the body has ways to fight off lung infection. These include the following:

- Coughing deeply, which expels germs and keeps germ-trapping mucus from building up in the lungs
- Swallowing, causing the trachea (TRAY-kee-ah; or windpipe) to close by the vocal cords and the epiglottis (ep-i-GLOT-is). The closing of the trachea and the gag reflex prevent people from inhaling food, vomit, or stomach acid into their lungs.
- Upward waving cilia (SILL-ee-ah), small hairs that line the inside of the windpipe, filtering particles out of the air before they reach the lungs
- Good functioning of the immune system, a complex set of organs, chemicals, and white blood cells that attack germs that enter the body

These defenses usually prevent pneumonia, but sometimes a person's defenses may be weakened by illness, age, or other factors. The defenses also may be overwhelmed by a particularly heavy or virulent* dose of germs.

What Are Some Different Types of Pneumonia?

More than 75 kinds of germs can cause pneumonia. Bacteria and viruses are the most common causes. Fungi and parasites are less common causes. Chemicals, drugs, and radiation can also cause lung inflammation.

* **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

* **virulent** comes from the Latin word for poisonous, and describes a microbe that is especially well suited to countering the immune system.

* **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

* **intestines** are the muscular tubes that food passes through during digestion after it exits the stomach.

* **bladder** (BLAD-er) is the sac that stores urine produced by the kidneys prior to discharge from the body.

* **croup** (KROOP) is an infection involving the trachea (windpipe) and larynx (voice box) that typically occurs in childhood. It causes inflammation and narrowing of the upper airway, sometimes making it difficult to breathe. The characteristic symptom is a barking cough.

Aspiration (as-puh-RAY-shun) pneumonia occurs when someone accidentally inhales food or vomited material into the lungs.

Bacterial pneumonia Bacterial pneumonia can attack anyone, from infants to adults. The disease can be more severe in older people and those with underlying health conditions. The death rate from bacterial pneumonia is higher among the elderly than in other age groups. The most common cause of bacterial pneumonia is *Streptococcus pneumoniae* (strep-tuh-KAH-kus noo-MOH-nye), also called pneumococcus (noo-moh-KAH-kus). Sometimes a cold will be followed by streptococcal pneumonia, because the fluids produced by a cold's runny nose and sore throat make an excellent breeding ground for streptococcal bacteria. If the infection is not properly treated with antibiotics, the bacteria can multiply and cause infection not only in the lungs but also in the bloodstream, brain, and other parts of the body.

Other bacterial causes include the following:

- *Mycoplasma pneumoniae* (my-koh-PLAZ-muh noo-MOH-nye), which leads to an infection known as “walking pneumonia” because it is often mild enough to go undiagnosed for a long period of time
- *Staphylococcus* (stah-fih-loh-KAH-kus), which usually affects patients in hospitals
- *Chlamydia trachomatis* (klah-MIH-dee-uh trah-KOH-mah-tis), often seen in infants. Two other species of chlamydia also can cause pneumonia, usually in adults: *Chlamydia pneumoniae* (kla-MIH-dee-uh noo-MOH-nye) and *Chlamydia psittaci* (kla-MIH-dee-uh sih-TAH-see).
- Species of the bacteria *Klebsiella* (kleb-zee-EH-luh), *Pseudomonas* (soo-doh-MOH-nuz), and *Legionella pneumophila* (lee-juh-NEL-uh noo-MOH-fee-luh, the bacterium that causes Legionnaires', lee-juh-NAIRZ, disease)

Viral pneumonia Viral pneumonia, usually seen in children, makes up nearly half of all pneumonia cases. This type of pneumonia is usually not severe or long lasting. Causes of viral pneumonia include the following:

- Respiratory syncytial (RES-puh-ruh-tor-ee sin-SIH-shul) virus, or RSV, which typically causes more severe illness in infants and very young children
- Adenoviruses (ah-deh-no-VYE-ruh-sez), which affect the tissue lining the respiratory tract* and sometimes the eyes, intestines*, and bladder*
- Influenza (in-floo-EN-zuh) viruses, which cause flu. Pneumonia arising from influenza viruses is an important cause of serious illness among the elderly and people with other health problems.
- Parainfluenza (pair-uh-in-floo-EN-zuh) viruses, which also cause croup*

WILLIAM OSLER

Sir William Osler (1849–1919), often called the father of modern medicine, spent much of his life studying pulmonary diseases (diseases of the lungs) and is known for calling pneumonia the “old man’s friend.” He gave pneumonia this grim nickname because it swiftly ended the lives of many old men and women who had been suffering with other untreatable diseases. Ironically, Osler himself died of pneumonia after contracting influenza.

Fungal pneumonia Fungal pneumonia usually targets people with weakened immune systems. For instance, pneumonia caused by *Pneumocystis jirovecii* (noo-moh-SIS-tis yee-roh-VET-zee-eye) (formerly classified as *Pneumocystis carinii*), which was later identified as a fungus, is most common in patients with compromised immune systems, particularly those who have AIDS*. Other fungal infections that can involve the lungs are histoplasmosis (his-toh-plaz-MOH-sis), blastomycosis (blas-toh-mye-KOH-sis), coccidioidomycosis (kok-sih-dee-oyd-oh-mye-KOH-sis), and aspergillosis (as-per-jih-LOH-sis).

Who Is at Risk for Pneumonia?

Anyone can get pneumonia, but it tends to strike people whose natural defenses against infection are weak, especially the elderly and infants and young children. People with AIDS and organ transplant patients (who must take drugs to weaken the immune system) are also at higher risk, as are people living with diabetes*, chronic obstructive pulmonary disease (a lung disease), heart failure, tuberculosis*, sickle-cell anemia*, or another serious illness.

Pneumonia is a common infection among people who are hospitalized for something else, especially people recovering from surgery and those who are placed on breathing machines (ventilators). Hospital-acquired pneumonia is almost always bacterial and is often caused by strains* of bacteria that are resistant to many antibiotics. For this reason, and because it affects people who are already sick, hospital-acquired pneumonia is more frequently serious or fatal compared to cases of pneumonia acquired outside the hospital.

What Happens When People Have Pneumonia?

Symptoms Symptoms of pneumonia vary depending on the cause of the pneumonia and the health of the person with the infection. Symptoms of bacterial pneumonia may appear suddenly and include high fever, chills, rapid breathing, a deep cough that brings up greenish mucus which is sometimes mixed with blood, and severe chest pain that worsens with

The United States and the World

Pneumonia was a leading cause of death in the United States in the early decades of the twentieth century. In the early 2000s, antibiotics and good medical care usually cured pneumonia, even in the sick and elderly. Yet pneumonia occurred in so many people that, combined with influenza, it still ranked as the seventh most common cause of death in the United States. An estimated 2 million Americans got pneumonia each year, and about 60,000 died from it. In many developing countries, pneumonia remained a much greater problem, ranking first or second as a cause of death.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body’s pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **tuberculosis** (too-ber-kyoo-LO-sis) is a bacterial infection that primarily attacks the lungs but can spread to other parts of the body.

- * **sickle-cell anemia** also called sickle-cell disease, is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.
- * **strains** are various subtypes of organisms, such as viruses or bacteria.
- * **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.
- * **bronchoscopy** (brong-KOS-ko-pee) is a procedure used to examine the bronchi, the major air passages in the lungs, with an instrument called a bronchoscope, which is a tool for looking inside the lungs that is made up of a lighted tube with viewing lenses. A bronchoscope has channels through which samples of material can be taken from the lungs for study in the laboratory.
- * **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- * **antifungal drugs** (an-ty-FUNG-al drugs) are medications that kill fungi.
- * **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.
- * **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

breathing and coughing. Other symptoms include a bad headache, loss of appetite, tiredness, nausea, and vomiting.

People with atypical or mycoplasma pneumonia often get a persistent dry cough, sore throat, skin rash, and muscle and joint pain. Because these are not the classic symptoms of pneumonia, people may think they just have a mild case of flu.

Viral pneumonia can produce symptoms similar to those of the flu, including fever, muscle aches, breathlessness, rapid breathing, and a dry cough, which can worsen and eventually bring up a small amount of mucus.

People who are elderly or who have immune system problems often have milder symptoms in the beginning, even though their illness may be more dangerous. They might, for instance, have just a low-grade fever, tiredness, or confusion, and a sense of being ill.

Diagnosis To identify the infection, the doctor first asks questions about the patient's symptoms and then listens to a patient's chest with a stethoscope. Fluid in the lungs often produces a crackling sound when a person breathes, which can point to pneumonia. Sometimes the doctor will not be able to hear any air moving through the affected part of the lung. Chest x-rays may also be taken, and a cloudy, dense-appearing area may be seen in one or both lungs, particularly in a person who has bacterial pneumonia.

Next, the doctor may take samples of blood and sputum (SPYOO-tum, coughed-up mucus) to try to find out what is causing the pneumonia. These samples can be examined under a microscope and sent to the lab for culture* and identification of the organism causing the infection. In severe cases, a bronchoscopy* or a lung biopsy* may be performed.

Treatment If a specific type of bacteria has been identified as the cause of the pneumonia, the doctor can prescribe antibiotic drugs that target those bacteria. If the germ is not identified but bacteria are suspected, the doctor may give antibiotics that are active against the most likely bacteria, which is called empirical treatment. If the cause is a virus or fungus, antibiotics will not help. Instead, antiviral and antifungal drugs* may be prescribed, although not all viruses have treatments.

When the pneumonia is severe, people are often hospitalized, particularly if they are in danger of dehydration*, need more oxygen, or cannot breathe well enough on their own.

Two medical organizations, the Infectious Diseases Society of America and the American Thoracic Society, jointly developed guidelines for physicians on the best methods for diagnosing and treating pneumonia. The guidelines are revised every few years to reflect current medical research.

People with pneumonia get relief from symptoms and aid their recovery by:

- Taking an over-the-counter, non-aspirin pain reliever such as acetaminophen* to ease fever and muscle aches

DOCTORS AND BEST PRACTICES

Various physician organizations have developed recommendations for the diagnosis and treatment of many diseases, including pneumonia. The pneumonia guideline of the Infectious Diseases Society of America, for example, describes the specific laboratory, x-ray, and other tests that should be performed to diagnose pneumonia; lists the specific drugs that should be used to treat different types of pneumonia; and gives specific benchmarks for when it is safe for a patient recovering from severe pneumonia to leave the hospital. Guidelines such as these are developed by groups of medical experts who carefully review the latest medical research. By following this type of best-practice guideline, doctors can be confident they are giving their patients up-to-date and effective medical care.

- Resting and drinking liquids to combat dehydration
- Using a humidifier to keep air cool and moist, to ease breathing
- Staying away from cigarette smoke, which irritates the lungs

With treatment, bacterial pneumonia symptoms usually improve within a day or two and are gone in one to two weeks, but symptoms of viral pneumonia and mycoplasma pneumonia can last longer.

How Is Pneumonia Prevented?

The pneumococcal (nu-moh-KAH-kal) vaccine* works well against pneumococcal bacteria that cause pneumonia and is recommended for people over age 65 and children under two years of age, those with certain other illnesses, or those with weakened immune systems. The vaccine typically needs to be given only once in a lifetime. Yearly flu vaccines can help prevent pneumonia caused by influenza viruses. Because pneumonia often is caused by contagious respiratory infections, people can protect themselves further by avoiding being near people who are sick; by hand washing; not touching used tissues; and never sharing food, drinks, or eating utensils.

▶ See also **AIDS and HIV Infection • Bacterial Infections • Chlamydial Infections • Common Cold • Influenza • Legionnaires' Disease • Mycoplasma Infections • Streptococcal Infections • Tuberculosis • Viral Infections**

Resources

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org>.

* **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.



▲ Dr. Jonas Salk innoculates a child during polio vaccine field trials in 1954. *The Library of Congress.*

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

* **enterovirus** (en-tuh-ro-VY-rus) is a group of viruses that can infect the human gastrointestinal tract and spread through the body causing a number of symptoms.

American Lung Association. 1301 Pennsylvania Ave. NW, Suite 800, Washington, DC, 20004. Toll free: 800-LUNG-USA. Web site: <http://www.lungusa.org>.

Poison Ivy/Poison Oak/Poison Sumac *See Skin Conditions.*

Poliomyelitis

Poliomyelitis (po-lee-o-my-uh-LYE-tis), or polio, is a condition caused by the polio virus and involves damage of nerve cells. It may lead to weakness and deterioration of the muscles and sometimes paralysis. Thanks to an extremely successful vaccination program, this disease has disappeared from the United States and much of the world, although it still exists in some countries.*

What Is Poliomyelitis?

Poliovirus, part of the enterovirus* group, makes its home in the alimentary canal, which includes the mouth, esophagus, stomach, intestines, colon, and rectum, but when the viral infection spreads it can destroy nerve cells that make muscles work. These damaged nerve cells, called

ENDING POLIO: A TIMELINE

1955: Jonas Salk's vaccine containing dead, or inactive, poliovirus (IPV) is licensed, and mass numbers of school children are vaccinated, leading to an enormous decrease in the number of polio cases over the next few years and a 60–70 percent prevention rate.

1963: Albert Sabin's oral polio vaccine (OPV), containing a live but weakened virus, becomes the new recommended vaccination in the United States. It offers lifelong protection, can be swallowed, and is easy to administer. In very rare cases, however, it actually causes paralytic polio.

1979: The last cases of wild polio (polio that is not vaccine-related) are reported in the United States.

2000: IPV becomes the exclusive polio vaccine used in the United States. Experts believe that because polio has virtually disappeared in the United States, the benefits of using OPV are no longer worth the very small risk of contracting the disease from OPV.

motor neurons, cannot rebuild themselves. As a result, the body's muscles no longer function correctly.

Types of paralytic polio include spinal, bulbar (BUL-bar), and bulbospinal (bul-boh-SPY-nul). The spinal type is most common, affecting the muscles of the legs, trunk, and neck. The bulbar form involves nerves of the brain stem* and can cause problems with breathing, talking, and swallowing. Bulbospinal polio is a combination of the first two types.

How Common Is Poliomyelitis?

Polio essentially has been wiped out in the United States and many other developed countries following the introduction of a polio vaccine in 1955. Before that, polio occurred in epidemic* form, with more than 21,000 paralytic cases (mostly children) in the United States in 1952 alone. The last cases of naturally occurring polio infection (known as “wild polio”) acquired in the United States were reported in 1979. In the following two decades, only 152 cases of polio were reported, most of them vaccine-associated paralytic polio (VAPP), a rare complication of the oral (by mouth) polio vaccine (OPV). Children in the United States in the early 2000s receive a vaccine containing an inactivated form of the virus that cannot cause polio. Although wild polio has not been found in the United States for more than two decades, it is still present in parts of Africa and Asia.

Is Poliomyelitis Contagious?

Poliovirus is extremely contagious and can pass easily from person to person. The virus typically is found in feces* and can spread when people touch contaminated objects and then touch the mouth or nose, or handle food without washing their hands first. The virus can live in feces for weeks, making the spread of infection difficult to control. It can also spread through contact with tiny drops of fluid from a sick person's mouth or nose or by drinking contaminated water. After entering the mouth or nose, the virus multiplies in the throat or gastrointestinal tract and eventually can invade the bloodstream where it can move to other parts of the body. In a very small number of people, about 1 to 2 percent, the virus invades the central nervous system*, that is, the brain and spinal cord, where it can cause paralysis.

The infection is most contagious seven to 10 days before symptoms begin and for the same period after they appear. The virus spreads more readily in areas with poor sanitation.

What Are the Signs and Symptoms of Poliomyelitis?

Poliovirus infections come in four types: asymptomatic (a-simp-toh-MA-tik), abortive, nonparalytic (non-pair-uh-LIH-tik), and paralytic (pair-uh-LIH-tik). In more than 90 percent of cases, people do not know that they have caught the poliovirus because they experience no symptoms (asymptomatic) or only minor symptoms (abortive), such as sore throat, vomiting, or other symptoms resembling those of the flu. Nonparalytic



▲ Dr. Albert Bruce Sabin developed the oral polio vaccine. *The Library of Congress.*

Polio in History

Polio has caused paralysis and death for most of human history. Reference to paralytic poliomyelitis can be found in Egyptian stone engravings more than 3,000 years old. At the start of the 20th century, however, few people had ever heard of the disease until epidemics of polio began to occur with regularity in developed countries. In the summer of 1916, polio became a more familiar condition in the United States when a devastating epidemic struck New York. The outbreak left 27,000 people paralyzed and 9,000 dead. Almost 40 years later, on April 12, 1955, the announcement came that Dr. Jonas Salk had developed the first effective vaccine against paralytic poliomyelitis. With the development of this and other later vaccines, polio was eradicated throughout most of the industrialized world.

- * **brain stem** is the part of the brain that connects to the spinal cord. The brain stem controls the basic functions of life, such as breathing and blood pressure.
- * **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.
- * **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.
- * **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.
- * **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.
- * **ventilator** (VEN-tuh-lay-ter) is a machine used to support or control a person's breathing.

polio has more severe symptoms, including stiff neck due to meningitis and muscle stiffness in the back and legs. Paralytic polio, the rarest but most severe form of the disease, attacks the central nervous system (the part of the nervous system that includes the brain and spinal cord) and can cause muscle weakness, spasms, and paralysis. About one-third of patients who develop paralysis recover much of the use of their muscles weeks to months after infection. The remainder have long-lasting effects from the disease.

How Is Poliomyelitis Diagnosed?

A doctor may suspect polio in an ill patient with paralysis, particularly if the person has not been immunized against polio. The doctor may follow up with questions about recent travel, because while the polio vaccine has wiped out the disease in the United States, polio still occurs in some other countries. During a physical examination, a doctor looks at the extent of the muscle paralysis and may take samples of blood, bowel movements, fluid from the throat, or cerebrospinal fluid*, and have them tested for the virus.

What Is the Treatment for Poliomyelitis?

No cure for polio exists. Doctors instead focus on easing a patient's symptoms, which includes controlling pain and muscle spasms and matching supportive care to the patient's muscle weakness. For abortive cases and many nonparalytic cases of polio, a doctor typically recommends rest, fluids, and pain medication, as well as moist heat on muscles to ease stiffness. The doctor may also prescribe antibiotics to treat urinary tract and other bacterial infections that can occur in patients with polio.

Patients with severe cases of polio, particularly the paralytic form, often require hospitalization. In the 1940s and 1950s, medical professionals placed patients inside metal tanks called iron lungs, which assisted their breathing. Although medical technology has progressed since then, many people who have polio still need machines called ventilators* to help them breathe as they recover, as well as additional supportive care. Patients with paralytic polio may need physical therapy, crutches, leg braces, or surgery to help them regain their strength and movement.

What Should People with Poliomyelitis Expect?

If the disease does not damage the spinal cord and brain, patients typically make a full recovery. Symptoms in cases of abortive polio generally last less than a week. In nonparalytic cases, symptoms can continue for one to two weeks. If the polio infection causes paralysis, several months may pass before the muscles begin to regain their strength and mobility. Permanent paralysis, described as paralysis that lingers after 12 months, usually occurs in the legs, but sometimes affects other muscles, too. People who become paralyzed by the poliovirus receive physical therapy to keep their muscles from deteriorating, and they may need leg braces to walk or

FDR AND POLIO

Franklin Delano Roosevelt (FDR, 1882–1945) contracted polio at the age of 39 while vacationing on Campobello Island in New Brunswick, Canada. After a day of swimming and playing with his children, he went to bed tired and aching and awoke unable to move his legs. Two weeks later, doctors identified his illness as polio. Roosevelt never walked unassisted again.

When he contracted polio in 1921, Roosevelt had already begun a life in politics, and he did not let the disease stop him. In 1932 he ran for president of the United States and won. Although FDR did not try to hide his bout with polio, he went to great pains to disguise the extent of his disability. The public never saw him in his wheelchair. In 1938 FDR established the March of Dimes, which funded the research and immunization effort that eliminated polio from the Americas.

In 1998 a sculpture of Roosevelt in his wheelchair was added to the FDR memorial in Washington. Depicting him this way was controversial. Some people felt that he would not have liked being shown in his wheelchair in the sculpture. Others argued that he would be glad to have his image encourage people with disabilities to accomplish great work.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **kidney stones** are hard structures that form in the urinary tract. These structures are composed of crystallized chemicals that have separated from the urine. They can obstruct the flow of urine and cause tissue damage and pain as the body attempts to pass the stones through the urinary tract and out of the body.

a wheelchair to get around. Others may require help breathing for the rest of their lives. Additional complications include the following:

- Pneumonia* due to swallowing difficulties
- Fluid in the lungs
- Kidney stones*
- High blood pressure
- Post-polio syndrome, which affects 25–50 percent of people previously infected and develops many years, sometimes decades, after the initial infection. It causes symptoms of muscle pain, new or increased weakness, and paralysis.

Although a diagnosis of paralytic polio is a frightening one, most survivors go on to lead fulfilling lives. The violinist Itzhak Perlman, who caught the virus at four years of age and wears leg braces, is one example. Franklin D. Roosevelt, who got polio at the age of 39, went on to become president of the United States.

How Can Poliomyelitis Be Prevented?

The polio vaccine is the best way to prevent the disease, and its use has eliminated polio from the United States and much of the world. Its success is similar to that of another virus-caused illness: smallpox. Whereas polio still exists in some countries, smallpox has disappeared completely due to a worldwide smallpox-vaccination effort that in about 10 years

* **mucous membranes** are the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.

eradicated the smallpox virus worldwide by 1980. A similar program for polio vaccination was underway in the early 2000s, but the disease persisted in such places as Afghanistan, India, Pakistan, and numerous countries in Africa. In many of these countries, poor sanitation and crowded conditions contribute to the spread of the disease just as health officials are trying to get everyone immunized.

In the early 21st century, IPV is the only polio vaccine used in the United States, and it does not cause VAPP. Children might have a sore spot where they receive the shot, but side effects from the vaccine are very rare. Children receive IPV routinely as part of the childhood immunization schedule. Most adults who were vaccinated as children do not need to receive the vaccine again. People traveling to places where polio is still found (such as Africa and Asia), lab workers who handle poliovirus, and medical professionals who care for patients with polio may need a repeat vaccination. If polio is wiped out worldwide, then immunization against polio will no longer be needed.

▶ See also **Meningitis • Vaccination • Viral Infections**

Resources

Books and Articles

Kehret, Peg. *Small Steps: The Year I Got Polio*, anniversary ed. Morton Grove, IL: Albert Whitman, 2006.

Tocci, Salvatore. *Jonas Salk: Creator of the Polio Vaccine*. Enslow, 2003.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

World Health Organization. Avenue Appia 20, 1211 Geneva 27, Switzerland, Web site: <http://www.who.int/en>.

Polyps

Polyps (POL-ips) are growths of tissue that project from the mucous membranes. These growths normally are benign (be-NINE), which means they are not a threat to someone's health, but in some cases they can develop into cancerous tumors. Medical professionals do not completely understand the cause of polyps.*

What Are Polyps?

Three of the most common types are colorectal, cervical, and nasal polyps.

Colorectal polyps Colorectal polyps grow in the colon* or rectum*, which are both parts of the large intestine. The early discovery of polyps is important because between 75 and 90 percent of colorectal cancers develop from polyps. People who have colorectal polyps may notice unusual cramping, stomach pain, or bleeding when they have a bowel movement, or they may not experience any symptoms at all. Doctors usually check for polyps in people who have these symptoms. Doctors may also check for polyps in people whose relatives have been diagnosed with colorectal polyps, because polyps sometimes run in families. Most colorectal polyps develop in people who are more than 50 years old.

Polyps may start off benign, but over a period of years, they can transform into invasive cancer. Medical professionals can find and remove polyps before they become cancerous and thus prevent most colorectal cancer. For this reason, medical professionals recommend that people of a certain age or with a certain family history of colorectal cancer be screened for polyps. The most common procedure for diagnosing colorectal polyps is colonoscopy (ko-lon-OS-ko-pee), an examination of the rectum and the entire colon. The doctor inserts a flexible lighted instrument into the colon that transmits images of the inside of the colon to a monitor. If this procedure reveals any polyps, a doctor orders their removal to prevent the development of cancer. In the past, doctors sometimes ordered another procedure, called sigmoidoscopy (sig-moyd-OS-ko-pee), instead of colonoscopy. The sigmoidoscope, however, only examines the rectum and lower colon and does not reach the upper part of the colon where many cancerous polyps may occur.

Medical professionals generally recommend that individuals have their first colonoscopy at least by the age of 50 and then that they continue to have screenings every few years. The age of the first screening colonoscopy—and the frequency of subsequent ones—depends on the number of risk factors each person has. Risk factors include a diagnosis of irritable bowel syndrome or a family history of colorectal cancer. The higher the risk, the earlier screening colonoscopies should begin, and the more frequently they should be repeated.

Cervical polyps Cervical polyps develop in the cervix, which is the lower part of the uterus*. The discovery of cervical polyps are important because, while most are benign, some may be cancerous and a sign of cervical cancer.

The most common symptom of cervical polyps is abnormal bleeding from the vagina*. Cervical polyps are relatively common and are usually found during a woman's annual pelvic examination, when the doctor checks the uterus, cervix, and vagina for any abnormalities. Most cervical

* **colon** (KO-lin), also called the large intestine, is a muscular tube through which food passes as it is digested, just before it moves into the rectum and out of the body through the anus.

* **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.

* **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.

* **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.



King George III of England (1738–1820), who reigned from 1760 to 1820, is thought to have had porphyria (from a painting by Benjamin West). *National Archives & Records Administration.*

- * **benign** (be-NINE) refers to a condition that is not cancerous or serious and will probably improve, go away, or not get worse.
- * **asthma** (AZ-mah) is a condition in which the airways of the lungs repeatedly become narrowed and inflamed, causing breathing difficulty.
- * **ataxia** disorder involving an unsteady gait.
- * **cystic fibrosis** (SIS-tik fy-BRO-sis) is a disease that causes the body to produce thick mucus that clogs passages in many of the body's organs, including the lungs.
- * **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

polyps are benign*, and medical professionals can remove them easily. Only rarely do cervical polyps develop into cancer.

Nasal polyps Nasal polyps develop in the sinuses, the cavities in the skull that are located near the top of the nose and under the eyes. People who develop nasal polyps usually have a history of allergies, hay fever, sinus infections, asthma* ataxia* (motor dysfunction), or cystic fibrosis*. Nasal polyps can cause problems with breathing, so medical professionals will either remove them or treat them with medications that the person inhales. Nasal polyps rarely become cancerous.

▶ See also **Allergies • Cervical Cancer • Colorectal Cancer • Cystic Fibrosis**

Resources

Organizations

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-ACS-2345. Web site: <http://www.cancer.org>.

American Social Health Association's National HPV and Cervical Cancer Prevention Resource Center. P.O. Box 13827, Research Triangle Park, NC, 27709. Telephone: 919-361-8400. Web site: http://www.ashastd.org/hpv/hpv_learn_dysplasia.cfm.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: <http://www.cdc.gov>.

Porphyria

Porphyria (por-FEER-ee-a) refers to a group of acquired or inherited disorders that result when problems occur in the pathway the body uses to convert chemicals called porphyrins into heme, a compound primarily found in red blood cells. Common symptoms of porphyria are sensitivity to light, skin rashes, abdominal (ab-DOM-i-nal) pain, discoloration of the urine, and changes in mental status or personality.

What Is Porphyria?

When individuals inherit a defective gene* from one or both parents, they may develop a form of porphyria. Sometimes, however, individuals who do not inherit the disorder may still develop it. The term “porphyria” derives from the Greek word “porphura,” which means “purple pigment.”

In many patients experiencing an acute attack of this disorder, body fluids, such as the urine, turn purple in color.

Porphyria is divided into eight different types. All eight types are a result of a problem in the chemical process by which the body produces heme, a compound that carries oxygen and makes blood red. The production of heme requires eight different enzymes*. If any one of these enzymes fails, compounds that should be turned into heme build up in the body instead, especially in the liver* and in the bone marrow*, and cause problems. Some of these compounds are called porphyrins (POR-fi-rinz), from which the disease takes its name. It is the failure of various enzymes that cause the different forms of porphyria.

Some of the eight types of porphyria are rare. While exact numbers are not available, an estimated one person in 10,000 to 50,000 may be affected with some form of porphyria.

Acute intermittent porphyria This form of porphyria only occurs when it is triggered by certain drugs, starvation or crash dieting, infection, and some hormones* in women. This form of porphyria is more common in women than in men. It usually occurs first during the early adult years. Symptoms include stomach pain, leg cramps, and muscle weakness. As its name indicates, it tends to occur from intermittently (periodically). In its most acute* forms, it can cause seizures*, paralysis*, depression*, and even hallucinations* or coma*.

Porphyria cutanea tarda Porphyria cutanea tarda (ku-TAY-ne-a TAR-da) (PCT) is the most common form of porphyria and causes blisters on the parts of the body that are exposed to sunlight. Some people with this form also develop liver disease, and up to 50 percent of patients with PCT also have hepatitis* C. Substances that can cause an attack of PCT include alcohol, heavy intake of iron (iron overload), or the use of birth control pills. Porphyria cutanea tarda usually does not affect younger women. However, the increased use of substances that can trigger an attack, such as alcohol or birth control pills, has resulted in increased numbers of younger women developing the disease. This type of porphyria is not inherited. Only about 20 percent of cases have a family history of the disease.

Protoporphyrin Protoporphyrin (pro-to-por-FEER-ee-a) usually starts in childhood. The skin is extremely sensitive to sunlight, and painful rashes, redness, and itching may develop.

How Is Porphyria Diagnosed and Treated?

Diagnosis Medical professionals diagnose porphyria when they find an excess of porphyrins (compounds involved in making heme) in the urine. More laboratory tests help pinpoint specific forms of porphyria. Individuals who have received a diagnosis of porphyria should consult their doctor about all medicines, other drugs, or hormones they are taking or thinking about taking, as some are dangerous to individuals with this disorder.

* **enzymes** (EN-zimes) are proteins that help speed up a chemical reaction in a cell or organism.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **bone marrow** is the soft tissue inside bones where blood cells are made.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **hallucinations** (ha-LOO-sin-AY-shuns) occur when a person sees or hears things that are not really there. Hallucinations can result from nervous system abnormalities, mental disorders, or the use of certain drugs.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **hepatitis** (heh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.

Treatment Treatments vary depending on the patient's specific needs:

- To treat acute intermittent porphyria, a patient receives heme in a drug called hematin.
- Drug treatment for some other forms of porphyria is also available.
- Doctors may recommend a type of sugar called glucose to help treat acute attacks.
- For porphyria cutanea tarda, in which the patient's body has an excess of iron, patients often benefit from systematic draining of the blood, in which medical professionals remove a pint of blood from the patient's body once or twice a week for several weeks, until iron levels drop to normal.
- In those patients with both PCT and hepatitis C, doctors treat both illnesses, because the treatment of hepatitis C is essential to the control of PCT.
- Avoiding light and other substances that can trigger an attack is important for people who are susceptible to any form of porphyria. Most sunscreens are not helpful for preventing skin eruptions.
- Sometimes a patient may take beta-carotene (bay-ta-KAR-o-teen) to help with light sensitivity. Beta-carotene, a compound found in certain foods such as dark-green and deep-yellow fruits and vegetables, is one of the building blocks of vitamin A.
- To prevent attacks, doctors also recommend that patients avoid those substances that trigger symptoms.

Resources

Organizations

American Porphyria Foundation. 4900 Woodway, Suite 780, Houston, TX, 77056-1837. Toll free: 866-273-3635. Web site: <http://www.porphyrifoundation.com>.

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD, 20892-3570. Toll free: 800-891-5389. Web site: <http://digestive.niddk.nih.gov/ddiseases/pubs/porphyria/index.htm>.

Post-Traumatic Stress Disorder

Post-traumatic stress disorder, or PTSD, is a condition in which a person has long-lasting psychological symptoms after experiencing an extremely stressful event. In PTSD, people who have survived a terrifying event relive their terror in nightmares, memories, and feelings of fear. It can

be severe enough to interfere with everyday living and can occur after a natural disaster, military combat, rape, mugging, or other violent event. More than one-third of PTSD victims never fully recover.

Sara's Story

Sara felt herself trying to scream, but no sound came from her throat. Hands seemed to be gripping her. A face appeared, and Sara reached up and swung her arms wildly. She tried to fight off her attacker, but she felt defenseless. Suddenly Sara heard her mother's voice trying to wake her, to pull her out of the nightmare. She cried as her mother hugged her tightly in the dark. Sara had experienced the same nightmare many times over the past several weeks. The details sometimes changed, but the dream always ended the same way: with someone trying to hurt her. In reality, Sara had been attacked the previous month on her way home from school. Now she was showing signs of PTSD.

What Is Post-Traumatic Stress Disorder?

PTSD is a condition that occurs among people who have lived through or seen a traumatic, or very stressful, event, such as war, natural disasters, serious accidents, child abuse, rape, or other threatening acts of violence. Psychological trauma refers to an emotional shock that leads to lasting psychological damage. The traumatic event may be any event that involves the threat of serious injury or death and to which the person responds with fear and helplessness. For some individuals with PTSD, the traumatic event involves a direct attack on them. For others, simply being a witness to a violent incident, such as a murder, can lead to PTSD. The condition is a problem particularly for people who engage in military combat or whose countries are the site of such combat. People with this disorder often relive the terrifying events through nightmares and disturbing memories. They may have trouble sleeping and may feel emotionally numb or cut off from other people. The symptoms can be severe enough and last long enough to interfere with everyday activities. PTSD is considered acute if the symptoms last less than three months after the traumatic event and chronic if the symptoms last more than three months. Delayed onset PTSD occurs when the symptoms do not begin until six or more months after the traumatic experience.

Who Is Affected by Post-Traumatic Stress Disorder?

It is estimated that about 10 percent of women and 5 percent of men in the United States have PTSD at some point in their lives, but this is a small fraction of all those who have experienced a highly stressful event. In women, the events most often linked to PTSD are rape, sexual abuse, physical attack, being threatened with a weapon, and childhood abuse. In men, the most common events are rape, combat, and childhood neglect and abuse.

Shell-shocked Veterans

About 30 percent of men and women who have spent time in combat zones experience what is called Post-traumatic stress disorder. In years past, a number of names were given to the emotional problems some soldiers had after returning from war, including the following:

Civil War: soldier's heart

World War I: shell shock

World War II: combat fatigue

- * **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **cortisol** (KOR-ti-sol) is a hormone that helps control blood pressure and metabolism, the process of converting food into energy and waste products. It plays a part in the stress response.
- * **epinephrine** (eh-pih-NEH-frin) is a chemical substance produced by the body that can also be given as a medication to constrict, or narrow, small blood vessels, stimulate the heart, and cause other effects, such as helping to open narrowed airways in conditions like asthma and croup.
- * **norepinephrine** (NOR-e-pi-ne-frin) is a body chemical that can increase the arousal response, heart rate, and blood pressure.
- * **opiates** (O-pea-atz) are painkilling chemicals that can cause sleepiness and loss of sensation.

Children and teenagers can show signs of PTSD. Researchers have found that the disorder is extremely common in young people who experience such violence as seeing a parent murdered or raped, witnessing a school shooting, or being the victim of sexual abuse. It is also common in young people who are exposed to a lot of violence in their community. While it is unclear why PTSD develops in some people but not in others, at least one factor, a high degree of family support, lowers the risk of PTSD in young people.

Victims of PTSD are at higher risk for alcohol or other substance abuse and suicide attempts. PTSD increases risk for other disorders such as clinical depression, panic disorders, and social phobias. Victims of PTSD are also more likely to engage in impulsive behaviors. Females have a higher risk for developing PTSD than males. Females are also more likely to develop PTSD as a result of a violent crime such as rape. Individuals with a prior history of trauma, preexisting anxiety disorders, or preexisting depression are at an increased risk for developing PTSD.

What Causes Post-Traumatic Stress Disorder?

Traumatic events occur frequently. The National Center for Post-Traumatic Stress Disorder estimates that just over 60 percent of men and 50 percent of women experience at least one traumatic incident at some point. Not all develop PTSD, but studies show that up to 14 percent of them do. The cause of PTSD can be any event that threatened serious physical harm. Such events include violent personal attacks, such as rape, sexual molestation, or mugging; natural disasters, such as hurricanes, tornadoes, or earthquakes; accidents, such as fires or car crashes; terrorist attacks, such as the the 2001 World Trade Center bombing in New York City and at the Pentagon in Washington, D.C.; wartime suffering; or military combat. The common element in these events is that people lived through a period when they faced great harm and felt fearful and defenseless. Their situations were life-threatening and overwhelming.

In the early 2000s, doctors did not understand why some people respond to such experiences by developing PTSD, while others do not. However, researchers have reported finding physical changes in some people who have survived traumatic events. Researchers investigated factors that may set apart people who experience PTSD after a very stressful event from those who do not. They have found that people with PTSD tend to have abnormal levels of key hormones* involved in the body's response to stress. In particular, levels of cortisol* are lower than normal, while levels of epinephrine* and norepinephrine* are higher. In addition, when people are in danger, they produce high levels of natural opiates*, body chemicals that temporarily block pain. Scientists have found that people with PTSD keep making higher levels of these substances even after the danger has passed, which may account in part for the emotional numbness often experienced in the disorder.

What Are the Symptoms of Post-Traumatic Stress Disorder?

The symptoms of PTSD may be mild or severe. One person may become slightly cranky, for instance, while another may have violent outbursts. In general, the symptoms seem to be worse if another person caused the event that triggered PTSD. People may have more trouble with their feelings after a rape, for example, than after a flood. Common symptoms of PTSD include:

- Reliving the event in nightmares or disturbing memories
- Being very distressed by reminders of the event
- Avoiding places or situations that bring back the unwanted memories
- Trying to avoid thinking or talking about the event
- Being unable to recall an important part of the event
- Losing interest in activities that were once enjoyed
- Feeling distant from other people or emotionally numb
- Having sleep problems
- Being irritable or angry
- Having trouble concentrating
- Being easily startled

Most people who have been through a very frightening event will have a noticeable reaction in the days and weeks just afterward. The diagnosis of PTSD is considered only if the symptoms last more than a month. The course of the disorder varies. Some people with PTSD recover within months, whereas others have symptoms that last much longer. Occasionally, the onset of symptoms may not show up until years after the stressful event.

In severe PTSD, people can become overwhelmed by the feeling that nothing really matters. Because they almost lost their lives in an unexpected event, they may fear they are still at risk. This fear causes them to withdraw and become depressed. Depression, in turn, makes it hard for them to concentrate, learn, or perform a job. Students may experience falling grades. People with PTSD may also have difficulty sleeping, because they are trying to avoid nightmares. They may be overly protective of themselves and loved ones and avoid situations in which most people would say there is no danger. They may be easy to anger, or they may experience chest pains, rapid breathing, or dizziness for no apparent reason.

What Are Flashbacks?

Among the most disturbing symptoms of PTSD are flashbacks, vivid waking memories in which people relive a terrifying event. Ordinary objects and activities serve as reminders of the event and act as the triggers. Triggers may be prompted by sights, smells, or sounds, such as when a combat veteran has a flashback of his experience after hearing the crack

School Violence and PTSD

If violence occurs in a school, psychologists and social workers provide counseling for students who witness or experience it. Such students are at risk for PTSD. Common symptoms in children include the following:

- Having flashbacks and disturbing memories
- Having recurring nightmares and dreams of death
- Believing in omens and predictions of future disasters
- Expecting an early death
- Avoiding any reminders of traumatic experiences
- Fearing another trauma
- Repeatedly engaged in play that reenacts the trauma
- Feeling emotional numbness or anger
- Being disinterested in activities
- Having frequent stomachaches or headaches
- Being nervous much of the time

of fireworks that sound like gunfire. During flashbacks, people may lose touch with reality and reenact the event for minutes or hours. While having a flashback, people may actually believe they see, hear, or smell aspects of the original experience. For the duration of the flashback, they may believe that the awful event is happening all over again. Because of the overwhelming nature of flashbacks, people with PTSD may consciously avoid known triggers.

How Are Children Affected?

Young children with PTSD may experience less specific fears, such as being afraid of strangers. They may also avoid situations and become preoccupied with words or objects that may or may not be linked to the stressful event. They may have sleep problems, and they may lose previously learned skills, such as toilet training. In addition, they may act out parts of the distressing event in their play.

Older children may also reenact part of the event in play or drawings. They may remember details that happened during the event in the wrong order. In addition, they may believe that there were warning signs that predicted the event. As a result, they may think that they can avoid future problems by always staying alert for such signs. Teenagers show symptoms similar to those of adults, but they are more likely to become aggressive or to make poorly thought-out decisions they later regret.

How Is Post-Traumatic Stress Disorder Treated?

Some studies show that counseling people soon after a disaster may prevent or relieve the symptoms of PTSD. For example, a study of 12,000 children who lived through a hurricane in Hawaii found that those who got counseling early were doing much better two years later than those who did not get counseling.

Cognitive behavioral therapy Cognitive behavioral (COG-ni-tiv bee-HAV-yor-al) therapy helps people change specific, unwanted types of behavior and faulty thinking patterns. In one form of the therapy, people describe and mentally relive a stressful event under safe, controlled conditions. This lets them face and gain control of the fear that was overwhelming during the actual event. In most approaches, gradual exposure to the traumatic event is paired with relaxation in a supportive environment. With systematic desensitization, people start out with less upsetting events and work up to the most disturbing event, or they confront the stressful event one piece at a time.

Group therapy In group therapy, several people with similar problems meet as a group with a therapist. This setting is often ideal for people with PTSD, because it lets them get support and help from others who understand what they are going through. Group therapy may help people feel more confident and able to trust again. In addition, as people share their stories and tips for coping with the fear, rage, grief, and shame

caused by their experiences, they may start to shift their focus from the past to the present.

Play therapy Play therapy may help young children who are not able to talk about their feelings directly. The therapist uses play, games, and art to help children remember and describe the stressful event safely and express their feelings about it.

Medications Medications may help reduce certain symptoms, such as sleep aids for those with PTSD who have trouble sleeping and anti-anxiety drugs for those who are easily startled. Antidepressants may improve conditions that often occur with PTSD, such as depression and panic disorder, in which repeated attacks of overwhelming fear strike often and without warning. Anticonvulsants* have also been used to control impulsive behavior and sudden emotional changes.

Resources

Books and Articles

Beckner, Victoria Lemle, and John B. Arden. *Conquering Post-Traumatic Stress Disorder: The Newest Techniques for Overcoming Symptoms, Regaining Hope, and Getting Your Life Back*. Beverly, MA: Fair Winds Press, 2008.

Schiraldi, Glenn R. *The Post-Traumatic Stress Disorder Sourcebook*, 2nd ed. New York: McGraw-Hill, 2009.

Slone, Laurie B., and Matthew J. Friedman. *After the War Zone: A Practical Guide for Returning Troops and Their Families*. Cambridge, MA: Da Capo Lifelong, 2008.

Thomas, Peggy. *Post Traumatic Stress Disorder*. Farmington Hills, MI: Lucent Books, 2008.

Organizations

Anxiety Disorders Association of America. 8730 Georgia Avenue, Silver Spring, MD, 20910. Telephone: 240-485-1000. Web site: <http://www.adaa.org>.

Anxiety Disorders Education Program, National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 888-8ANXIETY. Web site: <http://www.nimh.nih.gov/anxiety>.

Center for the Prevention of School Violence. 313 Chapanoke Road, Suite 140, Raleigh, NC, 27603. Toll free: 800-299-6054. Web site: <http://www.ncsu.edu/cpsv>.

Help for Post-Traumatic Stress Disorder

Counselors for treating PTSD include the following:

- **Crisis counselor:** a professional who provides emotional support, practical help, and information to individuals or groups who recently have survived large-scale violence or disasters.
- **Clinical psychologist:** a mental health professional who has earned a non-medical doctoral degree. Clinical psychologists can do psychological testing and provide mental health counseling.
- **Psychiatrist:** a medical doctor who has completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can prescribe medications, diagnose mental illnesses, and provide mental health counseling.
- **Victim's advocate:** a professional who provides emotional support, practical help, and information to victims of a crime such as sexual assault.

* **anticonvulsants** (an-tie-kon-VUL-sents) are medications that affect the electrical activity in the brain and are given to prevent or stop seizures.



▲
Actress and model Brooke Shields during a news conference in Washington, DC, May 11, 2007. Shields, who suffered from postpartum depression, was on Capitol Hill to support legislation for federal investment in postpartum depression education, detection and treatment. *AP Images.*

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **estrogen** (ES-tro-jen) a steroid hormone that stimulates the development of female sexual characteristics and maintenance of the female reproductive system.

* **progesterone** (pro-JES-teh-ron) is a female steroid sex hormone that prepares for and supports pregnancy.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.

Emergency Services and Disaster Relief Branch, Center for Mental Health Services, Substance Abuse and Mental Health Services Administration. 5600 Fishers Lane, Room 17C-20, Rockville, MD, 20857. Telephone: 301-443-4735. Web site: <http://www.mentalhealth.org/cmhs/emergencyservices>.

National Center for PTSD. 215 North Main Street, White River Junction, VT, 05009. Toll free: 802-296-5132. Web site: <http://www.ncptsd.org>.

Postpartum Depression

Postpartum depression (PPD) is a serious depression occurring within the first year after giving birth and lasting more than a few weeks.*

What Is Postpartum Depression?

Many new mothers experience the “baby blues,” also called maternal or postpartum blues. This is hardly surprising considering that the female hormones* estrogen* and progesterone*, which are maintained at very high levels during pregnancy, drop precipitously during the first 24 hours after giving birth. Giving birth is also a life-changing experience for all mothers, and having a new baby is both stressful and exhausting. However, women who suffer from postpartum depression have feelings of anxiety*, sadness, or emptiness that interfere with their daily routines and possibly with their ability to care for the baby. Women who are predisposed to stress and depression may have a particularly hard time coping with a fussy baby and the fatigue that accompanies caring for a newborn.

Characteristics associated with PPD may include the following:

- Feeling insecure or inadequate as a mother
- Loss of one's sense of personal identity
- Feeling overwhelmed by responsibilities
- Feeling abandoned by a partner, family, and/or friends
- Being overcome by worry regarding the baby's safety and health
- Having problems with breastfeeding

How Common Is Postpartum Depression?

An estimated 10 to 15 percent of new mothers experience PPD. However, some experts believe that it is under-diagnosed and that PPD is the most common problem confronting new mothers. Clinical depression occurs in about 15 to 25 percent of the population and is more common in

WHO IS AT RISK FOR PPD?

Factors that can increase a woman's susceptibility* to PPD include the following:

- Previous depression or another mental illness such as bipolar disorder*
- A family history of depression or other mental illness
- An unplanned or unwanted pregnancy
- Being a young mother
- Depression during pregnancy
- Complications during pregnancy
- Vulnerability to stress
- Lack of emotional support from partner, family, or friends
- Stressful situations, including marital or financial difficulties, job loss, poverty, abuse, illness, or death of a loved one
- Substance abuse*

women than in men. Furthermore, women are most likely to experience depression during their primary reproductive years, ages 25 to 45, so it is not surprising that they may be prone to PPD. Women who have experienced PPD previously have a 50 percent risk of recurrence following subsequent pregnancies.

What Causes Postpartum Depression?

Although the precise cause of PPD is unknown, physical, emotional, and lifestyle factors can all contribute. Women suffering from PPD are thought to have an increased genetic* susceptibility to depression resulting from hormonal changes, including those that occur during their monthly menstrual cycle*.

However, an abrupt drop in female hormones is only one of the physiological changes that accompanies giving birth. During pregnancy the endocrine* system's stress response is damped down. In most cases the stress response returns to its normal pre-pregnancy level following delivery. In women with PPD, however, the endocrine system can overreact to stress, producing too much of the stress hormone cortisol*. A woman's inability to filter out irrelevant or stressful stimuli* also has been associated with PPD.

The levels of thyroid gland* hormones may drop sharply after giving birth, leading to low energy, fatigue, and depression. Postpartum levels of neurotransmitters* that support feelings of well-being, such as serotonin*, can also be low. Postpartum changes in blood volume, blood pressure,

* **susceptibility** (su-sep-ti-BIL-i-tee) means having less resistance to and higher risk for infection or disease.

* **bipolar disorder** a group of mood disorders that are characterized by alternating episodes of depression and mania.

* **substance abuse** is the misuse of alcohol, tobacco, illegal drugs, prescription drugs, and other substances such as paint thinners or aerosol gases that change how the mind and body work.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.

* **endocrine** (EN-do-krin) refers to a group of glands, such as the thyroid, adrenal, and pituitary glands, and the hormones they produce. The endocrine glands secrete their hormones into the bloodstream, and the hormones travel to the various organs in the body that they affect. Certain hormones have effects on mood and sometimes are involved in symptoms such as irritability, emotional swings, fatigue, insomnia, depression, suspiciousness, and apathy.

* **cortisol** (KOR-ti-sol) is a hormone that helps control blood pressure and metabolism, the process of converting food into energy and waste products. It plays a part in the stress response.

* **stimuli** (STIM-yoo-lie) are things in the environment that excite a person to function, become active, or respond. The singular form is stimulus.

* **thyroid gland** (THY-roid GLAND) is located in the lower part of the front of the neck. The thyroid produces hormones that regulate the body's metabolism (me-TAB-o-LIZ-um), the processes the body uses to produce energy, to grow, and to maintain body tissues.

* **neurotransmitters** (nur-o-trans-MIH-terz) are chemical substances that transmit nerve impulses, or messages, throughout the brain and nervous system and are involved in the control of thought, movement, and other body functions.

* **serotonin** (ser-o-TO-nin) is a neurotransmitter, a substance that helps transmit information from one nerve cell to another.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **hyperactivity** (hy-per-ak-TI-vi-tee) is overly active behavior, which makes it hard for a person to sit still.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **paranoia** (pair-a-NOY-a) refers to either an unreasonable fear of harm by others (delusions of persecution) or an unrealistic sense of self-importance (delusions of grandeur).

and the immune system* can further contribute to fatigue and mood swings.

Other factors that can contribute to PPD include the following:

- Disrupted work and home routines
- Sleep loss
- Insecurities about being a good mother
- Unrealistic expectations of being a perfect mother
- Feeling unattractive
- Lack of free time
- A demanding baby or older children

How Do Women Know They Have Postpartum Depression?

Symptoms of PPD can vary greatly, but they include all symptoms of clinical depression lasting more than two weeks:

- Restlessness, hyperactivity*, and anxiety
- Lack of energy or motivation
- Severe mood swings
- Overreaction to minor problems
- Intense irritability or anger
- Feelings of being overwhelmed or hopeless
- Feelings of worthlessness, shame, or guilt
- Overwhelming sadness and excessive crying
- Loss of interest or pleasure in enjoyable activities
- Withdrawal from family and friends
- Loss of interest in sex
- Problems with concentration, decision-making, or memory
- Severe fatigue or exhaustion
- Insomnia or sleeping too much
- Over- or under-eating, excessive weight gain or loss
- Chronic* headaches, aches or pains, or stomach problems

Women with PPD may be overprotective of their babies or behave in a hyper-vigilant manner. They may also have difficulty bonding with their babies.

Symptoms of severe PPD include the following:

- Not eating
- Frantic behavior
- Paranoia*
- Disinterest in the baby
- Thoughts or fears of harming one's self or the baby

How Do Doctors Diagnose and Treat Postpartum Depression?

Diagnosis Many women with PPD attempt to hide it, seeing their depression as a personal weakness rather than an illness. They may feel embarrassed, ashamed, or guilty about their feelings. Physicians sometimes administer a questionnaire to distinguish between PPD and the postpartum blues. A 2008 study found that just three questions were enough to identify women with PPD. These questions detected the following:

- Blaming oneself when things go wrong
- Feeling anxious or worried without good cause
- Feeling scared or panicky without justification

A simple blood test can determine whether thyroid hormone levels are low.

Treatment PPD usually can be treated effectively with antidepressant medications*. There are antidepressants available that are unlikely to cause side effects* in breastfeeding infants. Medication is often combined with other treatments, especially supportive talk therapy with a psychologist*, psychiatrist*, therapist, or social worker. Talk therapy can help women work through problems and learn to change the ways that depression causes them to think, feel, and act. Sometimes psychotherapy* alone is used to treat PPD. Support groups or marriage or family counseling can also help. Exercise and good nutrition can improve mood and aid in recovery. Caffeine should be avoided since it can trigger anxiety and mood swings.

Hormone replacement therapy is sometimes used to treat PPD. Estrogen replacement therapy can restore estrogen levels and may ease PPD symptoms. Thyroid medicine is effective against depression stemming from low levels of thyroid hormones.

Alternative therapies that may help relieve PPD include the following:

- Omega-3 fatty acids in seafood or as a nutritional supplement
- Massage therapy
- Acupuncture for relaxation
- Creative outlets such as art, music, or drama

Complications With treatment PPD usually eases within a few months. Halting treatment early can lead to relapse. Even with treatment women with PPD are more likely to have subsequent major depressive episodes.

Women with untreated PPD may have difficulty caring for their babies and accomplishing other tasks. This situation, in turn, can intensify feelings of low self-esteem*, guilt, and depression. Untreated PPD may last for a year or longer and progress into a chronic depressive disorder.

* **antidepressant medications** are used for the treatment and prevention of depression.

* **side effects** are unwanted symptoms that may be caused by vaccines or medications.

* **psychologist** (sy-KOL-uh-jist) is a mental health professional who can do psychological testing and provide mental health counseling.

* **psychiatrist** (sy-KY-uh-trist) is a medical doctor who has completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can diagnose mental illnesses, provide mental health counseling, and prescribe medications.

* **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.

* **self-esteem** is the value that people put on the mental image that they have of themselves.

IS IT THE “BABY BLUES” OR PPD?

Up to 80 percent of new mothers experience mood swings—feeling elated one moment and sad the next. These postpartum blues usually surface three to five days after delivery and subside within a few weeks as hormone levels stabilize. PPD lasts much longer and is usually much more severe and interferes with daily life. Sometimes the depression builds slowly, not peaking until as much as a year after delivery. PPD can develop after the birth of any child, not just the first.

Researchers believe that untreated PPD can adversely affect babies, possibly resulting in the following:

- Problems with mother-child bonding
- Increased crying
- Sleeping and eating difficulties
- Behavior problems, including temper tantrums and hyperactivity
- Developmental delays, including delays in language

Can Postpartum Depression Be Prevented?

Women with a history of depression should be monitored for a recurrence as soon as they become pregnant. Early recognition of PPD can lead to early treatment, minimizing its impact. Women with a history of PPD are sometimes started on antidepressants as soon as they give birth.

Some scientists believe that breastfeeding can help prevent PPD in some women. Lactating women have diminished neuroendocrine and behavioral responses to at least some types of stressors, other than those that present a threat to the infant.

Techniques for preventing or managing PPD include the following:

- Resting as much as possible and sleeping when the baby sleeps
- Getting good nutrition, exercise, and avoiding alcohol
- Having realistic expectations and asking for help when needed
- Taking time for oneself and one's partner and friends
- Sharing experiences with other mothers
- Joining a support group
- If possible, avoiding additional major life changes

Resources

Books and Articles

Brizendine, Louann. *The Female Brain*. New York: Broadway Books, 2006.

Kabir, K., J. Sheeder, and L. S. Kelly. "Identifying Postpartum Depression: Are 3 Questions as Good as 10?" *Pediatrics* 122, no. 3 (September 2008): 696–702.

Venis, Joyce A., and Suzanne McCloskey. *Postpartum Depression Demystified: An Essential Guide to Understanding and Overcoming the Most Common Complication after Childbirth*. New York: Marlowe, 2007.

Organizations

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web site: <http://womenshealth.gov/faq/depression-pregnancy.cfm>.

Postpartum Education for Parents. P.O. Box 6154, Santa Barbara, CA, 93160. Toll free: 805-564-3888. Web site: <http://www.sbpep.org>.

Postpartum Support International. P.O. Box 60931, Santa Barbara, CA, 93160. Toll free: 805-967-7636. Toll free: 800-994-4PPD. Web site: <http://postpartum.net>.

Prader-Willi Syndrome See *Intellectual Disability*.

Pregnancy-related Infections See *Congenital Infections; Pregnancy*.

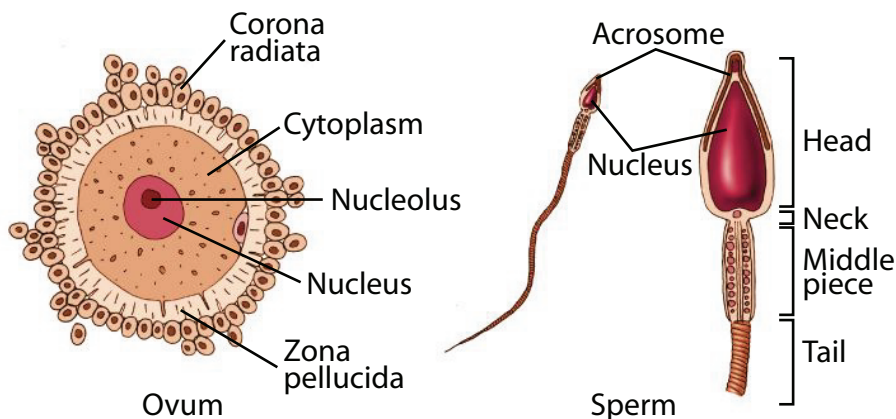
Pregnancy

Pregnancy is the period of time between conception (kun-SEP-shun) and birth. A full-term pregnancy lasts nine months and usually does not involve major health problems. Sometimes, however, complications develop that jeopardize the health of mother and/or baby.

What Is Pregnancy?

Pregnancy is the interval beginning when an egg and sperm unite and ending when a baby is born. A full-term pregnancy lasts nine months (38–40 weeks). Physicians calculate the start of pregnancy from the first day of the last menstrual period, with a full term pregnancy running 40 weeks. This pregnancy measurement is referred to as the menstrual age and is approximately two weeks ahead of when ovulation and fertilization actually happens. The stages of pregnancy are referred to as trimesters and are

Anatomy of human ovum and human sperm. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



- * **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.
- * **sperm** are the tiny, tadpole-like cells males produce in their testicles. Sperm can unite with a female's egg to result eventually in conception.
- * **chromosome** (KRO-mo-zom) is a unit or strand of DNA, the chemical substance that contains the genetic code to build and maintain a living being. Humans have 23 pairs of chromosomes, for a total of 46.
- * **embryo** (EM-bree-o), in humans, is the developing organism from the end of the second week after fertilization to the end of the eighth week.
- * **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.

each three months in duration. Each trimester is associated with distinct developmental stages.

Fertilization and Implantation Eggs are formed in the ovaries, a part of the female reproductive tract. Each month, one of the two ovaries forms egg follicles, fluid-filled cysts that have the potential to grow into mature eggs. Only one follicle actually creates and releases a mature egg each month. In releasing the egg, the follicle ruptures. The cells that made up the follicle then begin to secrete hormones* that are needed to maintain a pregnancy. The egg released from the ovary travels down the fallopian tube toward the uterus*. On this journey, if sperm* meets and fertilizes the egg in time to implant in the uterus, pregnancy has the potential to occur. Sperm and egg actually meet in the fallopian tube where a sperm fertilizes the egg. One sperm cell is all that is required to fertilize an egg.

Normal fertilization takes place over approximately 24 hours. During this time the outside of the egg changes to ensure that other sperm cells will not penetrate. Once the egg is fertilized, all of the genetic material necessary for a new life is present, and the gender is determined. The female can only contribute an X chromosome* (females are XX). Males may contribute an X or Y chromosome (males are XY). If the sperm that fertilizes the egg is carrying an X chromosome, the result will be female. If the sperm carries a Y chromosome, the result will be male. The fertilized egg is referred to as an embryo* as it undergoes multiple cell divisions. Three to four days later, the embryo leaves the fallopian tube and implants in the uterus, where the cells continue to divide and grow as the pregnancy progresses. Some women experience episodes of spotting, or slight bleeding, around the time of implantation. Once implantation occurs, a mucous plug is formed that seals the cervix* to prevent the entry of more sperm.

Human chorionic gonadotropin (hCG) is a hormone produced by the placental tissue growing near the embryo used in pregnancy tests. This hormone is present in the maternal blood about one week after conception, but not present in the urine for a home pregnancy test until three to four weeks into the pregnancy. Throughout pregnancy, distinct and intricately synchronized hormonal changes are necessary for a fetus to make it

to full term. Progesterone is the hormone necessary for a successful pregnancy to occur, and it also prevents menstrual cycles* during pregnancy.

First Trimester The first trimester lasts about 12 weeks. Week three to week eight are referred to as the embryonic stage of pregnancy. In this period, the internal organs such as the heart are forming, and the embryo is especially vulnerable to damaging outside factors such as alcohol, bacterial infections, viruses, and toxins that would not significantly harm an adult body. The nervous system, including the brain, forms around the third week of pregnancy. Proper formation of the nervous system requires an adequate amount of vitamins, including folic acid, one of the B vitamins. Without proper nutrition, an embryo may malformed or lost. Around the fifth week of pregnancy the heart begins to beat. After the eighth week, the embryo is referred to as a fetus*.

Second Trimester The second trimester lasts from week 13 to week 27. During this stage the fetus rapidly increases in size and length. Organs continue to grow and move into their final physical locations. Skin is formed, blood creation begins, movement occurs, and the fetus begins to hear sounds. The lungs are beginning to produce a substance known as surfactant, which allows the air sacs in the lungs to inflate properly and not collapse when they deflate. Without the surfactant, a baby cannot breathe outside of the body of the mother. This is one of the reasons why a baby born too early may not survive.

Third Trimester The third trimester lasts from about week 28 to the time of birth, usually around week 40. Week 40 is used to calculate the due date, but a full term pregnancy may be anywhere between 38 and 42 weeks. During the third trimester the fetus gains significant weight and the eyes open. The fetus can detect light and begins making antibodies as part of the immune system. After 38 to 40 weeks, the baby is delivered through the vagina* or by cesarean section*.

What Are the Normal Discomforts of Pregnancy?

As a woman gains weight and her body changes to accommodate a growing fetus, she may experience some of the following signs or symptoms:

- Anemia*
- Backache
- Breast tenderness
- Constipation
- Edema (water retention)
- Fatigue
- Food aversions and cravings
- Frequent urination
- Heartburn
- Hemorrhoids*



▲
Ultrasounds (also called sonograms) can be used to monitor the development of the fetus during pregnancy. *Photo Researchers, Inc.*

* **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.

* **cesarean section** (si-ZAR-ee-an SEK-shun) is the surgical incision of the walls of the abdomen and uterus to deliver offspring in cases where the mother cannot deliver through the vagina.

General weight-gain recommendations for women who are expecting only one baby. *Illustration by GGS Information Services, Inc. Reproduced by permission of Gale, a part of Cengage Learning.*



* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

* **hemorrhoids** (HEM-o-roidz) are a mass of dilated veins in swollen tissue at the margin of the anus or nearby within the rectum.

* **stretch marks** are stripes or lines on the skin (such as on the hips, abdomen, and breasts) from excessive stretching and rupture of elastic fibers, especially due to pregnancy or obesity.

* **varicose veins** (VAR-i-kose VAYNZ) are abnormally swollen or dilated veins.

Recommended weight gain for pregnant women

<u>If you are:</u>	<u>You should gain:</u>
Underweight	About 27 to 40 pounds
Normal weight	About 25 to 35 pounds
Overweight	About 15 to 25 pounds
Obese	About 15 pounds or less

SOURCE: National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, U.S. Department of Health and Human Services

- Nausea and vomiting
- Stretch marks*
- Varicose veins*

Symptoms vary from woman to woman, and even between pregnancies for an individual woman.

What Are the Common Complications of Pregnancy?

Most women get through pregnancy and give birth without any major health problems. However, a few experience complications, and some of these threaten the health of both mother and/or baby. In the worst cases, these problems can be very frightening, and they are very difficult to handle when they result in the loss of a baby.

Hyperemesis gravidarum (morning sickness) Hyperemesis gravidarum (morning sickness) is the name for the nausea and vomiting some women experience during pregnancy. But it is misnamed in some cases. Some women have it in the morning, others at noon, and still others at night. Some women feel queasy only occasionally, whereas others feel sick all day long. Overall, about half of all pregnant women experience some degree of morning sickness, but it usually subsides on its own after about the third month of pregnancy. Only rarely does it require medical attention. The cause of morning sickness is unclear, but probably it is related to the hormonal and other chemical shifts that occur in early pregnancy.

Miscarriage Miscarriage (MISS-care-ij) is also called spontaneous abortion; it occurs when a pregnancy suddenly ends on its own. Bleeding, cramping, and abdominal pain often signal a miscarriage. Most miscarriages occur before the fourteenth week of pregnancy, which is why many women wait to tell their family and friends about a pregnancy until they have passed the three-month mark. Occasionally, a woman will have a “late” miscarriage, which means that it occurs during the second trimester. After

the twentieth week, the unexpected end of a pregnancy is called stillbirth if the baby is born dead and premature birth if the baby is alive but born before the thirty-seventh week.

As many as 40 percent of pregnancies end in miscarriage, although most of these occur so early that a woman may not even realize that she is pregnant. Early miscarriages often occur when the body naturally rejects an embryo that is not developing properly. Later miscarriages are much less common. Reasons for late miscarriages include a placenta* that is improperly attached to the uterus, the placenta separating from the wall of the uterus for some reason, and other causes.

Gestational diabetes Gestational* diabetes* is a type of diabetes that occurs when a woman does not produce enough insulin to handle the increased blood sugar that accompanies pregnancy. Any woman can develop this common problem, but women who are older, are overweight, and who have relatives with diabetes are at higher risk. A special diet often can control the problem without medication. Untreated diabetes during pregnancy increases the risk of certain birth defects. Such infants often have abnormally high birth weights and are prone to developing low blood sugar in the hours after birth. Most cases of gestational diabetes are temporary and disappear after the baby is born.

Ectopic pregnancy An ectopic (ek-TOP-ik), or tubal, pregnancy is one in which the fertilized egg begins to develop outside the uterus, usually in a fallopian tube*. Cramps, nausea, dizziness, tenderness in the lower abdomen*, and light vaginal bleeding often accompany ectopic pregnancies. Early detection and treatment of an ectopic pregnancy are essential. If left untreated, the condition can lead to rupture of the fallopian tube and then to massive internal bleeding and shock, thus becoming life-threatening to the mother.

* **placenta** (pluh-SEN-ta) is an organ that provides nutrients and oxygen to a developing baby; it is located within the womb during pregnancy.

* **gestational** (jes-TAY-shun-al) means relating to pregnancy.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **fallopian tubes** (fa-LO-pee-an tubes) are the two slender tubes that connect the ovaries and the uterus in females. They carry the ova, or eggs, from the ovaries to the uterus.

* **abdomen** (AB-do-men), commonly called the belly, is the portion of the body between the thorax (THOR-aks) and the pelvis.

CESAREAN LAW

A cesarean section is the method of delivering a child by surgically opening the abdomen and uterus. It is performed when delivery through the vagina presents risk to the mother or child.

The name of the procedure comes from the traditional story that the Roman ruler Julius Caesar (100–44 B.C.E.) was delivered by such surgical means. More likely is the explanation that Cesarean law forbade the burial of a deceased mother before the baby was delivered.

Written accounts of the rescuing of an infant from its dead mother were recorded as early as 500 B.C.E. Cesarean sections were known to have been practiced by the ancient Romans, Indians, and Jews in the Roman era.

How Common Are the Common Pregnancy Complications?

The approximate percentages of pregnant women affected by the common complications of pregnancy are as follows:

- Ectopic pregnancy: 2 percent
- Gestational diabetes: 1 to 10 percent
- Miscarriage: as many as 40 percent of pregnancies end in miscarriage, often before a woman even knows she is pregnant. Of confirmed pregnancies, about 10 percent end in miscarriage.
- Morning sickness: 50 percent. Severe nausea and vomiting that require medical care occur in less than 0.5 percent of pregnancies.
- Placenta previa: 1 percent
- Premature birth: 7 to 12 percent of deliveries. About one-third of these are caused by preterm labor.
- Preeclampsia/Toxemia: 5 to 10 percent

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

An ultrasound* can be used to examine the abdomen and confirm the diagnosis of an ectopic pregnancy. An ultrasound sends sound waves into the body that bounce off internal structures. A computer converts the returning sound waves into an image of the internal structures. Ectopic pregnancies usually are removed surgically.

Incompetent cervix An incompetent cervix* is the cause of about 25 percent of late miscarriages. The cervix is the muscular opening of the uterus into the vagina (va-JY-na). An incompetent cervix opens too early due to the pressure exerted by the growing fetus. An incompetent cervix can be caused by many factors, including a genetic tendency for it, stretching or tearing of the cervix during previous deliveries, and carrying multiple fetuses. An incompetent cervix can be treated by stitching the cervix closed during the second trimester or by bed rest for the last several months of pregnancy.

Preeclampsia/eclampsia and toxemia The terms “preeclampsia/eclampsia” and “toxemia” are used interchangeably to mean pregnancy-caused hypertension (high blood pressure). The exact cause of preeclampsia/eclampsia is unknown and likely has multiple factors. Eclampsia is defined as preeclampsia plus convulsions. The only known treatment for advanced preeclampsia (in which blood pressure cannot be controlled with medications) or eclampsia is abortion or delivery by cesarean section or induction of labor. Most cases of toxemia are characterized by swelling of the face, hands, and ankles; too-rapid weight gain; headaches; and protein in the urine. When left untreated, toxemia can cause nausea, vomiting, blurred vision, convulsions*, and coma*.

Toxemia most often affects young women during the last months of their first pregnancy, and the cause is unknown. Often, treatment involves hospitalization until the blood pressure returns to normal, followed by limited activity and sometimes bed rest at home.

Placenta previa Placenta previa (PREE-vee-a) is a condition in which the placenta is lying low in the uterus. It can be dangerous if the placenta actually covers the cervix during labor and delivery. During birth the baby still requires the blood, oxygen, and nutrients provided by the placenta, and so the placenta should remain attached to the uterus until after the baby is born, and then it is expelled. Placenta previa can lead to premature labor, and women with this problem sometimes must limit their activity or stay in bed until the baby is born. Doctors can monitor the position of the placenta using ultrasound. When it is time for the baby to be born, doctors perform a cesarean section if the placenta is still covering or very close to the cervix.

Preterm labor and premature birth More babies are born past their expected due date than before it, but in the United States, one in eight babies is born prematurely. A premature birth means delivery

before the thirty-seventh week of pregnancy. About one-third of premature babies are born early because the mother goes into labor too soon (the other cases occur because the amniotic sac* ruptures prematurely or because a health problem with the mother or baby requires early delivery).

Among the many risk factors for preterm labor are smoking, alcohol use, drug abuse, vitamin deficiencies, a job that requires standing for long periods, infections such as German measles, placenta previa or other physical causes, and poor nutrition.

Preterm labor that results in a premature birth poses serious health problems for the baby who has not finished developing inside the uterus.

What Are the Risk Factors for Pregnancy Complications?

Older women (over 35 years) have a higher probability than younger women of experiencing high blood pressure, diabetes, and cardiovascular disease while pregnant, but these conditions are controllable with good medical care. Older women also are more prone to miscarriage, preterm labor, and postpartum (after birth) bleeding, and they have an increased risk of having a child with birth defects.

By contrast, teen mothers are twice as likely to have premature babies and babies with low birth weight as are older mothers. Teenagers are also prone to premature labor, prolonged labor, toxemia, and anemia. About one-third of pregnant teens do not receive adequate medical care during pregnancy (as compared to about one-fourth of older women). Finally, while the chance of dying from pregnancy-related complications is very low overall, the rate is much higher in women younger than 15 than in women older than 15.

Can Pregnancy Complications Be Prevented?

Many complications of pregnancy develop in healthy mothers for unknown reasons. However, if a woman is in poor health before becoming pregnant, the likelihood of her having complications is higher than usual. Regular prenatal* care, or medical care during pregnancy, is very important, because it allows doctors to detect and treat problems with mother or baby as early as possible.

Preventing Pregnancy

Birth control is the process of preventing a pregnancy. It may be attempted via barrier methods such as diaphragms and condoms, hormone supplements, or through behavioral methods such as timing when sexual intercourse occurs. Behavioral methods rely on attempting to determine a period of physical infertility based on knowledge of the woman's menstrual cycle. During these supposed periods of infertility the sexual

* **amniotic sac** (am-nee-AH-tik SAK) is the sac formed by the amnion, the thin but tough membrane that lines the outside of the embryo in the uterus and is filled with fluid to cushion and protect the embryo as it grows.

* **prenatal** (pre-NAY-tal) means existing or occurring before birth, with reference to the fetus.

* **contraception** (kon-tra-SEP-shun) is the deliberate prevention of conception or impregnation.

partners assume it is safe to have sexual intercourse without the risk of pregnancy. These methods are not completely reliable. Abstinence is the only way to eliminate the possibility of pregnancy.

Contraception devices The diaphragm and the condom are two commonly used contraception* devices. The diaphragm is molded rubber cup with a wire embedded around its edge. A woman is measured for this form of contraception by a medical professional, who also explains how to insert and position the diaphragm across the cervix. The diaphragm provides a mechanical barrier so that sperm cannot enter the uterus through the cervix. Used with spermicidal jelly, the diaphragm is an effective method of birth control with no side effects. The condom is a thin rubber sheath worn over the erect penis that collects the sperm, preventing it from entering the woman's vagina. Another kind of condom is inserted into the vagina before intercourse and serves the same barrier function. Diaphragms are washed and reused; condoms are used only once.

Behavioral birth control The rhythm method, also known as the fertility awareness method, involves avoiding sexual intercourse during the most fertile time in the menstrual cycle. The fertile time in a menstrual cycle is during the ovulation stage. Counting from the first day of the last menstrual cycle, ovulation generally occurs approximately eleven days later. The signs indicating the ovulation stage include increased cervical mucous and increased basal body temperature. The basal body temperature is the temperature of the body early in the morning while at rest. Basal body temperature increases slightly approximately one to two days after ovulation.

Birth control may be attempted by abstaining from sexual intercourse from day 11 and the appearance of cervical mucous until three days after the increase in basal body temperature. However, this method is often less successful because ovulation varies from person to person. Because a sperm may live in the female reproductive tract for up to seven days and the egg remains fertile for about 24 hours, a pregnancy may occur anywhere from seven days before ovulation to three days afterward. In addition, ovulation does not always occur on day 11 from the last menstrual cycle, does not always involve noticeable cervical mucous, and may have an irregular basal body temperature. Ovulation may take place anywhere from day 11 to day 21 of the cycle and at different times during each cycle. These variables cause the rhythm method of birth control to less dependable than other methods.

Some women assume if they do not menstruate, they are infertile. Sometimes extreme athletic activity or discontinuing birth control pills results in a temporary loss of menstruation or bleeding during the menstrual cycle. These periods without menstruation do not indicate infertility, and pregnancy may still occur despite the lack of monthly menstruation.

▶ See also **Infertility** • **Prematurity**

Resources

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Campos, Bonnie C., and Jennifer Brown. *Protect Your Pregnancy*. New York: McGraw-Hill, 2004.

Livoti, Carol, and Elizabeth Topp. *The Stress-Free Pregnancy Guide: A Doctor Tells You What to Really Expect*. New York: AMACOM, 2009.

Murkoff, Heidi, and Sharon Mazel. *What to Expect When You're Expecting*, 4th ed. New York: Workman, 2008.

Organizations

American Pregnancy Association. 1431 Greenway Drive, Suite 800, Irving, TX, 75038. Telephone: 972-550-0140. Web site: <http://www.americanpregnancy.org/pregnancycomplications>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncbddd/pregnancy_gateway.

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web site: <http://www.womenshealth.gov/pregnancy/complications>.

Prematurity

Premature (or preterm) babies are those born before the thirty-seventh week of pregnancy. Pregnancy is calculated from the first day of the mother's last menstrual period before conception (kon-SEP-shun). Full-term babies are born in the thirty-eighth to forty-second week of pregnancy.*

What Causes Premature Birth?

In the third trimester* of pregnancy (months 7, 8, and 9), the fetus* adds ounces of body weight and is better prepared for living outside the mother's body. However, sometimes the mother goes into labor before the full term of the pregnancy. A baby born from this early birth is referred to as premature. Many premature babies are not ready to live on their own.

There are a variety of reasons why a mother goes into labor early. In up to half of the occurrences, the exact cause is never determined. Histories

* **menstrual period** (MEN-stroo-al PE-re-od) is the discharging through the vagina (va-JY-na) of blood, secretions, and tissue debris from the uterus (YOO-ter-us) that recurs at approximately monthly intervals in females of breeding age.

* **trimester** (tri-MES-ter) is any of three periods of approximately 3 months each into which a human pregnancy is divided.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

Premature babies often are put in incubators to keep them warm and protected while they grow bigger. *Picture Partners/Photo Researchers, Inc.*

- * **prenatal** (pre-NAY-tal) means existing or occurring before birth, with reference to the fetus.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.
- * **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.
- * **apnea** (AP-nee-uh) is a temporary stopping of breathing.



of women giving premature birth show several risk factors. These risk factors include poverty, poor prenatal* care, poor nutrition, smoking, alcohol abuse, and drug abuse. Other risk factors include high blood pressure, preeclampsia (high blood pressure and excess protein in the urine after 20 weeks of pregnancy), and anxiety. Premature births happen more often to mothers under the age of 18 or over 35.

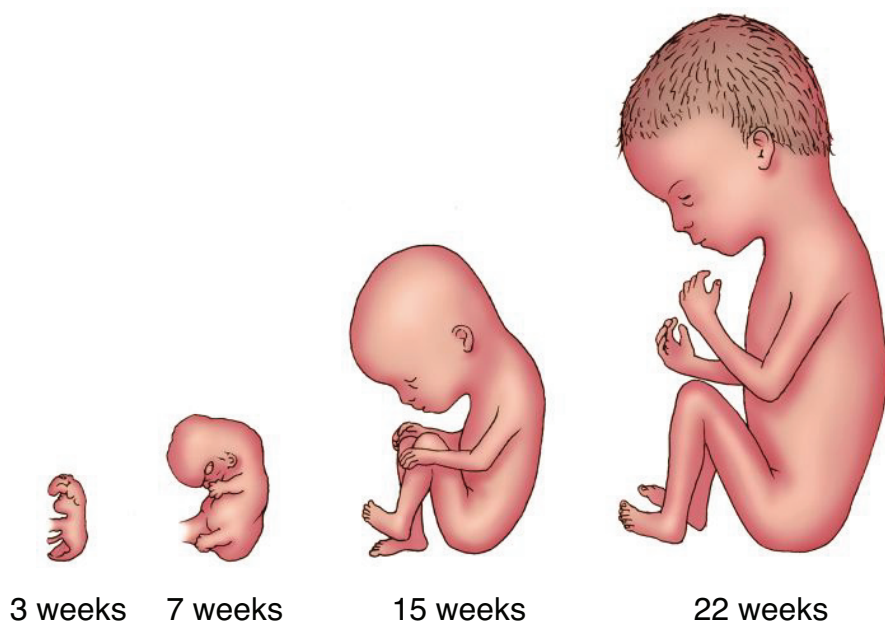
Physical abnormalities, such as a misshapen uterus*, may cause early labor. The cervix*, the opening to the uterus, may loosen and open too soon. In fact, a mother having a short cervix is the strongest predictor of premature birth. If the mother has a condition (such as high blood pressure) or the baby is at risk, the doctor may induce labor. Inducing labor means the mother is given a drug to start contractions.

What Does a Preterm Baby Look Like?

Preterm infants tend to look very frail, with thin pink skin with underlying veins showing through and very little body fat. Yet they are active. Even those born 12 weeks early can open their eyes and respond to sound, light, and being touched. Their skinny arms and legs are wrinkled and covered with fine hair, called lanugo (la-NOO-go).

Small babies must be kept warm. The surface area of any baby's skin is large relative to the mass of the body. Premature babies lose heat more quickly and need a climate-controlled incubator (IN-ku-ba-tor).

Breathing Some premature babies are not ready to breathe on their own. Apnea*, when breathing stops for several seconds, is common. A special apnea mattress assists breathing, and the heartbeat is monitored. If these episodes begin to last a long time, a ventilator (VEN-ti-lay-tor) or breathing machine is used.



Left to right: Embryo and fetus at 3 weeks; 7 weeks; 15 weeks; and 22 weeks. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Premature babies may experience respiratory distress syndrome (RDS) because the babies' lungs do not have the slippery lubricant called surfactant (sir-FAK-tant) that allows the lungs' tiny air sacs, called alveoli (al-VEE-o-ly), to open and close smoothly. Without surfactant, babies have to struggle to transfer oxygen* and carbon dioxide*. Infants may become exhausted and may not get enough oxygen. This lack of oxygen causes major changes in the body's chemistry. Artificial surfactant and breathing assistance may be needed temporarily, until babies begin to make natural surfactant on their own.

Feeding Feeding may be a problem for premature infants. Sometimes, they cannot suck adequately, and they are fed through a fine tube placed in the nose or mouth that goes into the stomach. Newborns, who even cannot tolerate tube feeding because their digestive system is too immature to handle any food, may receive nutrients through their veins.

Jaundice In preterm babies a yellow pigment called bilirubin (BIL-e-roo-bin) may accumulate in the blood and skin, causing jaundice (JAWN-dis). The liver* is not mature enough to break down bilirubin, and high levels may cause brain damage. Treatment involves phototherapy (fo-to-THER-a-pee), where the baby is exposed to fluorescent lights, which can help reduce the bilirubin level.

What Is Very Low Birth Weight?

A very low birth weight infant weighs less than about three pounds and is more than eight weeks early. Babies this small frequently need special care, but any newborn baby who is ill or has obvious problems may be looked after in special care units called neonatal* intensive care units (NICUs).

* **oxygen** (OK-si-je-n) is an odorless, colorless gas essential for the human body. It is taken in through the lungs and delivered to the body by the bloodstream.

* **carbon dioxide** (CAR-bon dy-OK-side) is an odorless, colorless gas that is formed in the tissues and breathed out through the lungs.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **neonatal** (ne-o-NAY-tal) pertaining to the first four weeks after birth.

Low birth weight is often times caused by lifestyle choices of the mother, who ignores prenatal care or does not see a physician. Smoking, alcohol, and drugs may also contribute to the baby's low weight.

In the 21st century, medical science is more able than ever before to help very tiny, very sick newborns survive. Specialized NICUs are available throughout the United States. It is costly to take care of these very sick babies, and the number of premature births is increasing. About 1 out of every 10 births in the United States is premature. Many babies survive, but some have lifelong learning and physical development problems.

▶ See also **Birth Defects and Brain Development • Fetal Alcohol Spectrum Disorders (FASD) • Pregnancy**

Resources

Books and Articles

Committee on Understanding Premature Birth and Assuring Healthy Outcomes, Board on Health Sciences Policy. *Preterm Birth: Causes, Consequences, and Prevention*. Washington, DC: National Academies Press, 2007.

Davis, Deborah L., and Mara Tesler Stein. *Parenting Your Premature Baby and Child: The Emotional Journey*. Golden, CO: Fulcrum, 2004.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncbddd/pregnancy_gateway.

Children's Hospital Boston. 300 Longwood Avenue, Boston, MA, 02115. Telephone: 617-355-6000. Web site: <http://www.childrenshospital.org/az/Site1476/mainpageS1476P0.html>.

Eunice Kennedy Shriver National Institute of Child Health and Human Development. 31 Center Drive, Building 31, Room 2A32, MSC 2425, Bethesda, MD, 20892-2425. Toll free: 800-370-2943. Web site: http://www.nichd.nih.gov/health/topics/Preterm_Labor_and_Birth.cfm.

March of Dimes. 1275 Mamaroneck Avenue, White Plains, NY, 10605. Telephone: 914-997-4488. Web site: <http://www.marchofdimes.com/prematurity/prematurity.asp>.

Premenstrual Syndrome (PMS) See *Menstruation and Menstrual Disorders*.

Presbyopia

Presbyopia is a naturally occurring type of farsightedness in which the ability to see close objects well is reduced as people get older.

As many adults pass age 40 or so, they find that it becomes harder to read newspapers and books. They start to hold these items farther away from their eyes than they had in the past because they are trying to bring the print into focus. Eventually, as the joke goes, they find that their arms are too short. This condition is called presbyopia (pres-be-O-pe-a), which is from the Greek words meaning “old eyes.” The condition causes a person to become slightly farsighted.

Normally, small muscles bend the clear lens at the front of the eyeball to focus a close image, such as the words on a page. But as individuals reach their thirties and forties, the lens loses its elasticity and becomes too thick and too rigid to flex easily, which causes presbyopia.

The first sign of presbyopia usually occurs when people find that they cannot read small print as easily as they did in the past. Their eyes may feel tired more quickly, or they may develop headaches during close work. Eventually, many people need eyeglasses for reading.

People who are already farsighted need to see their optometrist* if they notice these symptoms, as they will probably need stronger prescription eyeglasses for reading. For people with nearsightedness, presbyopia may seem at first to help their vision because the condition changes how close images are focused in a way that makes them clearer. This is sometimes called “second sight,” and people with nearsightedness sometimes find for a time that they do not need their eyeglasses to read. Eventually, though, they may need eyeglasses or perhaps bifocals* to see clearly.

▶ See also **Farsightedness • Nearsightedness**

Resources

Books and Articles

Fekrat, Sharon, and Jennifer S. Weizer, eds. *All about Your Eyes*. Durham, NC: Duke University Press, 2006.

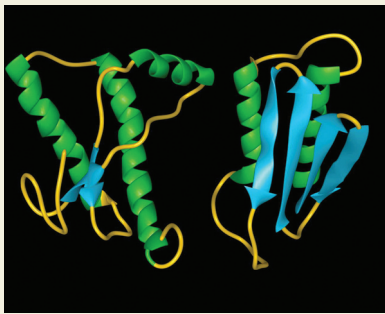
Organizations

American Optometric Association. 243 N. Lindbergh Boulevard, St. Louis, MO, 63141. Toll free: 800-365-2219. Web site: <http://www.aoa.org/presbyopia.xml>.

National Eye Institute. 2020 Vision Place, Bethesda, MD, 20892-3655. Telephone: 301-496-5248. Web site: <http://www.nei.nih.gov>.

* **optometrist** a licensed specialist who practices optometry, a healthcare profession that specializes in eye examinations and prescribing corrective lenses.

* **bifocals** or multifocal (progressive) lenses are prescription eyeglasses that have lenses divided into two or more sections. The bottom section allows a person to see things clearly that are close, and the top section allows a person to see things clearly that are far away.



▲ Computer generated illustration of human prion protein in its normal shape at molecular level (left), and disease-causing prion protein in its abnormal shape (right). AP Images.

- * **degenerative** (dee-JEN-er-uh-tiv) means progressively worsening or becoming more impaired.
- * **neurologist** (new-RHAL-eh-jist) a physician who specializes in diagnosing and treating diseases of the nervous system.
- * **kuru** (KUR-ew) is a progressive, fatal brain disease characterized by tremors and loss of muscle coordination that is caused by eating contaminated brain tissue from other humans who had the disease.
- * **blood transfusions** (trans-FYOO-zhunz) are procedures in which blood or certain parts of blood (such as specific cells) are given to a person who needs them due to illness or blood loss.

Pressure Sores See *Bedsore* (*Pressure Sores*).

Prion Diseases

Prion diseases are fatal degenerative brain diseases that can be transmitted between species, as when meat from cattle with mad cow disease is eaten by humans, or inherited, as when a genetic mutation is passed from parent to child, as in Creutzfeldt-Jakob disease (CJD). These diseases cause sponge-like holes in the brain.*

What Are Prions and Who Discovered Them?

Prion diseases (also called transmissible spongiform encephalopathies [TSE] because of the sponge-like holes they leave in infected brains) are caused by prions. Prions are protein particles that can reproduce themselves, but unlike all other infectious materials, prions do not contain genetic material. Yet like viruses, bacteria, and fungi, prions cause infection. Prions change normal protein molecules into infectious ones by altering their structure. Prions were discovered by Stanley Prusiner (b. 1942), a neurologist* at the University of California in San Francisco, who won the 1997 Nobel Prize for his work. There are many prion diseases, including mad cow disease, or bovine spongiform encephalopathy (BSE). The most common form of prion disease in humans is Creutzfeldt-Jakob disease (CJD), which occurs in individuals 60 years and older and which has another form, variant CJD (vCJD), that occurs in individuals under 30 years of age. Prion diseases can spread through contact with contaminated blood or tissue, but they are not easily contagious from human to human.

Prusiner spent two decades studying self-reproducing prions, when other scientists did not believe they existed. Shunned by the scientific community at the time, Prusiner proved that prions were infectious proteins that cause brain disease in people and animals. The Nobel Prize for Medicine or Physiology was awarded to him for discovering this new type of disease-causing agents that contains no DNA.

What Are Prion Diseases?

Prion diseases are fatal brain diseases. They can be caused by infection, inherited due to genetic mutation, or occur without either of these causes. Infectious prion diseases include scrapie in sheep and goats, kuru* in cannibalistic humans of Papua New Guinea, and mad cow disease (BSE), which is transmitted to humans who consume infected beef products. Prion diseases can also be transmitted through injections of infected material or contaminated blood transfusions*, through organ transplants, and by surgical instruments.

Hereditary prion diseases include CJD, fatal familial insomnia (FFI), and Gerstmann-Sträussler-Scheinker disease (GSS). Hereditary prion diseases are caused when a certain protein, found on the surface of neurons, is mutated so that a certain prion protein forms. In addition, sometimes prion diseases occur without an infectious or genetic explanation.

What Are Various Kinds of Infectious Prion Diseases?

Forms of Creutzfeldt-Jakob disease Cases of sporadic CJD, in which no one can explain how the affected individuals were infected, occur at the rate of one case per million people per year worldwide. This sporadic form of prion disease makes up 85 percent of total CJD cases, and 80 percent of all prion disease cases. In the United States approximately 200 CJD cases occur per year. Approximately 15 percent of CJD cases are inherited and associated with a different prion type than that of sporadic CJD. Inherited CJD may show up among groups in certain geographic areas. CJD is seen in Libya or among Slovakia-born Israelis. Other communities genetically at increased risk are in some areas of Chile. CJD cases caused by accidental infection from surgical instruments and transplants are extremely rare and make up less than 1 percent of total cases. In the United States the CJD death rate is about one case per million people per year, and cases are almost always in patients older than 30 years of age.

Gerstmann-Sträussler-Scheinker disease and Kuru GSS is rarer than CJD, striking one person in every 10 million people. These figures are likely to be underestimated because prion diseases may be misdiagnosed as other neurological disorders. Kuru appears in approximately 1 percent of the New Guinea population where it occurs. Kuru is found mostly in children older than five years and adult females less than 40 years of age.

Mad cow disease An epidemic* of mad cow disease (BSE) began in the United Kingdom in 1985 when cattle feed was contaminated with brain tissue from scrapie-infected sheep. More than 170,000 cattle were infected before the disease was brought under control. Cattle feed containing sheep matter was banned in 1988. In 1989 slaughter techniques that allow nerve tissue to be included in beef intended for human consumption were banned. More than one million cattle may have been infected with BSE in the United Kingdom.

To prevent the spread of BSE to the United States, severe restrictions were placed on the importation of ruminants (cud-chewing grazing animals such as cattle) and ruminant products from Europe. Nonetheless, BSE appeared in cattle of the United States in December 2003, when the USDA announced a possible diagnosis in a cow from Washington state. The infected cow was believed to be imported from Canada in

* **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.

* **antigens** (AN-tih-jens) are substances that are recognized as a threat by the body's immune system, which triggers the formation of specific antibodies against the substance.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.

* **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.

* **Alzheimer's (ALTS-hy-merz) disease** is a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.

* **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

* **autosomal dominant** mode of inheritance in which only one copy of an abnormal gene is necessary to cause disease.

2001 and had been slaughtered for human consumption. The USDA recalled all beef slaughtered at the same slaughter plant on the same date as the infected cow. Many people turned to vegetarian diets, and many restaurants stopped serving beef. The number of new BSE cases declined sharply after that.

What Causes Prion Diseases?

Eating prions When prions are eaten, they are absorbed through Peyer's patches of the small intestine, which are lumps of lymphoid tissue that allow the passage of gut antigens* straight through them. Peyer's patches transfer microorganisms to the immune system* and normally support a protective immune response. However, prions do not activate an immune response. Prions taken up at Peyer's patches travel to various sites in the lymph system such as lymph nodes* and the spleen*. Because lymph sites often have many nerves, prions gain access to the nervous system, make their way to the spinal cord, and eventually the brain.

Injected with prions In addition to being caused by people eating contaminated meat products, prion diseases can be transmitted through injection of ground up infected tissues and contact with contaminated body fluids. While casual contact does not cause a person to get the disease, medical professionals must protect themselves from infected blood, brain tissue, and cerebrospinal fluid* of patients with prion diseases. In clinical practice, blood transfusions; organ transplants, including the cornea of the eye; contaminated surgical instruments; and some human-derived hormones have all caused prion infections.

Prions are harder to kill than bacteria and viruses. They cause plaque buildup in the brain similar to those seen in Alzheimer's (ALTS-hy-merz) disease*. Most brain cells contain enzymes that degrade these deposits. Prions are resistant to these enzymes. The plaques continue to grow and cause damage to the brain. Brain damage shows up as loss of coordination, paralysis, dementia*, and wasting, followed by death. Pneumonia also frequently occurs in patients with prion diseases. All prion diseases are inevitably fatal.

Prion diseases can be inherited in an autosomal dominant* manner, which means if one parent carries the mutation, each offspring has a 50 percent chance of inheriting the mutation. In this manner patients with a prion disease have inherited at least one copy of a mutated gene. There are a variety of possible mutations, and each type of mutation results in a different type of prion disease.

What Are Some Inherited Prion Diseases?

Each of the diseases described here occur due to an inherited genetic mutation. What distinguishes these diseases is which gene or gene sequence is affected. In addition, some cases of these diseases occur without medical professionals being able to explain why. These cases are called sporadic, meaning "occasionally" or "in scattered instances."

Gerstmann-Sträussler-Scheinker disease GSS typically occurs in individuals between 35 and 55 years of age. It is characterized by progressive dementia, unsteady gait, and associated motor complications, and it takes between two to ten years before the patient dies. GSS is almost always inherited but has been known to occur sporadically as well.

Creutzfeldt-Jakob disease CJD was first described in the 1920s as a one-year long progressive dementia, followed by death. One symptom of CJD is marked intellectual impairment, behavioral changes, and a variety of motor disturbances, including twitching. CJD typically occurs between in individuals between 50 and 75 years of age. While CJD is an inherited disease, the majority of CJD occurs sporadically. Other CJD cases are due to accidental exposure to infected material.

Fatal familial insomnia FFI typically occurs in individuals between 18 and 60 years of age. This disease is characterized by progressive sleep disturbance classified as untreatable insomnia*, ataxia* (motor dysfunction), and a breakdown of normal bodily functioning such as involving temperature regulation, heart rate, and breathing rate. The disease causes death within six months to three years. Postmortem studies associate this prion disease with severe selective atrophy (wasting) of the thalamus*, a brain region controlling sleep and wakefulness. Sporadic FFI has been reported without the characteristic gene mutation.

What Are Other Infectious Prion Diseases?

Scrapie Scrapie was first described in sheep and goats more than 200 years ago. It is transmitted through feed contaminated with nerve tissue. It can also be transmitted through pasture infected with the placental* tissue from infected sheep. The term “scrapie” comes from the behavior of infected sheep, who rub up against the fences of their pens to remain upright despite severe difficulty walking, balancing, and a loss of muscular coordination due to brain damage.

Kuru Kuru was described in 1950 as a progressive loss of muscular coordination and gait control associated with a shivering tremor. Infected individuals were sick for three to nine months before they died. The word “kuru” comes from the Fore language and means “tremor.” This disease occurs mostly among the Fore highland people of southern New Guinea, whose cultural practice involved a ritual in which they ate the brain tissue of recently deceased family members. The brain tissue was ground into a pale grey soup, heated, and consumed. Statistically, women of the Fore tribe were more likely than men to develop kuru, probably because women handled the brain tissue and prepared the soup. These women were infected through small skin abrasions and through eating the soup. The symptoms of kuru resemble those of CJD. After this ritual practice stopped, the disease ceased to occur.

Bovine spongiform encephalopathy Humans consuming infected beef are at risk for BSE. BSE is very hard to control because it can be

* **insomnia** disorder characterized by difficulty sleeping

* **ataxia** disorder involving an unsteady gait.

* **thalamus** portion of the brain that processes sensory information as well as sleep cycles

* **placenta** (pluh-SEN-ta) is an organ that provides nutrients and oxygen to a developing baby; it is located within the womb during pregnancy.

- * **grafts** are tissue or organ transplants.
- * **spinal tap** also called a lumbar puncture, is a medical procedure in which a needle is used to withdraw a sample of the fluid surrounding the spinal cord and brain. The fluid is then tested, usually to detect signs of infection, such as meningitis, or other diseases.
- * **electroencephalogram** an instrument that records the electrical activity of the brain.
- * **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.
- * **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

transmitted between many types of species. Whereas food items containing blood or nerve tissue are potential vectors (agents for carrying the disease) for human infection, milk and milk products from cows are not believed to pose any risk for causing the BSE prion to humans.

Acquired Creutzfeldt-Jakob disease While CJD is an inherited disease it can also be acquired through accidental exposure to CJD prion contaminated material through a medical procedure using tainted human matter or surgical instruments. Recipients of corneal transplants and of grafts* of dura mater (brain-associated connective tissue) have been infected with CJD. Because prions are resistant to many sterilization procedures, surgical instruments used in brain surgery have infected new patients two years after being sterilized. More than 100 people have been infected with CJD through injections of human growth hormones prepared from pools of pituitary glands that included materials from humans with CJD. In the early 2000s, growth hormones are prepared through recombinant DNA technology and surgical instruments used on potentially infected patients have new sterilization guidelines, so the transmission of CJD via these routes has ceased.

Variant Creutzfeldt-Jakob disease The disease referred to as vCJD appeared in 1996 during the mad cow disease epidemic in the United Kingdom. These patients were infected with prions from contaminated beef, the BSE prion. Mad cow disease, as it is called in cattle, is responsible for this form of prion disease in humans. Victims of vCJD are usually young, and on average they die in their late 20s. However, the incubation period before the onset of symptoms may be as long as 40 years. vCJD affects people from 15 to 65 years of age. Symptoms include psychiatric problems, abnormalities in the sensory system such as vision defects, intellectual impairment, loss of muscular coordination, and gait disturbances that follow a pattern identifiable as but different from CJD. The illness lasts at least six months before death occurs.

Miscellaneous Infectious Prion Diseases

Cats and mink are susceptible to species-specific forms of TSE. In many mid-western states of the United States, some elk and mule deer carry a form of TSE called chronic wasting disease (CWD). CWD prions may possibly be transmissible to humans who eat venison the same way as mad cow disease can be transmitted to humans who eat contaminated beef. All mammals may have the potential to carry prion diseases.

How Is a Prion Disease Diagnosed?

As of 2009, there was no single diagnostic test for any prion disease. Physicians initially rule out other, treatable forms of dementia. Standard diagnostic tests include a spinal tap* to exclude other diseases and an electroencephalogram (EEG)* to record the patient's brain wave pattern. CT scans* and MRIs* can rule out the possibility of stroke and reveal

characteristic patterns of brain degeneration associated with various types of prion diseases.

Many cases of prion diseases may have been misdiagnosed as other neurodegenerative disorders. However, modern diagnosis also depends on detection of prion proteins and identification of genetic mutations. A genetic sequence analysis can be performed for a number of different mutations associated with familial CJD. The types of mutations present determine which symptoms will be most prominent. However, confirmation requires tests of brain tissue obtained through brain biopsy* or autopsy*. Brain biopsies are usually performed only when required to exclude another, treatable condition.

How Are Prion Diseases Treated?

There is no known effective treatment to stop or cure prion diseases. Treatment focuses on alleviating the patients' symptoms and increasing their comfort. Treatment may include pain relievers, catheters to collect urine, intravenous fluids to maintain hydration, and frequently repositioning the patient to avoid bedsores*. There is no recovery or rehabilitation for prion diseases. Prions bring about slow degeneration of the central nervous system, inevitably leading to death. A very long time period may pass between a patient's becoming infected and the first appearance of symptoms, an incubation process that may take up to 40 years in humans. However, once the symptoms appear, the patient generally dies within a few months to a few years with rapid, progressive symptoms.

▶ See also **Creutzfeldt-Jakob Disease • Kuru**

Resources

Books and Articles

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Yam, Philip. *The Pathological Protein: Mad Cow, Chronic Wasting, and Other Deadly Prion Diseases*. New York: Copernicus, 2003.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

Creutzfeldt-Jakob Disease Foundation. P.O. Box 5312, Akron, Ohio 44334. Toll free: 800-659-1991. Web site: <http://www.cjdfoundation.org>.

Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 888-INFO-FDA. Web site: <http://www.fda.org>.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **autopsy** (AW-top-see) is an examination of a body after death to look for the cause of death or the effects of a disease.

* **bedsores** also called pressure sores, are skin sores caused by prolonged pressure on the skin and typically are seen in people who are confined by illness or paralysis to beds or wheelchairs.

* **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.

* **sperm** are the tiny, tadpole-like cells males produce in their testicles. Sperm can unite with a female's egg to result eventually in conception.

National Institutes of Health. 9000 Rockville Pike, Bethesda, MD, 20892. Telephone: 301-496-4000. Web site: <http://www.nih.gov/index.html>.

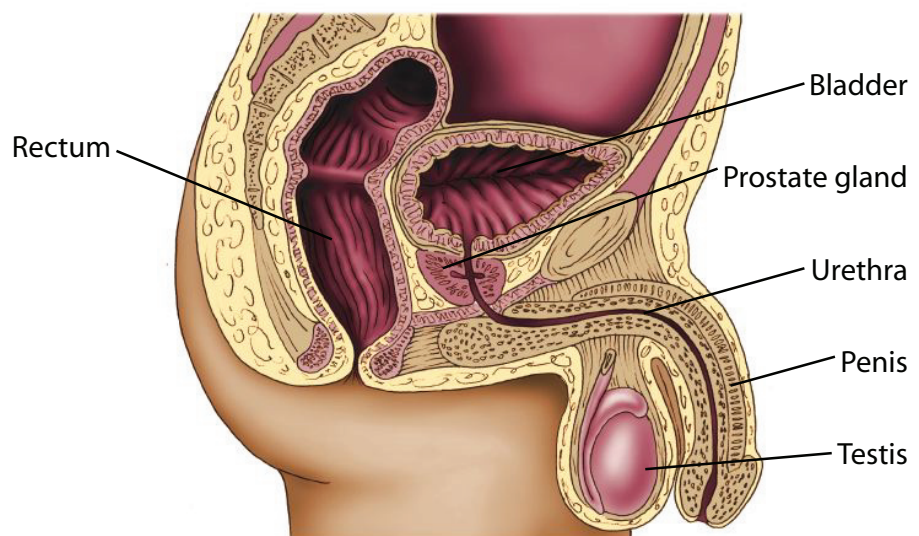
National Prion Disease Pathology Surveillance Center. Case Western Reserve University, 2085 Adelbert Road, Room 418, Cleveland, Ohio 44106. Telephone: 216-368-0587. Web site: <http://www.cjdsurv.com>.

Prostate Problems

The prostate (pros-TATE) is the walnut-sized male gland located below the bladder and in front of the rectum. It can be subject to enlargement, inflammation (prostatitis), or cancer, especially as men age.*

What Is Prostatic Enlargement?

Prostatic (pros-TAT-ik) enlargement is more commonly known by the difficult-sounding name benign prostatic hyperplasia (be-NINE pros-TAT-ik hy-per-PLAY-zha), or BPH. Breaking this name down into parts makes it easier to understand. Prostatic indicates that this is a condition that affects the prostate. The prostate surrounds the upper part of the urethra (yoo-REE-thra), the tube that empties urine from the bladder and out through the penis. The prostate makes a thick fluid that is important in the transportation of sperm*. Hyperplasia means too much formation of cells. It indicates that in this condition too much tissue grows in the prostate gland, making it larger than normal. Finally, benign means that this



Anatomy of the human male reproductive system showing the position of the prostate gland. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

extra tissue is not cancerous and will not spread to nearby tissues or other parts of the body. BPH mainly affects men over the age of 50. Doctors believe that roughly half of men over age 60 and 8 out of 10 men over age 80 have this condition. Researchers are not sure what causes this condition, but they believe it may involve changes in hormone* levels related to aging.

How Is BPH Diagnosed?

Many men with an enlarged prostate have no symptoms at all. Others may have difficulty urinating. A doctor can feel whether the prostate is enlarged during a digital rectal examination, which involves placing a gloved finger into the rectum and feeling the prostate gland through the rectal wall. Because an enlarged prostate is sometimes a sign of prostate cancer, the doctor often takes a blood sample and tests it for a substance called prostate-specific antigen (AN-ti-jen), or PSA. Usually, this substance is present at abnormally high levels when a man has prostate cancer. Levels in the normal range would suggest to the doctor that BPH is the more likely diagnosis. If the diagnosis is still uncertain, the doctor may need to do further tests before ruling out cancer.

How Is BPH Treated?

BPH is rarely a threat to life but may require treatment to relieve symptoms. As the prostate enlarges, it pushes against the urethra and bladder, blocking the normal flow of urine, almost like a clamp on a garden hose. Men with this condition feel like they need to urinate more often because they cannot empty the bladder completely. Two types of drugs are commonly prescribed to shrink the prostate: alpha blockers and 5-alpha reductase inhibitors. The alpha blockers block cell receptors in the prostate so factors causing growth cannot interact. These drugs (e.g., Flomax, Hytrin, Cardura) also treat high blood pressure. The reductase inhibitors (e.g., Avodart, Proscar) limit production of a hormone thought to cause enlargement. In some cases, surgery may be necessary.

Prostatitis

Prostatitis (pros-ta-TITE-is) is the inflammation of the prostate. It can be sudden and serious (acute) or develop over time (chronic) and causes urinary problems and pain.

What Is Prostatitis?

Bacteria in the prostate or aggravation from a variety of sources causes swelling and soreness in the prostate. Symptoms can include fever; the urge to urinate frequently; pain when urinating or ejaculating, or pain in the prostate itself and lower back; and blood in the urine. Acute prostatitis is less common and may cause flu-like symptoms and pain may extend to the genitals. A third, most common type, nonbacterial prostatitis, is chronic, with similar symptoms, but without fever and as the name implies, no bacteria in the prostate, but white blood cells or pus cells may

* **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

appear in the urine. The cause is not clear but may relate to physical exertion, strong vibrations or muscle spasms, or a narrowed urethra.

How Is Prostatitis Diagnosed and Treated?

Doctors perform physical and digital rectal exams and perhaps a PSA test to rule out other conditions. Urine and blood tests help determine the specific type of prostatitis. Antibiotics are used to combat infection, with chronic cases taking longer to treat. Medications may be used to relax muscles and help urination. Surgery may clear ducts in some acute cases.

Prostate Cancer

Prostate cancer occurs when cells in the prostate take on an abnormal appearance and start dividing without control or order. These cancer cells often spread to nearby tissues and organs and sometimes to other parts of the body.

Christina's Story

Christina loved that her grandfather lived with her family. He certainly did not act like most seventy-year-olds! He taught her everything she knew about basketball and shot baskets with her every night during the season. Lately, though, Grandpa admitted that he was not feeling quite up to playing with Christina. He often woke up feeling tired because he had to go to the bathroom several times during the night. Christina heard her grandfather tell her mother that he felt like his bladder was always full and that sometimes his urine even looked pinkish or reddish, like it might have blood in it. When the doctor heard about these symptoms, he told Grandpa to come in right away. The doctor ran some tests and confirmed his initial suspicion: Grandpa had prostate cancer. When Christina heard the word cancer, she was scared. She knew that people could die from this disease. Grandpa reassured her that there were treatments available that could help him. Plus, the doctor had said that his cancer was growing slowly and had not spread to other parts of the body, a positive indication that Grandpa would not die.

What Is Prostate Cancer?

Prostate cancer is the most common kind of cancer and the number two cause of male cancer deaths in the United States. It is found almost exclusively in men age 50 and older. With each decade of life after 50, a man's chance of developing prostate cancer increases. About 200,000 men in the United States are diagnosed with prostate cancer every year. This cancer occurs when cells in the prostate divide without control or order, forming tumors. Tumors may or may not be cancerous. Prostate cancer varies widely among men with the condition. Some men develop small, slow-growing tumors that remain within the prostate gland. Others develop fast-growing, aggressive tumors that spread quickly into the surrounding bone. They also can spread to nearby organs such as the bladder, rectum, and

lymph nodes*. Still other cases are between these extremes. How doctors treat the disease usually depends on how rapidly the tumor is growing.

What Are the Symptoms of Prostate Cancer?

When it begins, prostate cancer usually does not cause any symptoms. That is why doctors recommend that men age 40 and older have digital rectal examinations every year. A gland that feels hard, lumpy, or enlarged may indicate prostate cancer. Later symptoms may include a need to urinate frequently, especially at night; difficulty urinating or holding back urine; pain or burning while urinating or having sex; blood in the urine or semen; and frequent pain or stiffness in the lower back, hips, or upper thighs. Although these symptoms may indicate prostate cancer, they can also be caused by some other condition.

How Is Prostate Cancer Diagnosed?

Doctors usually start with a digital rectal examination. They also may take a blood sample and test it for PSA. Physicians may order additional laboratory tests or a urine sample to check for blood or other signs of infection. The only sure way to know whether cancer is present is to do a biopsy (BY-op-see). The doctor uses a needle to remove a small amount of tissue from the prostate and has it examined under a microscope. The appearance of the cells will show whether cancer is present and, if so, how quickly it is likely to grow and spread. Cells that are just slightly abnormal suggest that the cancer is slow growing. Extremely abnormal cells suggest that the cancer is likely to grow and spread more quickly. If cancer is diagnosed, the doctor may order additional tests to determine whether the disease has spread to other parts of the body.

How Is Prostate Cancer Treated?

Treatment depends on several different factors: the man's age and general health, how aggressive the cancer is, and whether it has spread outside the prostate. Sometimes, the best treatment is no treatment at all. For some older men and men with serious health problems, the possible risks and side effects of treatment may outweigh the benefits. Also, men whose cancer is slow growing or found at an early stage may not require treatment right away. In these cases, doctors may prefer to monitor their condition carefully and wait to see how the cancer develops. The usual treatments are surgery, radiation therapy, or hormonal (hoar-MOAN-al) therapy. Some patients may receive a combination of these treatments.

The surgery is called radical prostatectomy (RAD-i-kal pros-ta-TEK-to-mee), and it involves removing the entire prostate gland. Sometimes, nearby lymph nodes are removed as well. Radiation therapy uses high-energy rays to damage cells and stop them from growing and dividing. These rays might come from a machine, or they may come from radioactive material that is placed into or near the tumor. Hormonal therapy works by blocking the male hormones that the prostate cancer cells need

Changing Attitudes

In the late 1970s and through the 1980s, few men talked about prostate cancer, perhaps because they felt embarrassed or ashamed of the condition. After all, it affects two of men's most private activities: going to the bathroom and having sex.

In the 1990s, many famous men stepped forward to speak about their own experiences with this disease. Bob Dole, former U.S. senator and the 1996 Republican presidential candidate, was diagnosed with prostate cancer in 1991. He made this information public and used his fame to encourage other men to have yearly tests that might catch the disease early. He also introduced an amendment that called for increased funding for prostate cancer research. U.S. Army general Norman Schwarzkopf directed troops in the 1991 Gulf War. As a prostate cancer survivor, he led efforts to promote awareness of this disease. Professional golfers Arnold Palmer and Jim Colbert also made public their experiences with prostate cancer. Later they served as cochairmen of the Senior PGA Tour for the Cure, which raised money to support the Association for the Cure of Cancer of the Prostate. Fans pledged money for each birdie that their favorite player made.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

to grow. There are different approaches to hormonal therapy. Sometimes, surgeons remove the testicles (TES-ti-kulz), the smooth, oval-shaped glands located behind the penis. These are the body's main source of male hormones. Doctors also might give drugs or other hormones that prevent the testicles from making testosterone (tes-TOS-ter-one).

Life after Prostate Cancer

In many men, prostate cancer can be controlled or even cured. However, the treatments often cause lasting side effects. Some men can no longer have an erection, which means that the penis no longer becomes hard during sexual activity. Also, some men can no longer control the release of urine from the bladder. Fortunately, new treatments and surgical methods are available that may avoid these side effects. However, if these side effects occur, men may feel depressed or upset. Some men find it helpful to join a support group so they can talk to others in the same situation.

Can Prostate Cancer Be Prevented?

There is nothing a man can do to prevent prostate cancer. A diet high in fruits and vegetables and low in fat may help, but as of 2009 researchers had not confirmed this theory. Studies were under way in the early 2000s to test certain drugs that might help to prevent prostate cancer, but no definite results were available. The best way for men to protect themselves is to have annual checkups and report any unusual symptoms right away. Like other types of cancer, prostate cancer is easier to treat when found early.

▶ See also **Cancer: Overview • Incontinence**

Resources

Books and Articles

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Murray, Frank. *How to Prevent Prostate Problems: A Complete Guide to the Essentials of Prostate Health*. Laguna Beach, CA: Basic Health, 2009.

Organizations

American Cancer Society. 1599 Clifton Road, NE, Atlanta, GA, 30329. Toll free: 800-ACS-2345. Web site: <http://www.cancer.org>.

National Cancer Institute. 6116 Executive Boulevard, Room 3036, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov>.

National Kidney and Urologic Diseases Information Clearinghouse.

3 Information Way, Bethesda, MD, 20892-3580. Toll free: 800-891-5388. Web site: <http://kidney.niddk.nih.gov/index.htm>.

Psoriasis

Psoriasis (so-RY-a-sis) is a long-lasting skin disease that causes patches of skin to become red, thickened, and covered with silvery-looking flakes.

What Is Psoriasis?

When the American writer John Updike wrote a book about his own life, titled *Self-Consciousness*, he spent a whole chapter describing his personal battle with the chronic* skin disease psoriasis. Updike called the chapter, “At War with My Skin.” The word “psoriasis” comes from the Greek verb for “to itch.” The disease causes patches of skin to become red, thickened, itchy, and covered with silvery flakes. The disease may also affect the finger and toe nails and the soft tissues of the genitals and inside the mouth. Approximately 1 million people with psoriasis experience joint inflammation (called psoriatic arthritis).

What Causes Psoriasis?

Two out of every 100 people in the United States have psoriasis. In some cases, the disease is too mild to notice. In severe cases, it can cover much of the body. The cause of psoriasis is still unknown. Scientists do know that the disease cannot be passed from one person to another. In other words, it is not possible to catch psoriasis from someone else who has it.

Some research suggests that psoriasis may be due to a problem with the immune system*. The immune system includes a type of white blood cell called the T cell. Researchers have speculated that people with psoriasis may have a problem with the immune system that causes it to make too many T cells in the skin.

People with psoriasis often notice that at times their skin gets worse, then gets better. The bad times, known as flare-ups, may be triggered by such conditions as climate changes, infections, stress, dry skin, and certain medicines. Flare-ups may also occur after the skin has been cut, scratched, rubbed, or sunburned. People whose relatives have psoriasis are more likely to have it. Scientists have studied families with psoriasis to try to find genes linked to the disease.

What Does Psoriasis Look Like?

Psoriasis causes patches of red, thickened skin with silvery flakes, most often on the scalp, elbows, knees, lower back, face, inside of the hands, and bottom of the feet. These patches are sometimes known as plaques



The red and white scaly rash caused by psoriasis often appears on the arm around the elbow. *Image copyright Kenxro, 2008. Used under license from Shutterstock.com.*

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **ultraviolet** light is a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

(PLAKS). They may itch or burn, and the skin may crack. The disease can also affect the fingernails, toenails, and soft areas inside the mouth and genitals. About one out of 10 people with psoriasis gets psoriatic arthritis (so-ree-AT-ik ar-THRY-tis), a condition that causes pain, swelling, and stiffness of the joints (the places where bones meet).

How Is Psoriasis Treated?

A doctor usually identifies psoriasis by looking carefully at the skin, scalp, and nails. If the problem is psoriasis, the doctor can try various treatments that may clear up the skin for a time. The choice of treatment depends on a person's age, health, and lifestyle and the severity of the psoriasis. No single treatment works for everyone, but most people can be helped. The following are some of the treatment choices:

- **Medicines put on the skin.** Some creams, lotions, soaps, shampoos, and bath products created to treat psoriasis may be helpful. Some bath products and lotions may help loosen flakes and control itching, but they are usually not strong enough to clear up the skin.
- **Treatments with light.** Many people with psoriasis improve if they get sunlight every day in small amounts. To better control the light that reaches the skin, doctors sometimes use special lamps that give off ultraviolet* rays, which are a part of sunlight. In some cases, the person also takes a medicine that makes the skin more sensitive to the ultraviolet light.
- **Medicines taken by mouth.** Some people with severe cases of psoriasis may be prescribed medicines taken by mouth or in a shot. However, all of these have side effects and toxicities.

Living with Psoriasis

Many people with psoriasis find that it helps to keep the skin moist. Lotions, oils, and petroleum jelly (such as Vaseline) are often useful for this purpose. During the winter months, heaters can make the air inside a house quite dry, so it may help to run a humidifier (hu-MID-i-fy-er), a machine that puts moisture back into the air. It is also a good idea for people with psoriasis to avoid getting harsh soaps and chemicals on their skin. In addition, they should protect their skin from injury by taking such steps as not wearing overly tight clothes or shaving with a dull razor.

▶ See also **Skin Conditions**

Resources

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Updike, John. *Self-consciousness: Memoirs*. New York: Knopf, 1989.

Organizations

American Academy of Dermatology. PO Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: <http://www.aad.org/DermAZ/psoriasis>.

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-226-4267. Web site: http://www.niams.nih.gov/Health_Info/Psoriasis/default.asp.

National Psoriasis Foundation. 6600 SW Ninety-second Avenue, Suite 300, Portland, OR, 97223-7195. Telephone: 503-244-7404. Web site: <http://www.psoriasis.org>.

Psychopharmacology

Medical doctors called psychiatrists prescribe medications for mental, emotional, behavioral*, and mood disorders*. These medications often are part of a treatment plan that includes psychotherapy, which typically is talk therapy either on a one-on-one or group basis.*

Psychopharmacology

Psychopharmacology (SY-koe-far-ma-KOL-o-jee) is the study of how medications affect moods, thoughts, and feelings. Psychopharmacology was mostly developed during the 20th century. Before it became a science, no medications were available to assist those who had schizophrenia* to quiet the voices in their heads and to help people who had depression to find the energy to face a new day. As of the early 2000s, a wide range of prescription medications are available, which have caused a transformation in the treatment of these disorders and many others.

Psychiatric medications are generally classified into categories that based on the chemistry of how they work in the body (mechanisms of action) or the symptoms they help relieve. Many medications fall into more than one category. For example, the same medication might improve symptoms of both depression and anxiety. The following list includes some major types of psychiatric medications:

- Antidepressant medications*, which include tricyclic antidepressants (TCAs), monoamine oxidase inhibitors (MAOIs), and selective serotonin reuptake inhibitors (SSRIs) (sometimes grouped

* **psychiatrists** (sy-KY-uh-trist) are medical doctors who have completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can diagnose mental illnesses, provide mental health counseling, and prescribe medications.

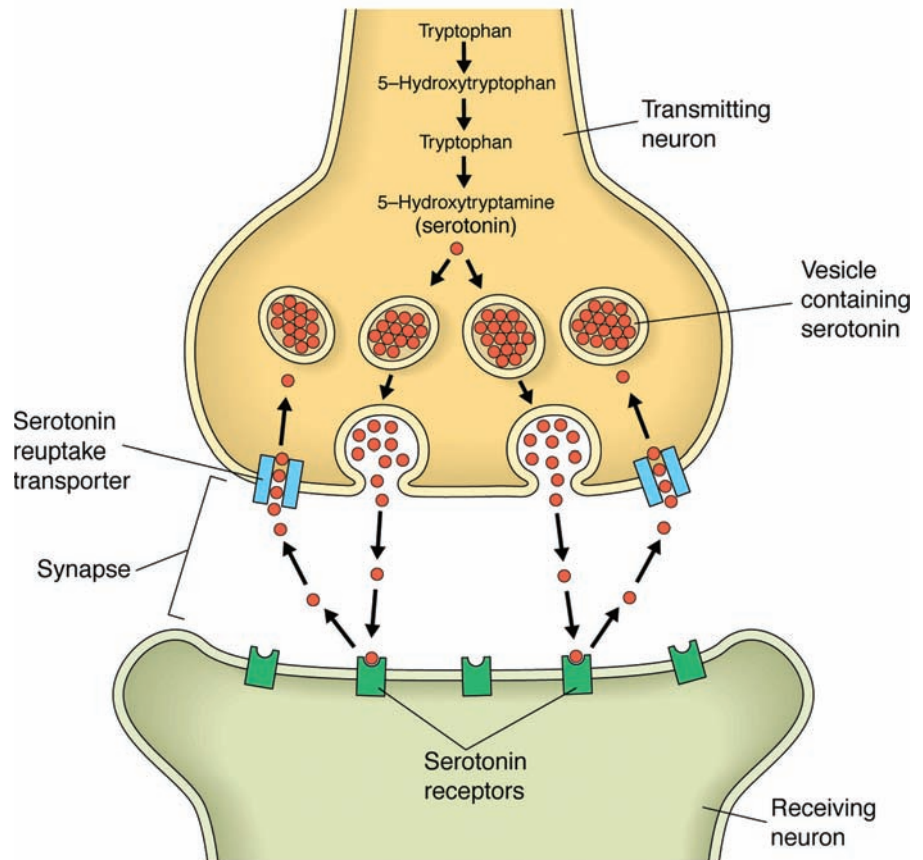
* **behavioral** means related to the way a person acts.

* **mood disorders** are mental disorders that involve a disturbance in the person's internal emotional state. They include depressive disorders, bipolar disorders, and mood disorders associated with the use of drugs or medical illnesses.

* **schizophrenia** (skit-so-FREE-nee-ah) is a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors, which distort their view of reality.

* **antidepressant medications** are used for the treatment and prevention of depression.

Psychiatric medications can help correct imbalances in the neurotransmitters that affect mood and behavior. Selective serotonin reuptake inhibitors (SSRIs), such as fluoxetine (Prozac), fit into the serotonin neuroreceptors on neuron dendrites. This blocks serotonin from entering the neuron and keeps it active for longer periods of time in the synaptic gaps between transmitting and receiving neurons. Serotonin (5-Hydroxytryptamine) is a calming neurotransmitter that is manufactured in nerve cells from the amino acid tryptophan. Turkey is one good source of tryptophan, which may help explain why people often feel relaxed and sleepy after Thanksgiving dinner. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



* **serotonin** (ser-o-TO-nin) is a neurotransmitter, a substance that helps transmit information from one nerve cell to another in the brain. It is associated with feelings of well-being.

* **norepinephrine** (NOR-e-pi-ne-frin) is a body chemical that can increase the arousal response, heart rate, and blood pressure.

* **anticonvulsants** (an-tie-kon-VUL-sents) are medications that affect the electrical activity in the brain and are given to prevent or stop seizures.

* **stimulant** (STIM-yoo-lunt) a drug that produces a temporary feeling of alertness, energy, and euphoria.

* **antipsychotics** describes a type of medication that counteracts or reduces the symptoms of a severe mental disorder such as schizophrenia.

under the heading of selective serotonin* and norepinephrine* reuptake inhibitors (SNRIs)

- Antianxiety medications (tranquilizers), which include barbiturates, benzodiazepines, and the atypical anxiolytic buspirone
- Antimanic medications (mood stabilizers), including lithium
- Anticonvulsant* medications, including phenobarbital
- Antipsychotic medications (neuroleptics)
- Stimulants*

Examples of well-known psychiatric medications include the brand names Prozac and Paxil (antidepressants); Valium, Xanax, and BuSpar (antianxiety medications); Tegretol (anticonvulsants); Thorazine and Haldol (antipsychotics*); and Ritalin and Concerta (stimulants).

How Do Psychiatric Medications Work?

Psychiatric medications target the complex arrangement of nerve cells, or neurons, and certain chemicals, called neurotransmitters*, in the brain and central nervous system*. Neurons manufacture neurotransmitters to carry messages from one nerve cell to the next. They do it by crossing a space, called the synaptic gap, between the axon (transmitting terminal) of one neuron and the dendrites (receiving terminals) of the next

neuron. When the neurotransmitter reaches the new neuron, it connects with a docking port, known as a neuroreceptor. This fit between the neurotransmitter and neuroreceptor is very specific, and the neurotransmitter fits its particular neuroreceptor the way a key fits a lock. A change in a neurotransmitter's chemical structure and therefore its shape, or an imbalance at any point in this complex process, may affect emotions, moods, thoughts, behaviors, and mental states. Psychiatric medications help restore proper balance. They often target important neurotransmitters, such as serotonin (ser-o-TONE-in), dopamine*, epinephrine, norepinephrine (monoamines), acetylcholine, gamma-aminobutyric acid (GABA), glutamic acid, enkephalins, and endorphins.

For instance, some people who experience chronic depression may not have enough serotonin in their systems. As a result, the nerve cells cannot communicate as well as they should, and depression results. The medication fluoxetine (Prozac) helps increase the amount of serotonin available in part by tricking the neuron into making more serotonin. It does this by blocking a sensor on the neuron that regulates serotonin production and essentially instructs the neuron to release more serotonin. MAOIs work differently. These drugs effectively impede the body's ability to "clean up" used neurotransmitters. Normally, the body has certain proteins that circulate in the brain where they break down neurotransmitters after they have done their job of transmitting a message from one neuron to another. MAOIs inhibit the proteins, thereby boosting the level of neurotransmitters in the brain, where they can then transmit additional messages between neurons.

Not all drugs are as clear-cut in how they work. Methylphenidate (Ritalin) is an example. For many years, scientists were unsure exactly why Ritalin was effective in treating ADHD* in children. In 2004, however, researchers announced that the drug increases levels of the neurotransmitter dopamine in the brain. They believe this dopamine upsurge leads to heightened concentration and motivation. Research on the exact mechanism of this drug, and many others, continued in the early 2000s.

What Are the Beneficial Effects of Psychiatric Medications?

Psychiatric medications can help improve many of the most distressing symptoms of mental, emotional, and mood disorders. They can reduce the stress of living with chronic diseases and conditions, and they can improve the effectiveness of counseling and psychotherapy. Among their most beneficial effects:

- Decreasing feelings of hopelessness, darkness, and apathy in depression
- Preventing relapse of depression
- Reducing cravings, anxiety, obsessions, compulsions, and phobias
- Preventing panic attacks

* **neurotransmitters** (nur-o-trans-MIH-terz) are chemical substances that transmit nerve impulses, or messages, throughout the brain and nervous system and are involved in the control of thought, movement, and other body functions.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **dopamine** (DOE-puh-meem) is a neurotransmitter in the brain that is involved in the brain structures that control motor activity (movement).

* **ADHD** or Attention Deficit Hyperactivity Disorder, is a condition that makes it hard for a person to pay attention, sit still, or think before acting.



▲
Methylphenidate (Concerta, Ritalin) is a stimulant. It often is prescribed to treat the symptoms of attention deficit hyperactivity disorder (ADHD). When misused, however, methylphenidate can harm the body in the same manner as other forms of amphetamine abuse.

Photo Researchers, Inc.

BRAND NAME VS. GENERIC MEDICATIONS

Psychiatrists and psychopharmacologists study the research on medications before prescribing them. They attend training sessions, read medical journals, and review descriptions in medical manuals that provide information on medications (how they work, how they help patients, whether they cause side effects, whether they can be used safely with a patient's regular diet and other prescription medications, and if a generic is available).

In the United States, when a new drug is developed, it is protected by a drug patent that usually runs for 17 years. The patent allows the company that developed it to manufacture and sell the medication exclusively. When the patent expires, other companies can manufacture and sell a generic version of the drug provided the generic drug has been tested and has received approval from the Food and Drug Administration.

A generic drug is the same as its brand-name counterpart in dosage, in strength, in how it works and should be taken, as well as in safety and quality. However, a generic drug is less expensive than the brand-name drug because the cost of the research and development of the original medication was undertaken by the first company.

Patients should talk to their doctors or pharmacists about availability of generic drugs for any of their prescriptions.

- Reducing hallucinations, delusions, inappropriate behaviors, and the internal voices that often accompany schizophrenia
- Calming impulsivity, hyperactivity, and mania
- Improving concentration, memory, and sleep

Selecting the right medication and the right dosage are complicated tasks, requiring that doctors take detailed medical histories from their patients and their patients' families. Doctors must know about other medical conditions the patient may have, about other medications the patient may be taking (including aspirin, alcohol, herbal supplements, and tobacco), and about the patient's diet and daily life. Doctors also must monitor patients who are taking medications to ensure that their symptoms improve and to adjust dosages or change prescriptions if side effects occur.

What Are the Adverse Effects of Psychiatric Medications?

Adverse effects are unwanted side effects, and psychiatric medications can have serious adverse effects, especially if the patient is not monitored carefully by a doctor. Depending on the medication, adverse effects may include:

- Drowsiness or sleepiness at the wrong time of day, making it dangerous to operate machinery or drive a car
- Restlessness or wakefulness at night

- Headache, dizziness, or blurry vision
- Dry mouth or increased thirst
- High blood pressure
- Skin rashes
- Nausea or vomiting
- Unwanted weight loss or unwanted weight gain
- Unwanted changes in thoughts or behavior, such as losing interest in dating, losing interest in creativity, or having suicidal thoughts that never occurred before
- Seizures, especially if a medication interacts with certain foods or other medications
- Muscle spasms, slurred speech, or a movement disorder called tardive dyskinesia

The complex chemistry of psychiatric medications and the central nervous system also can affect other body organs and systems, such as the blood, bone marrow, thyroid gland, liver, and kidneys. MAOIs can interact with cheeses, wines, or cold medications to cause seizures. Some medications can interfere with a child's normal growth and development. Others can pose serious risks to pregnant women, nursing mothers, and their babies. Older adults who are taking multiple prescriptions are at particular risk for harmful drug interactions. Some psychiatric medications can also lead to addiction, withdrawal* symptoms if the medication is stopped, and accidental overdoses. People who use psychiatric medications must see their doctors regularly and report side effects as soon as they notice them.

What Is Next in Psychopharmacology?

The science of psychopharmacology began in the middle of the 20th century, and researchers in the early 2000s were still making discoveries at a rapid pace. They were developing new medications that target more than one neurotransmitter at the same time, in order to improve symptoms in multiple categories at once. They were trying to learn why some drugs are effective, so they could use the knowledge to make them work better or to create new medications altogether, and they were also developing and running clinical trials on newer medications with fewer adverse effects, reduced risk of addiction and withdrawal symptoms, and less chance for tardive dyskinesia.

Psychiatric medications are most effective when the people who take them work with psychiatrists and medical doctors to update their prescriptions as often as necessary.

▶ See also **Anxiety and Anxiety Disorders • Attention Deficit Hyperactivity Disorder (ADHD) • Bipolar Disorder • Brain Chemistry (Neurochemistry) • Depressive Disorders • Obsessive-Compulsive Disorder • Psychosis • Schizophrenia • Tourette Syndrome**

Tardive Dyskinesia

Tardive dyskinesia (TAR-div DIS-kuh-NEE-zhuh) is one of the most distressing adverse effects of antipsychotic medication. It is a disorder of the neuromuscular system that causes muscle spasms and tics, which are involuntary movements affecting the eyes, tongue, face, neck, fingers, arms, toes, or legs. Tardive dyskinesia may disappear if the medication is stopped, but sometimes it becomes a chronic condition. People who develop tardive dyskinesia often continue taking their medication, however, because the beneficial effects outweigh this serious adverse effect.

* **withdrawal** a group of symptoms that occurs when a drug that causes physical or psychological dependence is regularly used for a long time and then suddenly discontinued or decreased in dosage.

- * **delusions** (de-LOO-zhuns) are false beliefs or judgment that remain even in the face of proof that they are not true.
- * **hallucinations** (ha-LOO-sin-AY-shuns) occur when a person sees or hears things that are not really there. Hallucinations can result from nervous system abnormalities, mental disorders, or the use of certain drugs.
- * **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

Resources

Books and Articles

- Hedges, Dawson, and Colin Burchfield. *Mind, Brain, and Drug: An Introduction to Psychopharmacology*. Boston: Pearson/Allyn and Bacon, 2006.
- Levinthal, Charles F. *Drugs, Behavior, and Modern Society*, 5th ed. Boston: Pearson/Allyn and Bacon, 2008.

Organizations

- American Academy of Child and Adolescent Psychiatry.** 3615 Wisconsin Avenue NW, Washington, DC, 20016-3007. Telephone: 202-966-7300. Web site: <http://www.aacap.org>.
- American Psychiatric Association.** 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.psych.org>.
- Food and Drug Administration.** 5600 Fishers Lane, Rockville, MD, 20857-0001. Toll free: 888-INFO-FDA. Web site: <http://www.fda.gov>.
- National Institute of Mental Health.** Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov>.

Psychosis

Psychosis (sy-KO-sis) is a broad term covering a range of mental illnesses associated with a loss of connection to reality. Illnesses that involve psychosis may severely impair a person's ability to relate to other people and to perform basic tasks of daily life.

What Is Psychosis?

“Psychosis” is a medical term used to describe serious mental disorders that cause a person to lose touch with reality. People with psychosis may have delusions*, hallucinations*, or dementia*; they may lose the ability to speak coherently or to understand what others say to them; and their thoughts, feelings, and behaviors may be inappropriate and disconnected from the reality around them without their being aware of the disconnection.

Disorders associated with psychotic symptoms In some cases, psychosis lasts only for a few days or weeks (acute or brief psychosis), but

sometimes it is a chronic* condition. Some of the disorders associated with psychosis include:

- Schizophrenia (SKIT-zo-free-nee-a) and related conditions, including brief psychotic disorder and schizophreniform (SKIT-zo-fre-ni-form disorder, which are characterized by hallucinations or delusions and may lead to problems in daily functioning
- Serious mood disorders, for example, major depression or bipolar disorder* with psychotic features
- Alzheimer's disease, a progressive disorder that affects the brain, most often in older adults, that usually causes dementia
- Alcoholism, which causes many physical problems, including liver disease and delirium tremens, a temporary condition involving hallucinations, delusions, fears, sweating, and discomfort, which typically occurs in the first few days after people with alcoholism stop drinking completely
- Wernicke-Korsakoff syndrome (VER-ni-kee KOR-sa-kof SIN-drome), sometimes called Korsakoff's psychosis, which causes confusion, severe memory loss, and inability to control muscle activity, often resulting from advanced alcoholism or thiamine (a B vitamin) deficiency
- Seizure disorders, which may temporarily disrupt the electrical patterns in the brain and the thought processes controlled by brain cell activity
- Postpartum psychosis, a disorder that sometimes affects women who recently have given birth
- Substance abuse, particularly relating to use of cocaine, steroids, and hallucinogens such as PCP and LSD

Treatment Psychosis is a sign of serious illness, and people with psychosis must be thoroughly evaluated and should receive appropriate medical treatment. Treatment often involves medication and psychotherapy and sometimes requires that a patient be hospitalized.

Medical treatment for people with psychosis improved greatly toward the end of the 20th century. Safer and more effective medications were developed. Many reforms to the laws were designed to safeguard the rights and freedoms of people with mental illnesses, so that they were no longer hospitalized against their will without a fair hearing and legal representation.

Psychosis and the Insanity Defense

The U.S. legal system rests on the notion of personal responsibility. To find a person guilty of a crime requires proof that the person committed the crime and that he or she can be found blameworthy. When might a person not be found at fault? One example is when the law allows a verdict of innocence, even when a crime has been committed, because



▲ Andrea Yates walks into the courtroom for a hearing on July 27, 2006, in Houston, where she was committed to the maximum-security North Texas State Hospital after being found not guilty by reason of insanity in the June 2001 bathtub drownings of her five children. *AP Images.*

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **bipolar disorder** a group of mood disorders that are characterized by alternating episodes of depression and mania.

CULTURAL BELIEFS ABOUT MENTAL ILLNESS

The fact that definitions of psychosis and mental illness changed over the years led to debate about whether mental illness really exists.

The astronomer Galileo Galilei (1564–1642), for example, was considered to be mentally ill because he believed that the Earth revolved around the Sun during an era in which everyone else in his culture believed the opposite. Galileo's belief threatened teachings of the Roman Catholic Church, and he was called before the Inquisition in 1633 and was asked to abandon his belief. When he refused to do so, he was condemned for heresy and held under house arrest for the last nine years of his life. Galileo was not mentally ill. Galileo understood that his culture did not accept his belief, but his personal commitment to scientific reality was more important to him than acceptance by his contemporaries.

British psychiatrist R. D. Laing (1927–1989) believed that mental illness was a form of withdrawal from reality that people chose when they no longer could tolerate situations that other members of their family or society found acceptable. He thought that “mental illness” was a sane response to an insane world. Laing believed that psychiatrists sometimes diagnosed mental illness when the true problems were, in fact, rebellion and a refusal to live in an unlivable

situation. Laing's publications include *Sanity, Madness, and the Family*; *Self and Others*; *The Divided Self*; and *The Politics of Experience*.

American psychologist Thomas Szasz (b. 1920) believes that mental illness is a metaphor for thoughts, feelings, and behaviors of which society disapproves. His well-known book *The Myth of Mental Illness* holds that society uses “mental illness” as a label to control people, forcing them to accept unwanted treatment and hospitalization. Szasz believes that all medical treatment must be voluntary.

While it is certainly true that medical diagnoses sometimes have been misused for social control, many mental health professionals do not agree with Laing and Szasz that mental illness is a myth, metaphor, or chosen response. To believe this would be to deny a biological basis for many instances of mental illness and to deny the pain, disorientation, and fear that people with mental illnesses experience.

People with psychosis are seriously ill with medical conditions that affect their thoughts, feelings, and ability to understand reality, sometimes even the reality that they need medical treatment. In fact, many patients later thank those who insisted they receive treatment, because when they recover they recognize that their illness had been affecting their thinking.

the crime was committed in self-defense. The other extreme circumstance that might “excuse” a crime is called the insanity defense.

Psychosis is a medical term involving illnesses that cause people to lose touch with reality. *Insanity* is a legal term used to describe some mental states that severely limit people's ability to understand their actions so that they cannot be held responsible for those actions. Legal tests for determining sanity during court trials using the insanity defense usually focus on whether the people on trial understood what they were doing when they committed crimes, understood the difference between right and wrong, and were able to control their own behavior.

As of the early 2000s, the legal test for insanity varies from location to location. Some states use the British M'Naghten rule, named after Daniel M'Naghten, who attempted a political assassination in England in 1843. Other states use the American Law Institute (ALI) test, also called the Model Penal Code. The ALI test was used during the 1982 trial of John Hinckley Jr., who attempted to assassinate President Ronald Reagan in

1981. When Hinckley was found “not guilty by reason of insanity,” a political backlash occurred, and the U.S. Congress introduced the legal concept of “guilty, but mentally ill.”

The American Psychiatric Association (APA), the medical group that publishes standards for classifying mental illnesses and supports research about their treatment, does not use the legal term *insanity*. The APA maintains that psychiatrists may testify in court to help trial participants understand mental illness and psychosis, but that questions of innocence, guilt, and moral responsibility need to be left to judges and juries.

▶ See also **Alcoholism • Delirium • Delusions, Delusional Disorders, and Paranoia • Hallucination • Personality and Personality Disorders • Schizophrenia • Substance Abuse**

* **cognitive** associated with thinking, learning, perception, awareness, and judgment.

Resources

Organizations

American Academy of Psychiatry and the Law. P.O. Box 30, One Regency Drive, Bloomfield, CT, 06002-0030. Toll free: 800-331-1389. Web site: <http://www.aapl.org>.

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.psych.org>.

National Alliance on Mental Illness. Colonial Place Three, 2107 Wilson Boulevard, Suite 300, Arlington, VA, 22201-3042. Toll free: 800-950-NAMI. Web site: <http://www.nami.org>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Telephone: 301-443-4513. Web site: <http://www.nimh.nih.gov>.

Puberty and Sexual Development

Puberty and sexual development mark a normal stage of life during which adolescents experience many physical, cognitive, and emotional changes.*

Concerns Regarding Puberty and Sexual Development

“Mostly I’m pretty scared because I don’t know if I’m normal or, you know, just strange. My body seems to be changing but not like some of my friends. I still look pretty much like a little kid and my best

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

friend looks like he's 18 or something. I don't want to go near the gym anymore because then I'll have to take a shower. I know the other guys are going to laugh at me because I, well, you know, just don't look developed."—John, age 13.

"Now I have zits all over my face, my nose is too big and my breasts are too small. It really bothers me. I don't think guys will ever notice me, let alone like me if my body stays like this—I'm a disaster."—Dominique, age 14.

"No one had told me anything about menstruation. When I started to bleed and nobody was at home, I got so scared I called 911."—Aisha, age 12.

During adolescence the body a child has had for several years seems to become different and sometimes strange. This phase of development is referred to as puberty and involves rapid changes in the body, including sexual maturation. Bodies change, attitudes about self and others change, thinking abilities change, and interest in sexual activities changes as well. The good news is that puberty does not last forever. Most people get through it by age 18.

What Is Sexual Development?

Adolescence in Western societies ranges from about 8 to 20 years of age. During this period there are major physical and emotional changes associated with sexual development. Puberty is the physical change that prepares individuals to reproduce.

Puberty is the growth stage in which the reproductive organs mature. Girls begin puberty, on average, about two years before boys. For girls, physical changes associated with puberty usually begin between the ages of 10 and 14, but they may be seen as early as age 8. For boys, the normal age range for the start of puberty is between age 12 and 16, but it can begin as early as age 9. The onset of puberty is not considered precocious unless it is before age 8 in girls or before age 9 in boys. African American girls, in general, start puberty a year earlier than girls of other races.

What starts puberty is unknown, but the hypothalamus, a small area located deep within the brain, plays a key role. During puberty the hypothalamus and pituitary gland, a pea-sized organ located just beneath the hypothalamus, send out chemical messages that cause the gonads, or sex glands (testes in boys, ovaries in girls), to increase production of sex hormones* (testosterone in boys; estrogen in girls). With the increase in these hormones, the body begins to develop secondary sex characteristics (e.g., body hair, breasts, deeper voice) as well as to undergo a growth spurt.

The organs involved in sexual reproduction also enlarge and develop. For girls this series of changes leads to menstruation and signals that the body is capable of sexual reproduction (having babies). For boys these changes lead to the production of sperm. Boys may have experienced erections throughout childhood; however, ejaculation, the release of sperm in

a fluid called semen, is only possible when this developmental level has been achieved.

Many studies suggest that neither girls nor boys are prepared for the physical changes that make their bodies seem strange and foreign. Most girls report they knew little or nothing about what usually is referred to as a “period” before their first menstrual flow. It is also typical for boys not to understand their newly acquired potential for ejaculation. Menstruation and ejaculation can be quite shocking and frightening experiences if one is unaware of them and unprepared.

What Are Sex Hormones?

The increase in growth rate that occurs during puberty is driven by the body’s increase in production of sex hormones: estrogen from the ovaries* in girls, and testosterone from the testicles* in boys. These hormones cause the skeleton to grow and to mature more rapidly. Hormones produced by the adrenal glands* at puberty contribute to the development of pubic hair (near the genitals) and underarm hair, but have little effect on bone growth. It follows, then, that disorders of pubertal development can affect a child’s growth pattern and ultimate height. Pubertal disorders usually are grouped into two categories: precocious or premature puberty (which starts earlier than expected) and delayed or late puberty.

Precocious puberty

In general, puberty is considered precocious (early) if changes in sexual development occur before age eight for girls and before age nine for boys. Most cases of precocious puberty result from the premature switching on of the puberty control center in the brain, located in the part of the brain called the hypothalamus (hy-po-THAL-a-mus). Hormones from the hypothalamus trigger the release of hormones from the pituitary gland (located at the base of the brain), which in turn stimulate the ovaries in girls and the testicles in boys to produce the higher levels of sex hormones needed to bring about the bodily changes of puberty.

The early growth spurt associated with precocious puberty causes these children to grow taller than their peers initially. However, their skeletons mature more rapidly causing them to stop growing at an age when their peers continue to grow. The result is that children with precocious puberty may end up smaller at the end of adolescence than their peers.

There are many possible causes for precocious puberty, including brain tumors* and other disorders of the central nervous system*; and tumors or other conditions that cause the gonads or adrenal glands to overproduce sex hormones. Childhood obesity* accelerates puberty and combined with other factors could lead to precocious puberty. In girls, the majority of cases of precocious puberty are idiopathic (id-ee-o-PATH-ik), which means the precise cause is unknown.

The first sign of puberty in girls is usually breast development and pubic hair. However, these signs of puberty may occur early without the

* **ovaries** (O-vuh-reeez) are the sexual glands from which ova, or eggs, are released in women.

* **testicles** (TES-tih-kulz) are the paired male reproductive glands that produce sperm.

* **adrenal glands** (α-DREEN-al glands) are the pair of endocrine organs located near the kidneys.

* **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

* **genetics** (juh-NEH-tiks) is the branch of science that deals with heredity and the ways in which genes control the development and maintenance of organisms.

* **cortisone** (KOR-ti-zone) is a medication used to relieve inflammation.

gonadal changes that mark the true beginning of puberty. Therefore, early breast enlargement or pubic hair growth alone or together are not indicators of precocious puberty unless accompanied by gonadal changes.

Precocious puberty often can be treated effectively or controlled with medications that decrease the overproduction of sex hormones or that block their effects on the body. In many cases, this type of treatment can prevent or decrease the shortening of the child's ultimate height that would otherwise occur.

Delayed puberty

Delayed puberty occurs when the hormonal changes of puberty occur later than normal, or not at all. Puberty is considered late if it has not begun by age 14 in girls or by age 16 in boys. Most children who experience delayed puberty follow a normal pattern and experience no actual abnormality. They do not experience growth spurts at the usual age, so they lag behind in height as their peers grow rapidly and mature sexually, but when puberty finally occurs for these children, they catch up. They may continue to grow into their late teens and may even exceed the final adult heights of some of their peers.

One of the main causes of delayed puberty is genetics*; if one of the parents experienced delayed puberty, the child most likely will also experience delayed puberty. Also, female athletes, including gymnasts and ballerinas, often have delayed puberty. Several medical conditions (such as disorders of the hypothalamus, pituitary, ovaries, and testicles) can result in delayed puberty by interfering with the pubertal rise in sex hormones. Many chronic disorders of other body organs and systems (such as the intestines and lungs), as well as long-term treatments with certain medications (such as cortisone*) also may cause delayed puberty.

What Changes in Attitudes, Thoughts, and Emotions Occur?

Puberty is a normal developmental stage that involves rapid and dramatic changes. In addition to physical changes, adolescents also experience changes in mood, thinking, and in social interests.

Mood Changes in hormones in the adolescent body can trigger sudden and unpredictable changes in moods. One minute a boy or girl may be laughing and then, for no apparent reason, he or she can suddenly become angry or tearful. The different feelings that adolescents experience often make them feel like their emotions are on a roller coaster. The increased production of sex hormones is just one of many factors that contribute to these mood swings.

Cognition During this stage of life, adolescents develop the ability to think in more abstract and logical ways. They have a greater ability to examine their own, as well as other's, thoughts. These improved cognitive abilities often contribute to the disagreements between adults and

adolescents as the adolescent is trying out new ways of thinking about various subjects. If adults are not prepared for the changing nature of the adolescent's thought process, then the adolescent may feel as if he or she is being misunderstood or "treated like a child." Similarly, because adolescents are just beginning to develop these different cognitive abilities, there may be times when they want to think and act more like they did when they were younger. The adults around them need to respond to these changes and provide appropriate, challenging opportunities, but not opportunities that will overwhelm or frustrate the adolescent. The adults surrounding the adolescent are also learning about this changing, new person and are undergoing their own developmental process.

Sensitivity Adolescents are also changing the way they think about themselves and others. Adolescents at this developmental stage are quite involved with their own thoughts and feelings. Many adolescents believe that others are similarly self-absorbed. Additionally, adolescents at this time believe that others are looking at them or thinking about them in a critical manner. Some adolescents become very sensitive about body image*, minor mistakes they make, or differences between themselves and others. Sometimes people feel that adolescents are hyper-sensitive, that adolescents care too much about relatively minor issues. For the adolescents, however, this hypersensitivity is part of their normal process of developing an understanding of who they are.

Uniqueness Adolescents have a new sense of personal uniqueness or egocentrism. At this stage, adolescents believe that no one else can ever understand how they feel, not parents, not even friends. Sometimes, to maintain a sense of personal uniqueness, adolescents may have ideas and beliefs that seem inaccurate or unrealistic, which is a normal reaction to the changes that the adolescent is undergoing.

Invulnerability Sometimes adolescents believe they are indestructible or invulnerable to danger. This belief can lead to reckless behaviors such as drug use, fast driving, daredevil behaviors, suicidal thoughts, or sexual promiscuity. Adolescents may be unable to comprehend accurately the potential risks and negative outcomes of reckless acts. The difference between their perception of risk and adult understanding of it makes for generational conflict; adults are responsible for keeping adolescents safe, and adolescents perceive adult actions as overly controlling, cautious, or out of touch.

What About Sexual Feelings?

Adolescent development comes with many new and different physical and emotional feelings. Some of the most confusing may be the sexual thoughts that cause sensations or reactions in the body. Both girls and boys experience sexual feelings. These feelings are pleasurable and exciting and perfectly normal. Sometimes it is difficult to know what one is expected to do with these new sexual feelings. Adolescents are aware of

* **body image** is a person's impressions, thoughts, feelings, and opinions about his or her body.

Did You Know?

There are between 15,000 and 30,000 whiskers on a man's face.

many, often conflicting, beliefs about sex. For example, even though masturbation is a common characteristic of human sexuality, many people feel embarrassed to talk about it or may feel it is harmful or sinful. Adults can help adolescents learn that sexual development and the physical changes of their bodies are normal. Unfortunately, many adults are reluctant to discuss these subjects, and adolescents are left with the impression that there is something wrong or shameful about the natural functioning of their bodies.

Menstruation

When girls reach a particular stage of development, usually between ages 9 and 15, menstruation (MEN-stru-A-shun) begins. Often referred to as a “period,” the word “menstruation” comes from the Latin word “mensis” meaning month. Each month an egg (ovum) is released from a woman’s ovaries, a process called ovulation. The egg carries half of the genetic information needed to create a baby. The other half is contained in the sperm cell provided by the male. If the egg is fertilized by sperm, the embryo implants in the uterus where it will grow. If the egg is not fertilized, the soft lining of the uterus is shed and passes out of the woman’s body. Every month a woman’s body readies for pregnancy. The time between one menstruation and the next is about a month and is called the menstrual cycle.

Information Menstruation is a normal and important fact of a woman’s life. Many young women are not adequately informed about menstruation. One study found that 43 percent of women felt frightened, panicky, or ill when they first started to menstruate. About one-third of women in another survey did not know about menstruation before they began menstruating. It is important for girls to be told about the various physical and emotional changes surrounding menstruation. For example, it is common for a woman’s breasts to feel swollen and tender before her period begins. Other women experience temporary weight gain of a few pounds or sudden cravings for carbohydrates such as chocolate prior to their periods. Some women feel they are absent-minded or disorganized or that their emotions are out of control before their periods begin. Many women experience cramps (pains in the lower abdominal area) at the start of their periods. All of these symptoms are normal and it is important that young women understand that these potential feelings are a natural part of menstruation.

Erections and Ejaculation

When boys reach puberty they may begin to experience more frequent erections. Erections occur when blood rushes into the penis, causing it to swell and stiffen. Ejaculations occur when sperm mixes with fluids from the prostate gland and exits through the opening of the penis. It is through ejaculation that sperm leaves the male’s body to enter the female’s body when the two combine during sexual intercourse to begin

a pregnancy. Not all erections lead to ejaculations or sexual intercourse. As boys mature, they may also have erections and orgasms during sleep. These are called nocturnal emissions (wet dreams). Nocturnal emissions are normal for boys. If a boy's pajamas or sheets are wet and sticky upon awakening, he has probably had a wet dream.

Sometimes a full bladder may cause an erection so it is not uncommon for males to awaken with an erection. Because there are many ways to excite the penis to erection, sometimes men have erections for no apparent reason. Boys may have erections at inconvenient times that can be embarrassing, perplexing, or even anxiety provoking. While these experiences are embarrassing and troublesome, they are all quite normal.

Masturbation

Masturbation is the self-stimulation of the genitals to achieve pleasurable sensations, sometimes resulting in sexual orgasm. It is one of the most common human sexual expressions. Children from about the age of two and a half years may masturbate. A recent study has shown that one-third of females and two-thirds of males report masturbating before they reached adolescence. Many parents are hesitant to condone or express their approval of masturbation. Many religions teach that masturbation is improper. It is a difficult topic to discuss openly even though the majority of teenage boys and girls report having masturbated by the end of puberty.

While masturbation is a safe and available release for sexual tension, many people masturbate and many do not. It is a matter of personal choice, guided by personal beliefs and values.

What Are Some Issues Associated with Sexual Activity?

While most people engage in some form of mutual sexual interaction at some time in their lives, when, with whom, and why are important factors that should be carefully considered before activities begin. In addition to the emotional price of having sex before one is ready, it poses some potential health risks and other problems. Unexpected pregnancy and sexually transmitted disease* are two results that may occur after engaging in sexual intercourse.

Pregnancy Pregnancy is a natural outcome of sexual intercourse. Unless a couple is prepared and ready to start a family, an unexpected pregnancy can cause many problems. This is one of the major reasons why individuals should consider the consequences of acting on sexual desire before engaging in intercourse. There are many ways to prevent pregnancy. These methods are called contraception or birth control. The most effective method of contraception, and the only one that is 100 percent effective, is to refrain from all sexual intercourse until ready for pregnancy, which is called "abstinence." Many religious groups and many parents support the idea that sexual intercourse should only occur in marriage.

* **sexually transmitted disease** is an infection, such as the human immunodeficiency virus (HIV) or herpes, that can be passed from person to person by sexual contact.

* **ejaculate** (e-JAH-kyoo-late) means to discharge semen from the penis.

* **gonorrhea** (gah-nuh-REE-uh) is a sexually transmitted disease (STD) spread through all forms of sexual intercourse. The bacteria can also be passed from an infected mother to her baby during childbirth. Gonorrhea can affect the genitals, urethra, rectum, eyes, throat, joints, and other tissues of the body.

* **chlamydia** (kla-MIH-dee-uh) are microorganisms that can infect the urinary tract, genitals, eye, and respiratory tract, including the lungs.

* **herpes** (HER-pee-z) is a viral infection that can produce painful, recurring skin blisters around the mouth or the genitals, and sometimes symptoms of infection elsewhere in the body.

Contraception There are many methods of contraception. Using no “protection” against pregnancy by trying to time sexual contact or trying not to ejaculate* during intercourse are generally not considered effective. There are other methods of contraception that allow a couple to engage in sexual intercourse with different levels of protection against unwanted pregnancy. Men may use a condom, sometimes referred to as a rubber or jimmy, during intercourse. A condom is a soft, thin latex or polyurethane cover that fits over an erect penis.

Other forms of contraceptives include birth control pills, diaphragms, and intrauterine devices or IUDs. These methods are obtained from a doctor or health clinic. These methods are only used by women and require a thorough physical examination before they are prescribed.

It is important to understand that any decision about contraception, like any decision about sex, should be an informed decision. Discussions with parents, health professionals, counselors, and trusted adults should be part of making mature and informed decisions about sexual activity. Many states regulate the age at which a person can receive prescription birth control methods.

Sexually transmitted diseases Although the proper use of condoms can decrease the risk, abstaining from intercourse or other risky sexual activities is the only sure way to prevent the spread of sexually transmitted diseases, such as HIV/AIDS, gonorrhea*, chlamydia*, and herpes*.

What Is Sexual Orientation?

Sexual orientation refers to the pattern of one’s feelings for and sexual attraction toward other people. People can be heterosexual, homosexual, or bisexual. Most people’s orientation is heterosexual (attraction to the opposite sex). However, many normal people have homosexual (attraction to the same sex) or bisexual (attraction to both sexes) orientation. It is estimated that as many as 10 percent of people are homosexual, and as of 2009 there were no reliable estimates for the prevalence of bisexual orientation. There are many problems with obtaining reliable estimates of the numbers of gays, lesbians, and bisexuals in the population due to the homophobic discrimination these groups face.

Experimentation During adolescence one’s sexual orientation is often unsettled. Some people engage in various forms of sexual experimentation and exploration during early adolescence. Some experiment because an opportunity presents itself. Others do so out of curiosity or peer pressure. Still others are encouraged by their family to date before they are ready; this early dating may lead to sexual experimentation. These incidents of experimentation may not be consistent with a person’s adult pattern of sexual orientation or attraction.

How does sexual orientation develop? Sexual orientation is one fact of human sexual life, and it is central to everyone’s core identity. Most

people appear to be primarily heterosexual, so the causes for orientations that are not expressed by the majority is perplexing to many people. Many people wonder if homosexuality or bisexuality is a matter of choice. Are people born with their orientation already determined? Or is orientation a matter of environmental factors? Many scientists believe in the early 21st century that sexual orientation is not a matter of choice. These scientists think sexual orientation is genetically determined, just like eye or skin color. Other scientists believe that childhood experiences contribute to determining sexual orientation. Many scientists feel that sexual orientation is determined by both genetics and life experiences. As of 2009, there was no conclusive scientific evidence that explained what determines sexual orientation.

▶ See also **Body Image**

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Department of Health and Human Services. 200 Independence Avenue SW, Washington, DC, 20201, Web site: <http://www.4parents.gov/sexdevt/index.html>.

Eunice Kennedy Shriver National Institute of Child Health and Human Development. 31 Center Drive, Building 31, Room 2A32, MSC 2425, Bethesda, MD, 20892-2425. Toll free: 800-370-2943. Web site: <http://www.nichd.nih.gov/health/topics/puberty.cfm>.

Q-R

Quadriplegia *See Paralysis.*

Rabbit Fever *See Tularemia.*

* **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.

Rabies

Rabies (RAY-beez) is a viral infection of the central nervous system that usually is transmitted to humans by the bite of an infected animal.

What Is Rabies?

Because of its devastating effects, rabies has been one of the most feared diseases since it was first described in ancient times. A member of the *Rhabdoviridae* family of viruses causes rabies. In the United States, the virus lives primarily in wild bats, raccoons, skunks, and foxes; it sometimes is found in other animals as well, such as wolves, coyotes, or ferrets. Small animals such as hamsters, squirrels, mice, and rabbits typically do not carry the virus. More than 90 percent of reported rabies cases in animals occur in wild animals. The most common domestic animals that become infected, or “rabid,” are cats, dogs, and cattle. Throughout the world most cases of human exposure to rabies are to rabid dogs, but in the United States cases related to dog bites are rare. Indeed, most cases are linked to bats.

When a rabid animal bites a person, the rabies virus, which lives in the animal’s saliva, is transmitted through the body, where it can attack the central nervous system (the part of the nervous system that includes the brain and spinal cord), leading to encephalitis* and death. After symptoms begin, the disease can progress very quickly and can be fatal within a few days.

How Common Is Rabies?

Almost all reported cases of rabies in the United States occur in animals. In the year 2000, 7,369 cases of rabies in animals were reported to the Centers for Disease Control and Prevention; 509 of those infections were in domestic animals (pets and farm animals). Only five people were infected with



▲
 Jeanna Giese, 15, leaves Milwaukee's Children's Hospital on January 1, 2005. Giese was treated for rabies with an experimental combination of drugs and is the first known person to survive the disease without receiving the rabies vaccine. *AP Images.*

On the Wild Side

The most commonly infected wild animal in the United States is the raccoon, but raccoons are more a threat to dogs and cats than to humans. An effective rabies vaccine for wild animals is available that can be placed in bait left in the wild.

- * **mucous membranes** are the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.
- * **nausea** (NAW-zha) refers to a feeling of being sick to one's stomach or needing to vomit.
- * **delirium** (dih-LEER-e-um) is a condition in which a person is confused, is unable to think clearly, and has a reduced level of consciousness.

rabies that year, and all of them died. On average, only one or two deaths from rabies are seen in humans each year in the United States.

Is Rabies Contagious?

Rabies has not been found to be contagious from person to person. In theory, if a person infected with rabies were to bite someone else, the virus might spread, but no such case has been recorded. Animal bites are the most common cause of rabies in people. Rarely, the virus may spread when saliva or tissue from an infected animal enters an open wound or a mucous membrane*, such as when an infected animal licks a person's broken skin. In rare instances, exposure to bats, with no known bite or scratch, causes human rabies.

What Are the Signs and Symptoms of Rabies?

Once a person has been infected with the rabies virus, symptoms may appear as soon as 10 days or as long as 90 days after exposure. These symptoms typically happen in stages. The first stage may include fever, a general ill feeling, sore throat, loss of appetite, nausea* (NAW-zee-uh), vomiting, depression, and headache. If the person has been bitten by an animal, there may be a tingling sensation around the area of the bite. As the disease progresses and attacks the nervous system, a person may have difficulty sleeping and experience anxiety, confusion, aggressiveness, or hallucinations (ha-loo-sin-AY-shuns, seeing or hearing things that are not really there).

THE STRANGE FACTS IN THE CASE OF EDGAR ALLAN POE

American author Edgar Allan Poe (1809–1849), whose name is synonymous with horror and mystery, died as perplexing and shocking a death as any that he concocted in the many suspenseful and macabre tales that he wrote.

Poe set out on a trip from Richmond, Virginia, to Philadelphia at the end of September 1849. The next anyone heard of him—about a week after his departure—he had collapsed outside a tavern in Baltimore and was found quivering and raving. Four days later, on October 7, he died in a nearby hospital.

For many years it was thought that his symptoms of delirium*, cold sweat, confusion, memory loss, and difficulty in swallowing, could be attributed to severe alcoholism. In 1996, however, R. Michael Benitez, a doctor at the University of Maryland Medical Center, concluded in a review of the historical record that Poe, in fact, might have died of rabies.

Other symptoms of rabies infection include partial paralysis*, seizures* or muscle spasms, inability to speak, sensitivity to light or sound, and hydrophobia (hi-druh-FOE-bee-uh), or avoiding drinking water or other liquids due to trouble swallowing. In the final stages, the person may experience double vision* or find it difficult to swallow saliva (which can make someone appear to be “foaming at the mouth”). The disease can progress to coma* and death.

Making the Diagnosis

People who may have been exposed to rabies need immediate medical attention. If a person has symptoms of the disease, a doctor will perform a physical examination and ask questions to figure out whether the person might have been exposed to a rabid animal. To diagnose rabies in a human, doctors can perform several laboratory tests, including examination of blood and spinal fluid for antibodies* to the rabies virus. Skin biopsies* and saliva tests may also be done to search for signs of the infection. One of the best diagnostic tests is done on brain tissue from the potentially infected animal. The results can tell doctors whether the animal was rabid. Animals with less risk of being infected (such as a pet dog) can be isolated and observed by the local health department to see whether any signs of rabies develop.

How Do Doctors Treat Rabies?

It is recommended that someone who might have been exposed to rabies wash the site thoroughly with warm, soapy water. A person who has been bitten by or who has come into direct contact with an animal that may be rabid can receive immediate treatment by a doctor to prevent the disease from developing. This is called postexposure prophylaxis*. The person receives one dose of rabies immune globulin*, which provides the body with antibodies against rabies, followed by five doses of rabies vaccine* given over a period of 28 days. The modern rabies vaccine is safe and effective. It is administered in the arm and is not particularly painful. This treatment has proven to be very effective in preventing the development of rabies when it is started within a day of exposure.

Once a person has symptoms of rabies, treatment typically is limited to life support in the hospital. Approximately 40,000 people in the United States and an estimated 10 million people throughout the world are treated as a precaution each year after having been exposed to animals suspected of being rabid.

How Long Does the Disease Last and What Are the Complications?

Once symptoms have appeared the disease can progress very quickly to coma and death, generally within one to three weeks. Rabies infection that is not treated immediately almost always causes death. In rare cases in which people have survived, they often have severe and permanent brain damage.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **double vision** is a vision problem in which a person sees two images of a single object.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **biopsies** (BI-op-seez) are tests in which small samples of skin or other body tissue are removed and examined for signs of disease.

* **prophylaxis** (pro-fih-LAK-sis) means taking specific measures, such as using medication or a device (such as a condom), to help prevent infection, illness, or pregnancy.

* **immune globulin** (ih-MYOON GLAH-byoo-lin), also called gamma globulin, is the protein material that contains antibodies.

* **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

LOUIS PASTEUR'S VACCINE BREAKTHROUGH

Louis Pasteur (1822–1895), a French scientist, studied infectious diseases and developed the germ theory, which became the basis for explaining fermentation, recommending pasteurization, promoting antiseptic medical operations, controlling contagion. Pasteur developed a vaccine that could prevent rabies in humans. Having successfully tested this vaccine on dogs, Pasteur tried it for the first time on a human when in 1885 he vaccinated nine-year-old Joseph Meister (1876–1940), who had been bitten by a rabid dog. The little boy survived and as an adult worked as a caretaker at the Pasteur Institute, a nonprofit research institute founded in 1887, which in the early 2000s focused its research on such infectious diseases as HIV and AIDS.

Can Rabies Be Prevented?

Vaccinating household pets against rabies is very important in preventing the spread of the disease. This method has dramatically limited the number of rabies cases seen in domestic animals in the United States. People who are at greatest risk of exposure, such as veterinarians, travelers to areas of the world where rabid animals are common, and laboratory workers who handle material that may contain the rabies virus, often are immunized (vaccinated) against the disease. Taking the following safety measures also can help prevent rabies:

- avoiding contact with unfamiliar or wild animals, especially bats and raccoons
- never feeding or handling a wild or unknown animal
- keeping trash that is stored outside carefully sealed, to avoid attracting raccoons and other animals
- consulting a doctor for advice about receiving the rabies vaccine before traveling to an area where rabies is more common, such as Asia or Africa

▶ See also **Animal Bites and Stings • Encephalitis • Zoonoses**

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Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/RABIES>.

Radiation Exposure Conditions

Radiation is a naturally occurring form of energy. Everyone is exposed to small amounts of radiation, but exposure to very high doses may cause serious illness and death.

What Is Radiation and Where Is It Found?

Radiation is a form of invisible energy given off by atoms, which are the tiny particles that make up chemical elements.

Non-ionizing radiation Non-ionizing radiation does not change the structure of an atom. Instead, it excites molecules and shakes them up.

HIROSHIMA, NAGASAKI, AND CHERNOBYL

Much of what scientists know about the effects of exposure to high levels of radiation is based on studies of survivors of the atomic bombs the United States dropped on Hiroshima and Nagasaki, Japan, during World War II and nuclear power accident that occurred in Chernobyl in 1986.

In August 1945, during World War II, American pilots dropped atomic bombs over the Japanese cities of Hiroshima and Nagasaki. The heat, which reached thousands of degrees, and the radiation released by these bombs damaged and destroyed life over millions of square miles. At Hiroshima alone, more than 70,000 people died immediately, and a similar number were seriously burned. Many more people died of radiation poisoning in the years following the explosion of these bombs.

On April 26, 1986, in the Ukraine city of Chernobyl in Eastern Europe, a nuclear power plant experienced a meltdown. Because of a malfunction, the radioactive core was exposed, releasing radiation into the atmosphere. Although most of the radiation fell close to the plant, the wind carried radioactive particles all over the world. At least 29 people in Chernobyl died from radiation exposure, and several hundred others were hospitalized. The city and nearby areas had to be permanently evacuated. In the early 2000s, cancer, birth defects, thyroid disorders, and skin diseases are still affecting people exposed to the radiation from the Chernobyl accident.

What Killed Aleksandr Litvinenko?

In 2006 Russian writer and political dissident Aleksandr Litvinenko suddenly fell ill and died three weeks later. The cause was a lethal exposure to polonium-210 radiation. He accused two former KGB agents with whom he had met just prior to becoming sick, but police later determined that the two former agents had introduced Litvinenko to a third man who actually delivered the lethal dose. According to the police in England, where Litvinenko was poisoned, Russian businessman and former KGB agent Andrei Lugovoi slipped the polonium-210 into Litvinenko's tea during their meeting.

The British police announced in May 2007 that they were charging Lugovoi with the crime, but as of November 2007, the Russian government continued its refusal to extradite him (return him to England so he could be charged for the crime he committed there). In the meantime, Lugovoi was running for a seat in the State Duma, which is an arm of the Russian legislature.

Natural sunlight, sun lamps, microwave ovens, radios, and televisions are sources of non-ionizing radiation.

Ionizing radiation Ionizing radiation is the more energetic form of radiation, and it can change the structure of an atom. Exposure to ionizing radiation can cause illness because it can damage the molecules within the cells of the body, prevent the cells from functioning properly, and destroy those cells.

Naturally occurring ionizing radiation comes from distant parts of the universe and from the sun. Radon, which is a colorless, odorless, radioactive gas, provides most of the background radiation on earth. Medical x-rays are a source of human-made ionizing radiation. Other sources of radiation are radioactive elements, which are used in medical research, nuclear power plants, and nuclear bombs.

How Does Radiation Affect the Human Body?

Radiation is a carcinogen (kar-SIN-o-jen), which means it is a cancer-causing agent. Because radiation occurs naturally from sources such as human bodies, space, rocks, soil, and radon gas, some exposure is unavoidable. Many scientists consider the dose that the average American receives during a year to be safe; however, the radiation people get in tanning salons is believed to contribute to the development of skin cancer. Both small and large doses of certain types of radiation are used in health care. For example, medical professionals use x-rays and CT scans (computerized axial tomography) to diagnose illnesses, and radiotherapy (high doses of radiation targeted at tumors) to kill cancer cells.

Exposure to very high doses of radiation or long-term exposure to smaller amounts, however, increases the risk of injury or illness. Problems may include the following:

- radiation burns on the exposed parts of the body
- genetic diseases or mental retardation in children whose mothers were exposed during pregnancy
- cancer of the bone marrow, thyroid, lung, breast, and kidney from long-term exposure to low levels of radiation
- lung cancer that may result from radon accumulating in basements and sticking to dust that people inhale
- damage to blood vessels and the brain, infection, and bleeding from whole-body exposure to very high doses of radiation, which usually leads to death.

The severity of the exposure-induced condition depends on the source of the radiation, the dose, the rate of absorption into the body, and the sensitivity of the particular tissue. A large dose of radiation can lead to cell death over hours, days, or weeks. Low exposure over time causes less dramatic effects because the body may be able to repair some of the cellular

damage. Scientists have learned, however, that higher doses increase the chance of getting cancer (but do not affect the type or severity of cancer) and that most cancers do not appear for 10 to 40 years after the person was exposed.

▶ See also **Burns • Cancer: Overview • Environmental Diseases • Genetic Diseases • Thyroid Disease**

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Organizations

- National Institutes of Health.** 9000 Rockville Pike, Bethesda, MD, 20892. Telephone: 301-496-4000. Web site: <http://www.nih.gov/health/chip/od/radiation>.
- World Health Organization.** Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: http://www.who.int/ionizing_radiation/en.

Ramsey Hunt syndrome See *Bell's Palsy*.

Rape

Rape is forced, unwanted sexual intercourse. Rape can happen to males or females, children or adults or elders, healthy people or people with disabilities. Rape is a crime even if the rapist is an acquaintance, a friend, a member of the family, or even a spouse.

What Is Rape?

Rape is forced, unwanted sexual intercourse involving the genitals or any other part of the body. Rape also is called sexual assault. It is an act of violence; it is not a form of consensual sex*, love, or intimacy. Rapists are



▲ People who have been raped need immediate attention at a clinic or hospital for medical treatment and for the collection of evidence of the crime. Rape kit evidence may include saliva or semen, which can be used to determine the rapist's DNA "fingerprint."
© PHOTOTAKE Inc./Alamy.

* **consensual sex** is sexual activity in which both people freely agree to participate.

* **semen** (SEE-men) is the sperm-containing whitish fluid produced by the male reproductive tract.

not always mentally ill. Committing a rape is a criminal act. Rape and sexual assault may be committed against females or males; children or elders; wives, dates, or intimate partners. Many rapes are never reported to the police. Rape may be committed by a stranger, but often it is committed by someone known to the victim. Sometimes physical force is used during a rape. Other times there may be intimidation. Sometimes rape occurs when the victim is drugged, drunk, or otherwise unable to respond.

What Is the Treatment for Rape?

People who have been raped may want to keep the assault secret. They may be upset, confused, and even embarrassed, perhaps mistakenly thinking that they were responsible for the attack. But it is important that they go to a clinic or hospital emergency room immediately, before showering or changing clothing. Immediate medical examination is necessary to treat injuries, to allow for further medical evaluation, and to gather evidence of the crime. “Rape kit” evidence may include body fluids such as saliva or semen* from the rapist or samples

WHO? WHOM? HOW OFTEN?

The National Center for Injury Prevention and Control, a part of the Centers for Disease Control and Prevention, and the Rape, Abuse & Incest National Network (RAINN) reports the following statistics about rape and sexual assault:

- 1 out of every 6 adult women has been a victim of rape.
- 60 percent of people who have been sexually assaulted do not report the assault to the police. However, reporting increased after 1993 and into the early 2000s.
- Among people who do report the assault to the police, 44 percent are younger than age 18, and 15 percent are younger than age 12.
- In 2000, about 8 in 10 rape or sexual assault victims stated the offender was a boyfriend or girlfriend, a relative, a friend, or an acquaintance.
- Some 20 to 25 percent of women in college experience sexual violence that meets the legal definition for rape or attempted rape.
- More than 7 percent of men in college report aggressive sexual behavior that meets the legal definition for rape or attempted rape.
- Women who have been raped experience physical injuries in approximately 36 percent of cases, need to be hospitalized overnight in 3 percent of cases, contract a sexually transmitted disease in 4 percent of cases, and become pregnant in 4 percent of cases.
- Death occurs in approximately 0.1 percent of all rape cases.

of the rapist's hair or clothing. Continuing medical care is necessary to prevent or treat sexually transmitted diseases or pregnancy. Emotional care also is important. Rape crisis workers who understand the trauma that rape can cause often are on hand to provide help, support, and referrals for counseling to aid in emotional recovery from the effects of the rape.

What Is Rape Trauma Syndrome?

Rape trauma syndrome is a form of post-traumatic stress disorder*. In addition to physical distress, people who have been raped may experience psychological symptoms that can include the following:

- Emotional numbness
- Alert watchfulness or jumpiness
- Sleep disturbances
- Nightmares
- Disturbing memories (flashbacks) of the sexual assault
- Avoidance of healthy sexual activity
- Increased levels of alcohol or drug use
- Feelings of helplessness, powerlessness, and hopelessness
- Depression
- School failure
- Suicidal feelings

People who are raped by acquaintances, dates, or family members may experience symptoms that are different from those of people who are raped by strangers. In such cases, in addition to the actual trauma of rape, there is the added trauma of loss of trust. Rape by a stranger may involve a weapon or other types of violence. When people who are raped also fear for their lives, it increases the likelihood of post-traumatic stress disorder. Some symptoms of rape trauma may ease with the passage of time, but often the help of a therapist or support group is necessary for more complete emotional healing to take place.

Prevention of Rape

Important steps toward rape prevention include avoiding alcohol and drugs that can lead to irresponsible or dangerous behavior, always discussing sexual activities with a partner and obtaining agreement about what will happen. It is also important to have friends or family members know details about a date, for example, where the date will take place and the date's name. Others need to speak up or stop a situation whenever they observe abusive sexual behaviors. Programs to prevent rape may involve male mentors counseling young men.

▶ See also **Violence**

Date Rape Drugs

Several medications that are useful when prescribed as sedatives, muscle relaxants, or sleeping aids have also been used to “force” people to have sex. These drugs have become known as date rape drugs:

- Flunitrazepam (Rohypnol), nicknamed “roofies”
- Clonazepam (Klonopin), also sometimes referred to as “roofies”
- Gamma-hydroxybutyrate (GHB), nicknamed “liquid Ecstasy”

When used illegally as club drugs or date rape drugs, these medications can cause euphoria and loss of consciousness. Sometimes these medications also can cause seizures or coma*. Date rape drugs may be added to drinks as a way of secretly causing someone else to take them. Caution about accepting drinks from others is one important part of rape prevention.

* **post-traumatic stress disorder** (post-trau-MAT-ik STRES dis-OR-der) is a mental disorder that interferes with everyday living and occurs in people who survive a terrifying event, such as school violence, military combat, or a natural disaster.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.



▲
The hand of a person with Raynaud's disease. The fingertips are white because the arteries are constricted, which cuts off blood supply and causes numbness and tingling. *Hercules Robinson/Alamy.*

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- Slaughter, Lynn. *Teen Rape*. San Diego, CA: Lucent Books, 2004.

Organizations

- National Center for Injury Prevention and Control.** 4770 Buford Highway NE, Mailstop K65, Atlanta, GA, 30341-3724. Telephone: 770-488-1506. Web site: <http://www.cdc.gov/ncipc>.
- National Sexual Violence Resource Center.** 123 North Enola Drive, Enola, PA, 17025. Toll free: 877-739-3895. Web site: <http://www.nsvrc.org>.
- Pennsylvania Coalition Against Rape.** 125 N. Enola Drive, Enola, PA, 17025. Telephone: 717-728-9764. Web site: <http://www.pcar.com/>
- Rape, Abuse, and Incest National Network.** 635-B Pennsylvania Avenue SE, Washington, DC, 20003. Toll free: 800-656-HOPE. Web site: <http://www.rainn.org>.
- White Ribbon Campaign.** 365 Bloor Street East, Suite 203, Toronto, Ontario, Canada, M4W 3L4. Telephone: 416-920-6684. Web site: <http://www.whiteribbon.ca>.

Rash *See Skin Conditions.*

Raynaud's Disease

Raynaud's disease is a disorder in which the vessels that supply blood to the fingers and toes (the digits) contract, causing the fingers and toes to turn white, feel numb, tingle, or burn.

What Is Raynaud's Disease?

In this condition, the arteries that supply blood to the fingers and toes respond to cold or other stimuli by going into spasm (contracting), reducing the supply of blood to the digits and turning them white. When there is no other underlying cause for this contracting, the condition is called Raynaud's disease. It can appear in people of any age, but it occurs most often between the ages of 20 and 40 and affects females more than males.

What Is Raynaud's Phenomenon?

Raynaud's phenomenon has the same symptoms as Raynaud's disease, but its cause is known to be another disease. Diseases that can cause Raynaud's phenomenon include rheumatoid arthritis, systemic lupus, and scleroderma, which are all chronic (long-lasting) disorders of the connective tissue*. Other possible causes include atherosclerosis (in which large arteries are blocked by fat deposits) and Buerger's disease (in which small arteries in fingers and toes are blocked by inflammation).

Collagen is a protein that makes up approximately 30 percent of all protein in the human body. It shapes the structure of connective tissues, including blood vessels. An immune system* that does not function normally can affect these structures. The resulting problems are known collectively as collagen vascular diseases. Raynaud's phenomenon is a collagen vascular disease. It may occur alone (without any other problems) or may predate (occur before) features of other collagen diseases by many years.

Scleroderma is a form of connective tissue disease. It commonly causes Raynaud's because scleroderma reduces blood flow to the extremities. Lupus erythematosus is an autoimmune disease* that can affect blood vessels. For this reason, individuals with lupus often develop Raynaud's phenomenon.

Who Is at Risk for Raynaud's Phenomenon?

People in certain occupations are at higher risk for Raynaud's phenomenon. Anyone whose work involves the constant and repetitive use of the fingers or who uses tools that vibrate, such as a jackhammer or chain saw, are at increased risk. People with medical conditions that affect small arteries or who have certain neurological conditions or connective tissue diseases, such as lupus or scleroderma, are at risk as well. Smoking may trigger or worsen spasms in blood vessels.

What Are the Symptoms of Raynaud's Disease?

In Raynaud's disease, a person's fingers and toes first turn white or blue when they become cold because the necessary amount of blood is not reaching them. They turn red when blood is flowing normally again.

When people get an attack of Raynaud's disease, their fingers and toes may feel numb or tingle and burn. In severe (but rare) cases the restriction of the arteries causes the fingers to thicken, which can lead to ulcerations (loss of tissue) at the finger tips as well as changes in the fingernails. In the worst case, gangrene (tissue death) can occur.

What Is the Treatment for Raynaud's Disease?

Raynaud's disease can be effectively treated with medications that prevent the constriction of the blood vessels. These include calcium channel blockers, alpha blockers, vasodilators and pseudoephedrine. Indeed, the frequency and severity of Raynaud's attacks may be diminished by calcium channel blockers. Newer treatments for Raynaud's disease include

* **connective tissue** helps hold the body together, is found in skin, joints and bones.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **autoimmune disease** (aw-toh-ih-MYOON) is a disease in which the body's immune system attacks some of the body's own normal tissues and cells.

mycophenolate and antimetabolite or chemotherapeutic agents that have been used to treat some forms of cancer. Some ointments or creams can also be prescribed to soften the skin, although these do not help to prevent attacks. A doctor diagnoses the condition by taking a careful history from the patient. Advice on preventing flare-ups of Raynaud's can help the person avoid further episodes. In severe cases, surgery may be required to cut the nerves that control the contraction and dilation of the blood vessels.

How Can Raynaud's Disease Be Prevented?

Although Raynaud's disease may not be completely preventable in people who are susceptible to the disorder, there are some preventive measures a person can take. Some of the "do's" and "don'ts" for people who experience Raynaud's are:

- **Stop smoking.** Cigarettes constrict (close up) blood vessels.
- **Avoid high-risk activities.** Vibrating machinery, such as pneumatic drills and chain saws, can trigger an attack of Raynaud's disease. Excessive typing and piano playing also involve repetitive finger motion and can trigger the disease.
- **Avoid substances that are known to trigger Raynaud's.** Polyvinyl chloride (PVC) and other substances may trigger an attack.
- **Wear layered clothing.** Retaining body warmth helps, because exposing the face or forehead to cold can trigger an attack.
- **Wear gloves or mittens.** Keeping hands warm protects them against cold and may avoid attacks.

▶ See also **Arthritis • Collagen Vascular Diseases • Lupus**

Resources

Books and Articles

Klippel, John. *Primer on the Rheumatic Diseases*, 13th ed. New York: Springer, 2008.

Imboden, John. *Current Diagnosis and Treatment in Rheumatology*, 2nd ed. New York: McGraw Hill, 2006.

Thompson, A.E., and J.E. Pope. "Calcium Channel Blockers for Primary Raynaud's Phenomenon: A Meta-analysis." *Rheumatology* (Oxford, England) 44, no. 2 (2005): 145–50.

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org>.

American College of Physicians. 190 N. Independence Mall West, Philadelphia, PA, 19106. Toll free: 800-523-1546. Web site: <http://www.acponline.org>.

American College of Rheumatology. 1800 Century Place, Suite 250, Atlanta, GA, 30345. Telephone: 404-633-3777. Web site: <http://www.rheumatology.org>.

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-226-4267. Web site: http://www.niams.nih.gov/Health_Info/Raynauds_Phenomenon/default.asp.

National Organization for Rare Disorders. 55 Kenosia Avenue, P.O. Box 1968, Danbury, CT, 06813-1968. Toll free: 800-999-6673. Web site: <http://www.rarediseases.org>.

Raynaud's Association. 94 Mercer Avenue, Hartsdale, NY, 10530. Toll free: 800-280-8055. Web site: <http://www.raynauds.org/contact/index.cfm>.

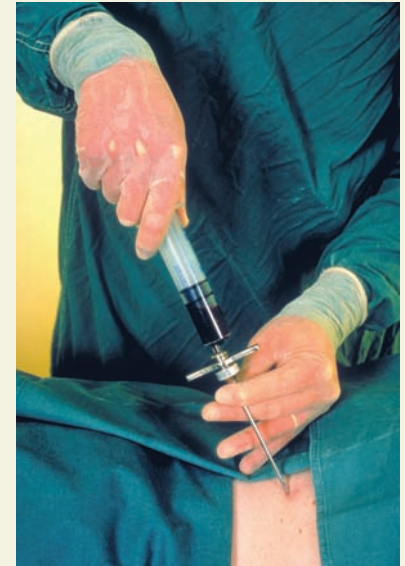
Regenerative Medicine

Regenerative medicine in the early 2000s was a new interdisciplinary branch of medicine that drew on fields as different as engineering, biology, physics, and chemistry in order to repair or replace damaged tissues and organs. The term regenerative comes from a Latin word that means “to reproduce” or “to regrow.”

What Is Regenerative Medicine?

Regenerative medicine is a field of medicine that began around 1985 with research into tissue engineering—the development *in vitro** of tissues or even entire body organs from living cells and various materials to support the growing cells. As of 2009, some doctors and researchers continued to use “regenerative medicine” as a synonym for tissue engineering.

In the early 2000s regenerative medicine began to be identified more with stem cell* research, particularly after news magazines and television programs ran dramatic stories about the potential of stem cells to cure diseases rather than simply treat them. The first human stem cell was isolated in the laboratory by James Thomson in 1998. Thomson's discovery was in turn made possible by the ability to fertilize a human egg with a human sperm in the laboratory. The first successful *in-vitro* fertilization of an egg had taken place in 1969. This procedure made it possible



▲ A doctor harvests donor bone marrow which will be used for the treatment of severe aplastic anemia and types of leukemia. *Simon Fraser/Photo Researchers, Inc.*

* **in vitro** in the laboratory or other artificial environment rather than in the living body.

* **stem cell** an unspecialized cell that gives rise to differentiated cells.

* **ethical** means having to do with questions of what is right and wrong, or with moral values.

* **cloning** (KLOH-ning) is a process in which a group of cells or even an entire organism is grown from a single stem cell and is genetically identical to it.

* **metabolism** (meh-TAB-o-liz-um) is the process in the body that converts foods into the energy necessary for body functions.

* **carbohydrates** are nutrients in food that help provide energy to the body.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

to create a human embryo in a laboratory for research purposes, which posed a number of serious ethical* questions.

These questions were raised again when a sheep named Dolly was successfully cloned in Scotland in 1997. Cloning* refers to a process in which multiple cells are obtained from a single cell and contain the same genetic material. Dolly the sheep was the first large mammal to be successfully cloned from an adult stem cell. Inevitably some scientists proposed the experimental cloning of human embryos.

What Are the Major Types of Regenerative Medicine?

Although the general public usually thinks of regenerative medicine in terms of stem cell research, there are at least four different fields within regenerative medicine as of 2009.

Medical devices and artificial organs An important branch of regenerative medicine involves work on medical devices. The Food and Drug Administration (FDA) defines a medical device as any product used in health care that does not involve chemical activity or use by the body's metabolism*. The FDA's definition of medical device includes test kits for the diagnosis of disease as well as such items as medical lasers, contact lenses, surgical sutures, and heart pacemakers.

Medical devices being developed by researchers in regenerative medicine include artificial organs or parts of organs that can be used to support a failing heart or liver until a transplant organ can be found. One such device in use as of 2009 was a ventricular assist device, or VAD. A VAD is a battery-powered pump that can be implanted in one or both of the lower ventricles (chambers) of the patient's heart to support its function until a suitable replacement heart is obtained. Another medical device that was in clinical trials as of 2009 was a form of liver support called a bioartificial liver device, or BAL. The word "bioartificial" means that the device involves living cells as well as mechanical parts. The BAL contains normal liver cells that would process the patient's blood while the patient's liver heals or until a donated liver is available for transplantation.

One type of engineered tissue that was developed in the 1980s as a treatment for burn victims was classified by the FDA as a medical device because it involves the use of material from nonhuman cells. This laboratory-made tissue is based on extracellular matrix (eks-truh-SELL-you-lar MAY-tricks), or ECM, derived from pig bladders or intestines. ECM is the part of the living tissue in all animals that lies outside the cell walls and gives support to the cells. It consists of complex carbohydrates* and proteins. The ECM in human as well as animal tissues is essential for growth and wound healing. ECM derived from pigs serves two important purposes in the treatment of human injuries: first, it prevents the body's immune system* from reacting to the injury by forming scar tissue. Second, it speeds up the process of tissue repair by the body's own cells. As of 2009, ECM was used to treat

various injuries from torn ligaments and tendons to second-degree burns, chronic pressure ulcers, and diabetic skin ulcers.

Tissue engineering Tissue engineering, which was the first type of regenerative medicine to attract attention, remained in 2009 an important field. The National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) in 2009 conducted research in tissue engineering to treat such disorders and diseases as broken bones, damaged spinal discs, and injuries involving the growth plates (areas of cartilage at the end of the long bones in children where growth of the bone occurs until the child reaches adult height).

Tissue engineering makes use of cells extracted from living tissue and seeded into artificial structures known as scaffolds. The scaffolds may be composed of either natural or artificial materials. Most scaffolds are designed to break down in or be absorbed by the body as the new tissue is formed—much like absorbable surgical sutures—although some are intended for permanent placement.

The cells that are to be seeded or implanted in the scaffold may be derived from the body of the person who is to receive the engineered tissue, from another human, or from a different animal species. Cells that are taken from the patient who will receive the new tissue are called autologous (aw-TAW-low-gus) cells. Those that are taken from another human are known as allogenic (all-oh-JEN-ik) cells, and those taken from animals are called xenogenic (zehn-oh-JEN-ik) cells.

The cells are extracted from their source by a series of steps. For a liquid tissue such as blood, the cells can be removed by processing in a centrifuge. A centrifuge is a machine that whirls a liquid at a high rate of speed inside a cylinder. The heavier cells or particles move away from the center and can be separated from the lighter particles. The cells in a solid tissue, such as skin or muscle, are removed in two steps. The tissue is first minced into very fine pieces and then placed in an enzyme* solution to remove the extracellular matrix. The tissue cells that remain are then separated from the enzyme liquid in a centrifuge.

After the cells have been extracted, they are implanted in a scaffold that has been formed into the shape of the tissue to be replaced. The most successful engineered tissues as of 2009 were those that had been developed to replace cartilage, skin, or blood vessels. About 22 different types of human cells were in 2009 being grown in the laboratory, including cells from muscle tissue, lung, liver, and heart tissue, nerve tissue, and eye tissue. One research project under way in 2009 involved engineering cells capable of secreting insulin, the hormone required to prevent or treat diabetes. The most notable breakthrough as of that year was in growing a complete human organ through tissue engineering, which took place in 2004, when doctors at Children's Hospital in Boston transplanted urinary bladders grown in the laboratory into children and adolescents with bladders damaged by birth defects. The cells used to construct the new bladders were derived from the patients' own tissues. In 2008 a team of

* **enzyme** (EN-zime) is a protein that helps speed up a chemical reaction in cells or organisms.

* **differentiation** (dif-feh-rent-see-AY-shun) the process in which embryonic or adult stem cells give rise to more specialized cells.

* **embryo** (EM-bree-o), in humans, is the developing organism from the end of the second week after fertilization to the end of the eighth week.

doctors in Spain created a new airway from cells taken from the patient and grown on airway tissue taken from a donor. The laboratory-engineered airway had been function normally for half a year as of early 2009.

Cell-based therapies Cell-based therapies, also known as cellular therapy, is the area of regenerative medicine that drew the most media attention in the early 2000s; it was also the most controversial. Cellular therapy makes use of stem cells, which are unspecialized cells that have the potential to form a wide range of specialized cells. The process in which stem cells create more specialized cells is called differentiation*. The two basic types of stem cells in humans are embryonic stem cells and adult stem cells. Embryonic stem cells divide and multiply to eventually form all the specialized tissues in the human embryo*. Adult stem cells function as a repair system for the body, forming new specialized cells in various tissues when needed, but also replacing worn-out cells in the skin, blood, and digestive system.

All stem cells have two basic properties. The first is self-renewal, which means that stem cells can go through many cycles of cell division and remain unspecialized. The second characteristic is potency, defined as the ability to form specialized cells of different types. There are three types of potency in stem cells. Some stem cells are totipotent, which means that they can form all the different cell types needed for human development and eventually give rise to a complete living organism. Totipotent stem cells are found only in the fertilized human egg and the first few cell divisions after fertilization (the first four to five days after fertilization). Pluripotent stem cells can form most but not all types of cells in the body. They are descended from totipotent stem cells and can be found in children and adults. Multipotent stem cells can form different types of specialized cells, but only within a closely related family of cells. Blood-forming stem cells are an example of multipotent stem cells. Most adult stem cells are multipotent.

As of 2009, most experiments on embryonic stem cells had been done on either mouse embryonic stem cells or human embryonic stem cells. As of early 2009, there were no approved medical treatments or human clinical trials involving human embryonic stem cells. Because these stem cells are pluripotent, they will differentiate into many different types of cells that may or may not be useful in the person who receives them. Embryonic stem cells will produce a type of tumor if injected directly into another organism. There is also the possibility of transplant rejection when embryonic stem cells are used. Moreover, experimentation with human embryonic stem cells is controversial because it requires the destruction of a potential human being.

The use of adult stem cells in developing new treatments for various diseases is less controversial because these cells do not require the destruction of an embryo. In addition, adult stem cells can sometimes be taken from the body of the patient who will receive treatment, which eliminates the risk of transplant rejection. Most adult stem cells are multipotent

THE CONTRIBUTIONS OF RITA LEVI-MONTALCINI

Developmental biologist Rita Levi-Montalcini was born in Turin, Italy, in 1909 and graduated from the medical school there in 1936. She went to work with her professor, Giuseppe Levi, but her career was cut short by a decree from Italian dictator Benito Mussolini and subsequent laws barring non-Aryan Italians from working in universities or practicing medicine. Not one to be deterred, she continued her research from a laboratory she set up in her bedroom.

In 1946 Levi-Montalcini went to work at Washington University in St. Louis where she stayed for 30 years. During that time she discovered the nerve growth factor which was the first growth-regulating signal substance to be discovered. That discovery helped increase the understanding of degenerative disease and opened the way to stem cell and regenerative medicine.

In 1986 Levi-Montalcini and her collaborator Stanley Cohen received the Nobel Prize in Medicine for their discoveries of nerve growth factor (NGF) and epidermal growth factor (EGF). On April 22, 2009, Rita Levi-Montalcini, the oldest living Nobel laureate, celebrated her 100th birthday.

* **umbilical cord** (um-BIH-lih-kul) is the flexible cord that connects a baby to the placenta, the organ that unites the unborn child to the mother's uterus, the organ in which the baby develops.

* **leukemia** (loo-KEE-me-uh) is a form of cancer characterized by the body's uncontrolled production of abnormal white blood cells.

* **lupus** (LOO-pus) is a chronic, or long-lasting, disease that causes inflammation of connective tissue, the material that holds together the various structures of the body.

* **multiple sclerosis** (skluh-RO-sis), or MS, is an inflammatory disease of the nervous system that disrupts communication between the brain and other parts of the body. MS can result in paralysis, loss of vision, and other symptoms.

* **cultured** (KUL-churd) means subjected to a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

and are derived from specific tissues; a few are pluripotent and are found mostly in bone marrow and the blood from a newborn's umbilical cord*. Cord blood can be harvested shortly after a baby's birth and stored in a public (cost-free) or private (for-profit) blood bank.

Some therapies based on the use of adult stem cells, such as bone marrow transplants for leukemia* and other types of blood or bone cancers, have been used successfully for years. Other treatments using adult stem cells from cord blood that were undergoing clinical trials as of 2009 are therapies for lupus*, multiple sclerosis*, and type 1 diabetes.

Stem cell research is conducted by using cells from a stem cell line, which is a family of dividing cells created from a single stem cell. The cells can be maintained in vitro for long periods in a laboratory. Embryonic stem cells are detached as single cells from the mass of cells at the center of the embryo and placed on a low laboratory container known as a Petri dish. The stem cell is provided with nutrients and growth factors—proteins that stimulate cell growth—that enable it to continue to divide without differentiating into specialized cells. Stem cells are cultured* in a high-humidity environment in an incubator at body temperature (about 98°F).

Clinical translation Clinical translation, which is also known as translational medicine, is the process of moving research in regenerative

* **Parkinson's disease** is a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.

medicine into clinical trials using human volunteers. It emerged as a way to speed up moving discoveries in the laboratory into actual practical applications. In the past, doctors involved in so-called pure research worked in different settings (usually universities or government institutes) from those who worked on turning basic scientific discoveries into useful new drugs or medical devices. Translational medicine aims to provide benefits to society as quickly as possible by linking basic discoveries to clinical investigation and then translating the results of clinical trials into changes in actual medical or surgical practice.

What Are the Issues Involved in Regenerative Medicine?

Political and social issues Regenerative medicine sparked a number of heated debates in the area of public policy as well as medicine and religion, most of which focused on embryonic stem cell research. One major issue was funding. Prior to 2002, most research in all fields of regenerative medicine was supported financially by private industry. After the topic of stem cells became a frequent subject in newspapers and on television shows in the early 2000s, it also became a political issue, particularly in the 2004 presidential campaign. The use of embryonic stem cells in particular became a major campaign issue, with Democrats describing any limitations on stem cell research as heartless and anti-scientific. In addition, the media used such celebrities as Christopher Reeve (paralyzed in an accident) and Michael J. Fox (diagnosed with Parkinson's disease*) to convince the public that embryonic stem cells held the promise of cures for all kinds of diseases within the near future. Many newspaper editorials used such words as "medical miracles" and even "magic" to describe the potential of embryonic stem cell research.

In November 2007, however, the debate over embryonic stem cells was changed by the announcement that teams of scientists in Japan and the United States had developed a technique for producing induced pluripotent stem cells, or iPSCs. Induced pluripotent stem cells are essentially adult stem cells from human skin that have been "reprogrammed" by gene-therapy viruses that contain four reprogramming factors. The skin cells are transformed over a two-week period into pluripotent stem cells that have the same properties as human embryonic stem cells. A major advantage of iPSCs is that no embryo is formed and no embryo is destroyed to create them.

The following political and social questions are related to regenerative medicine:

- Should research be supported by the government, by research universities, by drug companies and other biotechnology companies, or by all three? How much government money should be spent on regenerative medicine, as distinct from other areas of medical research?

SCIENTIFIC FRAUD: HWANG WOO-SUK

A major case of scientific fraud in South Korea cast a shadow on embryonic stem cell research around the world in 2004 and 2005. Hwang Woo-Suk, a veterinarian who became involved in biotechnology, claimed to have created a stem cell line from a cloned human embryo and to have generated eleven stem cell lines specific to individual patients from cloned human embryos. Hwang had become a respected leader in the field of animal cloning in 1999, when he claimed to have successfully cloned a dairy cow. If his cloning of a human embryo had been true, it would have made cloning a possible approach to developing routine treatments for human diseases.

By the fall of 2005, however, some of Hwang's colleagues began to ask questions about his research, and by December 2005, investigators showed beyond doubt that his cloned stem cell lines were fakes. Hwang was also investigated for misusing government funding for his own purposes and for forcing some of his younger female colleagues to donate their eggs for his research. Moreover, the discovery of his fraud was a political as well as scientific embarrassment because Hwang had made international headlines by publicly criticizing President George W. Bush's policy on embryonic stem cell research in May 2005. The Hwang episode illustrated that the large sums of money and political influence attached to scientific research in the early 21st century could lead some people to mislead the public about the current state of regenerative medicine or even to commit outright fraud.

- Who should make policy decisions about regenerative medicine? Politicians? Medical experts? The general public? How should ordinary citizens who are not scientists make their opinions known?
- Which diseases should get priority in regenerative medicine? Diseases that are most expensive to treat with current therapies? Those most likely to affect older adults? Those that affect the largest numbers of people? Those that currently require organ transplants for successful treatment?
- Who will be responsible for overseeing research in regenerative medicine so that cases of fraud like Hwang's can be prevented?
- How should journalists and others who write for the general public report on new discoveries without making exaggerated claims or misleading people about the potential of regenerative medicine?

Medical and scientific issues Some scientific issues in regenerative medicine have been discussed, such as the development of induced pluripotent stem cells and newer advances in tissue engineering. A number of scientific problems remain, however, as of 2009:

* **amniotic sac** (am-nee-AH-tik SAK) is the sac formed by the amnion, the thin but tough membrane that lines the outside of the embryo in the uterus and is filled with fluid to cushion and protect the embryo as it grows.

- Some diseases, such as Alzheimer's disease, cannot be treated with any known form of regenerative medicine.
- Cloning human embryos does not seem to be a useful approach to treating disease. Apart from Hwang's fraud, the human embryo is unusually difficult to clone. In addition, animals that have been cloned have low survival rates, shortened life spans, and are genetically abnormal. For example, Dolly the sheep was the only one of 277 cloned sheep embryos that survived to live birth. She had a number of health problems and had to be euthanized at six years of age—half the life span of a normal sheep. Even if human embryos could be successfully cloned, the need to test them for possible genetic abnormalities before using them in treatments raises many troubling ethical questions.
- The potential of embryonic stem cells to form tumors after they are injected constituted a problem that did not seem likely to be solved in the near future. In several studies that used experimental animals, between 70 and 100 percent of the animals died from the tumors formed by embryonic stem cells.
- There was also some evidence as of 2009 that individual embryonic stem cells kept in the laboratory for long periods of time can turn cancerous.
- In addition, there is no evidence as of 2009 that embryonic stem cells actually could help to heal disease or repair tissues in animals. In most cases the cells simply died after a few weeks. In sum, scientists had not learned to produce healthy adult tissue from embryonic stem cells as of 2009.
- A good deal of basic research in cell biology remained to be done. Scientists did not fully understand how the different types of cells in the human body communicate with one another. They also did not yet know how to mass-produce cells, guarantee their quality, and preserve them for long-term future use.

Religious issues Religious issues related to regenerative medicine focus on two concerns: the meaning and value of human life and the equality of living people. Much of the controversy over stem cell research concerned the use of embryonic stem cells, which can only be obtained by destroying an embryo, at least with 2009 technology. For those who believe that human life begins at conception, the destruction of a human embryo is the intentional ending of a human life.

Many people in the pro-life movement, did not, however, have any ethical objections to the use of adult stem cells or the development of iPSCs for regenerative medicine. Another possibility that was more acceptable on religious grounds was the use of cells obtained from the fluid in the amniotic sac*. In January 2007, researchers at Wake Forest University discovered a new type of stem cell in amniotic fluid. These cells could be removed from the fluid without causing the death of an embryo.

Religious believers note that respect for human life implies the equality of all human life. Many are concerned that accepting the destruction of human embryos for scientific research in the hopes of lowering health-care costs will lead by degrees to the acceptability of such “cost-saving” measures as the euthanasia of people with terminal illnesses, a practice accepted in the Netherlands as of 2009.

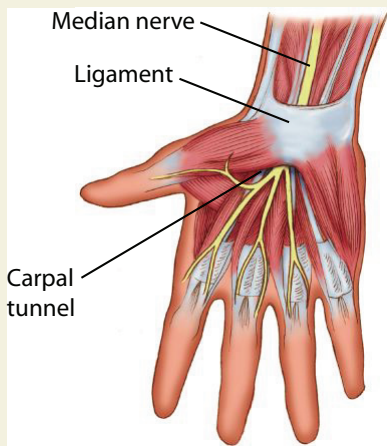
Another concern of religious believers is based on history: the dark side of medical experimentation on humans in the 20th century. The Tuskegee experiments on African American men with untreated syphilis (1932–1972), the infamous experiments by German doctors in Nazi concentration camps in the 1940s, and the Japanese experiments conducted on prisoners of war in the 1930s and 1940s, all show that human beings in positions of power can act without any concern for moral standards. It is not surprising that healthcare authorities in many developed countries set up regulatory frameworks for research in regenerative medicine in hopes of preventing future abuses of this type.

What Are the Possibilities of Regenerative Medicine?

The Department of Health and Human Services published a report in 2005 titled *2020: A New Vision: A Future for Regenerative Medicine*. Much of the report is taken up with discussion of such political concerns as FDA oversight of products and devices used in regenerative medicine; coordination of research among the dozen federal agencies currently involved in regenerative medicine; and cooperation among universities, private industry, and the government. The report does, however, outline some goals for regenerative medicine in the United States by 2020:

- Extending current successes in laboratory-grown tissues and organs to tissues that are more difficult to grow in the laboratory, such as bone
- Developing treatments that would stimulate a person’s body to repair its own damaged tissues as well as accepting tissue transplants formed in the laboratory
- Developing treatments for such diseases as diabetes (by supplying new insulin-producing cells to a damaged pancreas) and cancer (by replacing removed cancerous tissue with healthy tissue grown in the laboratory)
- Focusing on permanent cures for chronic* diseases such as heart disease and diabetes rather than periodic treatments. Much of the current high cost of health care in the United States involves managing these diseases and treating their complications.
- Speeding up laboratory development of whole organs for transplant as well as the creation of “patches” of engineered tissue to solve the growing gap between the need for organ transplants and the number of donated organs available
- Investigating treatments that might prevent tissue and organ damage before it starts

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.



▲ Carpal tunnel syndrome affects people who overuse their hands on piano or computer keyboards. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **syndrome** means a group or pattern of symptoms and/or signs that occur together.

Resources

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Schimpff, Stephen C. *The Future of Medicine: Megatrends in Health Care that Will Improve Your Quality of Life*. Nashville, TN: Thomas Nelson, 2007.

Straus, Eugene, and Alex W. Straus. *Medical Marvels: The 100 Greatest Advances in Medicine*. Amherst, NY: Prometheus Books, 2006.

Organizations

Food and Drug Administration. 5600 Fishers Lane, Rockville, MD, 20857-0001. Toll free: 888-INFO-FDA. Web site: <http://www.fda.gov>.

McGowan Institute for Regenerative Medicine. 100 Technology Drive, Suite 200, Pittsburgh, PA, 15219-3110. Telephone: 412-235-5100. Web site: <http://www.mirm.pitt.edu>.

Wake Forest Institute for Regenerative Medicine. Richard H. Dean Biomedical Research Building, 391 Technology Way, Winston-Salem, NC, 27157. Telephone: 336-713-7293. Web site: <http://www.wfirm.org>.

Regional Enteritis *See Inflammatory Bowel Disease.*

Repetitive Stress Syndrome

Repetitive stress syndrome occurs when doing something over and over again causes pain, muscle strain, inflammation, and possible tissue damage. Repetitive motion problems, also called repetitive stress injuries, are the most common form of occupational (workplace) illness.*

John's Story

As a member of the high school tennis team, John served with accuracy and overwhelmed his opponents with his backhand. He worked harder and practiced more than any other team member. Major college scouts were looking him over. During a major tournament, however, John felt pain and swelling where the tendons join the bones at the elbow. His repeated practice of straightening his elbow and extending his wrist—especially during his back swing—had caused small tears in the tendon and muscle. The doctor diagnosed epicondylitis (ep-i-kon-di-LY-tis), a classic case of “tennis elbow.”

What Is Repetitive Stress Injury?

Tennis elbow and runner's knee are common names for repetitive stress injuries (RSIs), which result from repeated movements that stress the tendons, ligaments, joint capsules, fascia (FASH-ee-a), and other soft tissues that surround or attach to muscles and bones. RSIs can cause inflammation* of the neck, shoulders, arms, wrists, hips, legs, and ankles.

People at highest risk include office workers using computer keyboards, factory workers using sewing machines or working on assembly lines, tennis players working with tennis rackets, football players, and dancers who damage ankles and hips. Common RSIs include the following:

- Carpal tunnel syndrome, which affects the hands and wrists
- Tendinitis, which affects the connective tissue that attaches muscles to bones, for example, Achilles tendinitis or shoulder (rotator cuff) tendinitis
- Bursitis, which affects the fluid-filled sacs between muscles and bones that cushion the joints
- Fasciitis, which affects the connective tissue that surrounds the muscles
- Shin splints, which affect the front of the lower leg Although most RSIs occur in adults, young people who spend too much time on computer keyboards, playing sports, or practicing on musical instruments also are at risk.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

LEON FLEISHER: LEFT-HANDED CONCERTS

In 1964, at age 36, Leon Fleisher was one of the world's great pianists. When he noticed a weakness in the little finger of his right hand, he practiced harder to overcome it. During the following 10 months, however, the other fingers in his right hand curled under until he was unable to play piano at all.

At that time, not much was known about how repetitive movements caused carpal tunnel syndrome and other overuse injuries. Fleisher tried many different medications and therapies, but finally had to switch his performance repertoire to concertos written for the left hand alone.

In 1995, Fleisher began physical therapy and deep tissue massage, which taught him how to "de-contract" the overused muscles in his right hand. In 1996, he was able to resume playing concerts with both hands.



▲ Office workers who overuse computer keyboards are at risk for repetitive stress injury. *T. Buck/Custom Medical Stock Photo, Inc. Reproduced by permission.*

What Happens When People Have Repetitive Stress Syndrome?

Symptoms Warning signs of repetitive stress injuries include the following:

- Electricity-like tingling in hands or fingertips
- Soreness or weakness in hands and arms
- Aching neck or shoulders
- Frequent headaches
- Pain that wakes the person up at night
- Pain that lasts more than 24 hours

Diagnosis The doctor's physical examination and medical history usually will reveal the repetitive motion that has stressed the soft tissue and caused the injury. The doctor may recommend x-rays or blood tests to rule out other causes.

Treatment Treatment begins with rest. Temporarily, the person must give up the activity that caused the problem or must adjust the repeated motions that caused the injury. Retraining and physical therapy may be required before the person can resume the activity. The doctor also may recommend putting a wrist or elbow in a splint to keep it from repeated bending. Other treatments include medication to relieve pain and inflammation, massage, or surgery in cases of severe injury.

Prevention Prevention always works better than treatment. Proper warm-ups and cool-downs, frequent rests, and improved ergonomic rules for the workplace are important preventive measures. Ergonomics is the science of adapting tools and equipment to the human body—for example, chairs and desks that can be adjusted to fit the body of the user may help to prevent repetitive strain injuries. The National Institute of Occupational Safety and Health has created new standards for workplace safety to reduce the number of cases of repetitive stress syndrome.

▶ See also **Arthritis • Carpal Tunnel Syndrome • Strains and Sprains**

Resources

Books and Articles

Pascarelli, Emil. *Dr. Pascarelli's Complete Guide to Repetitive Strain Injury: What You Need to Know about RSI and Carpal Tunnel Syndrome*. Hoboken, NJ: Wiley, 2004.

Organizations

American Academy of Orthopaedic Surgeons. 6300 North River Road, Rosemont, IL, 60018-4262. Toll free: 800-346-AAOS. Web site: <http://www.aaos.org>.

Association for Repetitive Motion Syndromes. P.O. Box 471973, Aurora, CO, 80047-1973. Telephone: 303-369-0803. Web site: <http://www.certifiedpst.com/arms/index.html>.

Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/niosh>.

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-226-4267. Web site: http://www.niams.nih.gov/Health_Info/Shoulder_Problems/default.aspx.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824, Web site: http://www.ninds.nih.gov/disorders/repetitive_motion/repetitive_motion.htm.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **mutations** (mu-TAY-shuns) are changes in a chromosome or a gene.

* **chromosome** (KRO-mo-zom) is a unit or strand of DNA, the chemical substance that contains the genetic code to build and maintain a living being. Humans have 23 pairs of chromosomes, for a total of 46.

Rett Syndrome

The severe, rare condition called Rett syndrome is a neurodevelopmental disorder that adversely affects the way the brain develops in children. It was named after Austrian physician Andreas Rett for his pioneering work in describing the disorder around 1966. Rett syndrome affects female children in almost all cases. Affected female babies generally develop normally until the age of 6 to 18 months. When it occurs in males, the fetus rarely survives. One female in 10,000 to 20,000 is affected. All races and nationalities are equally at risk. Although a cure had not been found as of 2009, early diagnosis and treatment was effective.*

What Are the Causes of Rett Syndrome?

Rett syndrome is caused by mutations* within the gene called MECP2, which is located on the X chromosome*. Because girls have two X chromosomes, the condition is less severe in females. Males have only one X chromosome. Consequently, the condition is much more severe, with boys dying before birth or within a few years.

About 75 percent of girls with Rett possess the MECP2 mutation. In the other cases, they have mutations in other genes that had not been identified as of 2009. In more than 99 percent of the cases, Rett is not

* **panic attacks** are periods of intense fear or discomfort with a feeling of doom and a desire to escape. During a panic attack, a person may shake, sweat, be short of breath, and experience chest pain.

inherited even though it involves genes. Instead, Rett is caused randomly, by what is called sporadic mutations in which neither of the child's parents have the MECP2 mutation.

What Are the Symptoms of Rett Syndrome?

The symptoms are difficult to detect initially because they vary with respect to severity and onset. Two of the early physical signs are slow head growth and decreased muscle tone. Other symptoms can include:

- Lack of coordination of muscle movements, starting with loss of muscle tone, and difficulties with balance and coordination, which leads to stiff-jerky walking and crawling
- Inability to use hands for most useful purposes, followed by repetitive hand movements such as the wringing, clapping, or rubbing
- Inability or reduced ability to speak
- Deterioration of social and mental abilities
- Slow growth of overall weight and height and unusual proportionality of stature
- Diminished growth of head
- Difficulties with chewing and swallowing
- Constipation and reflux (regurgitation)
- Unusual heart rhythms
- Irregular and uncoordinated breathing, including hyperventilation, sighing, and holding of breath
- Screaming or crying, along with irritability, without apparent reason
- Tendency for panic attacks*
- Social anxiety, avoidance of social contact and emotional interactions, along with minimized eye contact

FOUR STAGES OF RETT SYNDROME

The four stages of Rett syndrome (along with when it first begins) are: (1) Early Onset (between 6–18 months): this stage is vaguely described because only a few symptoms are noticed, such as slow eye movement, slow progress in crawling or walking, and hand wringing; (2) Rapid Destructive (1–4 years): purposeful hand and language skills are diminished; (3) Pseudo-stationary (2–10 years): this stage is characterized by loss of purposeful hand movements and increased crying but may show improvements over stage two in some symptoms; (4) Late Motor Deterioration (over 10 years): multiple symptoms are seen. There may be no further deterioration of the symptoms.

- General lack of interest with environment and surroundings
- Poor blood circulation, especially in lower legs, feet, and toes
- Frequency of seizures
- Grinding of teeth
- Scoliosis (abnormal curvature of the spine)
- Increase of bone fractures
- Tendency with sleeplessness

How Is Rett Syndrome Diagnosed?

Rett syndrome is diagnosed based on observations of the symptoms and behavior, noting the child's growth and development. Blood and urine tests are performed to eliminate other problems. Magnetic resonance imaging (MRI*) scans, computerized tomography scans (CT scans*), and electroencephalogram (EEG) scans are performed to identify abnormalities within the body. Nerve conduction tests are performed to measure the speed of impulses through nerves.

Physicians observe normal behavior through at least the age of six months and normal head size is seen at birth but followed by slowing head growth between the ages of three months and four years. In addition, language skills are seriously impaired, along with an unsteady, wide gait that forces torso shaking. Other symptoms and signs that indicate the condition include constipation, seizures, sleep problems, poor blood circulation, and behavioral problems. In about 15 percent of the cases, Rett syndrome children do not display classic symptoms. These cases are classified as atypical Rett syndrome.

Genetic testing can confirm the initial observation in a large percentage of cases. One specific test identifies accurately the MECP2 mutation in the X chromosome over 75 percent of the time. Severity of the condition is predicted from genetic testing. The severity of Rett syndrome in females can vary depending on the type and position of the mutation of MECP2 and the pattern of X-chromosome inactivation. It is generally assumed that 50 percent of a female's cells use the maternal X chromosome, whereas the other 50 percent uses the paternal X chromosome. But if most cells in the brain activate the X chromosome with the functional MECP2 allele, the individual will have very mild Rett syndrome. By contrast, if most neurons activate the X chromosome with the mutated MECP2 allele, the individual will have very severe Rett syndrome just as males with MECP2 mutations do (as they only have one X chromosome).

How Is Rett Syndrome Treated?

As of 2009, there was no known cure for Rett syndrome. Women usually live at least to middle age (40–50 years), but scientific study was sparse in this area. Symptoms usually grow worse or remain the same. Girls and women are rarely able to live an independent life. Treatment includes several of the following:

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **antipsychotics** describes a type of medication that counteracts or reduces the symptoms of a severe mental disorder such as schizophrenia.

- Alleviating gastrointestinal problems such as constipation and reflux
- Reversing nutritional problems such as weight loss
- Increasing communication and language skills with speech therapy
- Counseling of the patient and the parents or adult guardians
- Using medicines to control seizures and muscle stiffness
- Using sleep aids
- Controlling harmful behaviors with antipsychotics*
- Using physical therapy to help improve walking skills, along with flexibility and balance
- Using braces or casts for those with scoliosis, and splints to reduce wrist or elbow movements if repetitive motion is a problem
- Using occupational therapy to help with daily tasks in order to improve social activities such as to improve hand movements and coordination

Alternative treatments, which had not been medically proven to work, were also available, such as massage therapy, acupuncture, music therapy, yoga, chiropractic treatments, water therapy (such as swimming), animal-assisted therapy (such as with dolphins).

What Does the Future Hold for Rett Syndrome Patients?

Rett syndrome cannot be prevented. In most of the cases, it is acquired without warning. Males afflicted with this condition usually die within the first two years. Females can live over the age of 40 years. Those who die usually do so suddenly without any apparent cause. Death is usually from such medical conditions as seizure, cardiac arrest, and spontaneous brainstem dysfunction.

Constant care for children with Rett syndrome is usually necessary. They are usually able to perform daily necessities such as walking, eating, and performing bodily functions.

▶ See also **Genetic Diseases • Pervasive Developmental Disorders: Overview**

Resources

Books and Articles

Hunter, Kathy. *Raindrops and Sunshine: Tales of Triumph and Laughter*. Clinton, MD: IRSA, 2007.

Kerr, Alison, and Ingegerd Witt Engerstrom, eds. *Rett Disorder and the Developing Brain*. New York: Oxford University Press, 2005.

Lindberg, Barbro. *Understanding Rett Syndrome: A Practical Guide For Parents, Teachers, and Therapists*, 2nd rev. ed. Cambridge, MA: Hogrefe & Huber, 2006.

Organizations

International Rett Syndrome Association. 4600 Devitt Drive, Cincinnati, OH 45246. Telephone: 513-874-3020. Web site: <http://www.rettysyndrome.org>.

WE MOVE. 204 West Eighty-fourth Street, New York, NY 10024, Web site: <http://www.wemove.org/rett>.

Reye's Syndrome

Reye's (RIZE) syndrome is a rare and potentially fatal disorder in children that affects the liver, brain, and other organs. It may appear shortly after a viral infection such as chickenpox or influenza.

A Mystifying Situation

The children always arrived at the Australian hospital on the verge of death. They often would be unconscious or in a coma*. Sometimes their bodies suffered uncontrollable spasms, and the children seemed to be slipping into insanity.

It was a tragic—and puzzling—situation. Only a week or so earlier, the children had been experiencing the typical childhood infections such as earaches, chest colds, or sore throats. Then their condition took a turn for the worse.

Dr. R. Douglas Reye (1912–1978) was the director of pathology at that Australian hospital when these children died in the 1950s and early 1960s. He discovered odd symptoms, such as swollen brains, discolored livers, and damaged kidneys in the children. He realized that these children died from an as yet unnamed disease.

In 1963 George Johnson, a doctor in North Carolina, saw a link between the disease Reye had discovered and one he was seeing in children after an outbreak of influenza. The disease was initially called Reye-Johnson syndrome and was later known simply as Reye's syndrome.

In the early 2000s Reye's syndrome is rare because doctors have learned ways to lower people's risk of getting it as well as better ways of identifying and treating people with the illness. The syndrome is not contagious, although the viral infections that often precede it can be.

What are the Signs of Reye's Syndrome?

Typically, Reye's syndrome begins after a viral infection, such as a cold, influenza, or chickenpox. Such infections typically do not lead to Reye's syndrome, and some cases are so mild that no one notices. Other cases are more serious.

Although adults and babies can develop Reye's syndrome, it usually occurs in children between the ages of 2 and 16.

WARNINGS: Children and teenagers should not use this medicine for chicken pox or flu symptoms before a doctor is consulted about Reye Syndrome, a rare but serious illness reported to be associated with aspirin.

▲
Reye's Syndrome warning on aspirin box.
© Peter Arnold, Inc./Alamy.

Aspirin and Reye's Syndrome

Although the link between aspirin and Reye's syndrome is not conclusive as of 2009, many doctors and the U.S. government recommend that no child under age 16 take aspirin or products with aspirin during a viral infection. In fact, no child under age 12 with almost *any* illness should take aspirin. Aspirin substitutes, such as acetaminophen, are not linked with Reye's syndrome.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

Symptoms include vomiting, nausea, and drowsiness. There is also a change in behavior, and patients may act irrationally and seem to have lost touch with reality. If untreated, Reye's syndrome can cause loss of consciousness, coma, and death.

Reye's syndrome causes the brain and liver to swell and the liver to develop fatty deposits. The chemistry of the blood and other body fluids becomes abnormal.

What Causes Reye's Syndrome?

As of 2009, no one was sure how some viral infections develop into Reye's syndrome. Some doctors suspected that an unidentified virus causes Reye's syndrome. Others theorized that people with certain genes* are more likely to get it. Some studies in the 1980s linked aspirin to the development of Reye's syndrome.

How is Reye's Syndrome Treated?

Treatment for Reye's syndrome occurs in a hospital. Various medications and fluids are used to bring the patient's body back into balance. The patient's condition must be closely monitored, and sometimes the use of a breathing machine may be necessary to support an unconscious patient's respiration until the illness resolves.

▶ See also **Influenza • Varicella (Chicken Pox) and Herpes Zoster (Shingles) • Viral Infections**

Resources

Organizations

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824, Web site: http://www.ninds.nih.gov/disorders/reyes%5Fsyndrome/reyes_syndrome.htm.

National Reye's Syndrome Foundation. P.O. Box 829, Bryan, OH, 43506-0829. Toll free: 800-233-7393. Web site: <http://www.reyessyndrome.org>.

Rheumatic Fever

Rheumatic (roo-MA-tik) fever is a complication of a group A streptococcal infection, such as strep throat or scarlet fever, that can lead to permanent heart damage and death. It is most common in children.

Rheumatic Fever, Its Ups and Downs

Into the late 1980s, doctors thought rheumatic fever had almost disappeared from the United States. In 1950, before the widespread use of antibiotics to fight strep infections, more than 22,000 people died of

THE DISCOVERY OF ASPIRIN

In the mid-19th century, the Reverend Edmund Stone (1702–1768) unwittingly discovered the earliest known effective treatment for rheumatic fever and other conditions characterized by rheumatism. Stone, like many physicians of his time, believed that God grew healing herbs for specific diseases in the localities where those diseases naturally occurred. Willing to put his idea to the test, he administered willow bark, which he himself sampled, to some 50 people suffering with rheumatic fever. He reported effective results in each case. The bark was later found to contain the active ingredient salicin (SAL-i-sin), first extracted and analyzed by Dr. Thomas MacLagan (1838–1903) in 1874. Other chemists later produced the salicylate (sal-i-SY-late) group of drugs, which yielded sodium salicylate in 1899. This drug came to be known as aspirin and became useful for remedying symptoms associated with rheumatic fever as well as pain from other causes.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

rheumatic fever and the heart disease it caused. During the 1950s almost 25 of every 100,000 Americans got rheumatic fever each year. But as use of antibiotics such as penicillin became more common in the 1960s, and as increasing numbers of poor children had access to better medical care, rheumatic fever became rare.

By the early 1980s, only about 1 in every 100,000 Americans developed rheumatic fever. But by 1985, the disorder had re-emerged as a significant problem in some communities. There were outbreaks in Salt Lake City, New York, Dallas, San Diego, Akron, and Columbus.

Doctors were puzzled and renewed their interest in fighting rheumatic fever. The number of cases remained small in the United States, although in poor, less developed countries, rheumatic fever was a significant problem. Doctors were uncertain if the fever's comeback in the United States was temporary, but it showed that everyone needs to be watchful for the effects of strep infections.

From a Sore Throat to a Damaged Heart

Rheumatic fever sometimes results when the body's immune system reacts to infection by a bacterium known as group A *streptococcus*, commonly called strep. The same bacteria that cause strep throat can lead to other disorders, such as scarlet fever.

When the body becomes infected with the strep bacteria, the immune system* produces antibodies to fight the infection. Rheumatic fever results when these antibodies begin to attack other parts of the body instead of just fighting the infection. The antibodies react to organs such as the heart as if they were the strep bacteria, perhaps because parts of these organs are chemically similar to strep.

Doctors are not sure exactly why some strep infections develop into rheumatic fever and others do not. The disorder occurs most often in children between 5 and 15 years of age, although it can strike younger children and adults, too.

A Turn for the Worse

The first signs of rheumatic fever usually occur within several weeks after a strep throat infection. Sometimes people appear to have recovered from the sore throat but suddenly begin to show other symptoms:

- Muscle aches and joint pain and swelling resembling arthritis. The pain usually moves from one joint to another.
- Fever, vomiting, and sometimes nosebleeds
- A red rash, especially on the chest, arms, and legs, which might disappear in a few hours. Lumps below the skin also may occur.
- Fatigue and problems breathing, because the heart is affected. The heartbeat also may be abnormal.
- Sydenham's chorea, which is uncontrollable twitching and body movements.

The most dangerous consequence of rheumatic fever is inflammation and weakening of the heart muscle. The valves that control passage of blood in and out of the heart can be damaged so that they fail to open and close properly. This condition is called rheumatic heart disease. During an acute episode of rheumatic fever, a physical examination might produce abnormal findings regarding the heart; however, these can be subtle.

SYDENHAM'S CHOREA

Sydenham's chorea is the name for the involuntary movements and twitching that some rheumatic fever patients display.

“Chorea” (pronounced like the country Korea) comes from the Greek word for “dance.” During the Middle Ages, chorea was the term used to describe people who traveled to the shrine of St. Vitus in what later became Germany. Some of the people apparently suffered from conditions involving abnormal body movements, such as epilepsy, and hoped to be healed at the shrine. (Catholics consider St. Vitus the patron saint of those with epilepsy, as well as of dancers and actors.)

Thomas Sydenham (1624–1689), a prominent physician in England during the 1600s, used the term “chorea” in connection with infectious diseases such as scarlet fever. Later, when rheumatic fever was also connected with strep infection, Sydenham's chorea was the term used to describe the shaking of the upper limbs and face caused by swelling of the brain.

Sydenham's chorea is sometimes called St. Vitus' dance.

The heart damage that leads to poor function of the cardiac valves may take months to years to develop (after the initial episode) with symptoms and clinical findings on cardiac examination.

The Importance of Antibiotics

A doctor may suspect a strep infection if a patient with a sore throat also has a fever and severe headache. However, the symptoms and physical exam findings in people with strep throat are very similar to those in people with sore throat due to a virus infection or other cause. Therefore, strep infections must be confirmed with laboratory tests. Doctors use a cotton swab to wipe the throat to test for the strep bacteria.

If the infection is caused by strep, the doctor usually prescribes an antibiotic to be taken by mouth for several days or given as a one-time shot. Doctors stress that it is important to take all the antibiotic prescribed, even if the symptoms of the strep infection disappear.

Not all untreated strep infections lead to complications such as rheumatic fever. For people who get rheumatic fever, doctors use antibiotics as well as other drugs that reduce swelling and relieve pain. They also closely watch the heart to ensure that there are no problems with blood flowing through it. If the heart valves are damaged, surgery might be necessary to fix one or more valves.

The best way to avoid rheumatic fever is to treat strep infection promptly with antibiotics. Doctors, however, are concerned that some bacteria may become resistant to traditional antibiotics. In the early 2000s, research explored the best ways to use antibiotics and the development of new drugs to fight infections.

▶ See also **Heart Disease • Scarlet Fever • Sore Throat/Strep Throat**

Resources

Books and Articles

Margulies, Phillip. *Everything You Need to Know about Rheumatic Fever*. New York: Rosen, 2004.

Organization

American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org/presenter.jhtml?identifier=4709>.

Rheumatism See *Arthritis*.

Rheumatoid Arthritis See *Arthritis*.



▲ Rickets can cause bone deformities. If it begins before a person learns to walk, the spine may become abnormally curved.

If it begins or continues after the person starts to walk, the legs may become bowed by the weight of the body.

Biophoto Associates/Photo Researchers, Inc.

* **ultraviolet** light is a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

* **formula** is a prepared, nutritious drink or a dry drink mix designed specifically for infants.

Rickets

Rickets is a bone disease most commonly caused worldwide by a deficiency of vitamin D. The deficiency may be caused by a lack of vitamin D in the diet, a lack of exposure to sunlight, or a problem the body has with absorbing or using vitamin D. If left untreated, rickets results in bone deformities.

What Is Vitamin D?

Vitamin D is a nutrient essential for proper bone formation. It helps regulate the amount of calcium and phosphorus in the blood, and these minerals are important components of bone formation. Vitamin D is called the “sunshine vitamin” because it is formed naturally in the skin in the presence of the ultraviolet* (UV) rays found in sunlight. Vitamin D can also be obtained from food. Vitamin D is added to milk and infant formula*, and egg yolks, liver, cod-liver oil, and other fish oils are good dietary sources of vitamin D.

What Is Rickets?

Rickets is characterized by improper hardening of the bones, resulting in skeletal deformities if left untreated. Rickets affects primarily infants and children because bone growth occurs during childhood. Rickets can occur for a number of reasons.

Nutritional childhood rickets Rickets can occur because of a nutritional deficiency in vitamin D. In modern times this type of rickets is rare in developed countries. Children growing up in poor communities where vitamin D-rich foods may be scarce are the most susceptible to rickets. Children living in areas where there is a lack of sunshine, such as in the Northern Hemisphere in the winter, are also susceptible. Overcast and polluted atmospheres that block out the sun can also deprive children of vitamin D. Another form of nutritional rickets is seen in extremely premature babies if they are fed a vitamin D-poor formula or if their diet contains inadequate amounts of phosphorus and calcium.

Genetic childhood rickets Rickets also can occur due to inherited genetic disorders that result in improper absorption or use of vitamin D, calcium, or phosphorus. In the United States, the most common cause of rickets is a disease called familial hypophosphatemia (hy-po-fos-fa-TEE-me-a), which means “too little phosphorus in the blood.” In this genetic disease, phosphorus “leaks” out of the body through the kidneys. However, fewer than 10 out of every 1 million babies are affected by this disease.

Adult rickets Adult rickets, or osteomalacia (os-te-o-ma-LAY-sha), causes bone problems similar to those found in childhood rickets. Osteomalacia can be caused by a nutritional deficiency of vitamin D, but it most commonly

occurs when the body has problems absorbing phosphorus and calcium due to other illnesses (such as liver and kidney disease). In some instances, drugs that interfere with absorption of vitamin D cause rickets and osteomalacia.

What Are the Symptoms of Rickets?

Children with rickets may not have any symptoms, or they may feel pain and develop bone deformities. A child who has or is developing rickets may experience muscle cramps, twitches, and abnormal contractions of the hands and feet due to low levels of calcium in the blood. The muscles, limbs, and abdomen grow weak, and the bones of the skull remain soft. An infant with rickets may have difficulty developing such basic movement skills as sitting, crawling, and walking due to weakness and pain.

The type of bone deformity caused by rickets depends on the age at which the disease develops. If it begins before the walking stage, the spine may be abnormally curved. If it begins or continues after the child starts to walk, the legs may become bowed by the weight of the body. For children with rickets, the teeth take more time to grow in, and often the wrists and ankles are thickened. Because of weak bones, children with rickets also are susceptible to fractures (broken bones).

Osteomalacia can cause similar effects: soft bones, skeletal pain, muscular weakness, and susceptibility to fractures.

How Is Rickets Diagnosed and Treated?

Rickets can be diagnosed with blood tests, in which the amounts of calcium, phosphorus, and vitamin D are measured, and with x-rays. Nutritional rickets is treated with dietary supplements of vitamin D and calcium. If treated early enough, there will be no long-lasting effects. If untreated, a child may develop permanent bone deformities. Dietary supplements of vitamin D, calcium, and phosphate also may be prescribed for people with rickets caused by other diseases or by genetic defects.

A VITAMIN D TIME-LINE

- During the 1700s, cod-liver oil and sunlight were recognized as effective treatments for rickets.
- By 1918 scientists had discovered vitamins. Experiments on animals showed that cod-liver oil had a vitamin that helped prevent rickets.
- By 1924 ultraviolet (UV) light was used for treating rickets. The process was called irradiation. Researchers understood that vitamin D was formed by the effects of ultraviolet rays on the skin.
- During 1930 and 1931, scientists in England and Germany were able to produce pure vitamin D for the first time.

* **arthropods** are members of a group of organisms that lack a spinal column and have a segmented body and jointed limbs. This group includes various insects, ticks, spiders, lice, and fleas.

How Is Rickets Prevented?

Rickets can be prevented by consuming a diet rich in vitamin D as well as by spending time in the sun. A good source of vitamin D is vitamin D-fortified milk.

▶ See also **Broken Bones (Fractures)** • **Dietary Deficiencies** • **Growth and Growth Disorders**

Resources

Books and Articles

Navarra, Tova. *Encyclopedia of Vitamins, Minerals, and Supplements*, 2nd ed. New York: Facts on File, 2004.

Walker, W. Allan. *Eat, Play, and Be Healthy: The Harvard Medical School Guide to Healthy Eating for Kids*. New York: McGraw-Hill, 2005.

Organization

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/rickets.html>.

Rickettsial Infections

Rickettsial (rih-KET-see-ul) infections include those diseases caused by bacteria from the Rickettsiaceae family.

What Are Rickettsial Infections?

The diseases caused by rickettsial infections are alike in many ways. Rocky Mountain spotted fever, typhus (TY-fis), ehrlichiosis (air-lik-e-O-sis), and Q fever all have similar symptoms, including headache, high fever, and sometimes a rash. These infections also respond to the same type of treatment, and many of them spread in the same way: through the bites of blood-sucking arthropods*, such as lice, fleas, and ticks.

How Common Are Rickettsial Infections?

These infections do not occur frequently in the United States (although typhus is relatively common in other parts of the world, especially the tropics). Rocky Mountain spotted fever is the most common rickettsial infection in the United States: Up to 1,200 cases are reported yearly, compared to fewer than 100 typhus cases, and between 100 and 600 cases of ehrlichiosis.

Are Rickettsial Infections Contagious?

Rickettsial infections do not spread directly from person to person. Instead, most require blood-sucking arthropods, such as lice, ticks, and fleas, to carry the infection-causing bacteria between animals and people or from one person to another. When a flea, for example, bites an infected animal or person, it can ingest the infectious bacteria. If the flea then bites someone else, it can spread the disease to that person. In the case of Rocky Mountain spotted fever, however, the bacterium lives and reproduces within ticks. Once a tick acquires the bacterium (from its mother when it is still an egg, or through mating or feeding on an infected animal), it can infect people for the rest of its life. Q fever mainly spreads from livestock animals to people. The bacteria can pass into the animals' bowel movements, milk, urine, or fluids that accompany giving birth. People become infected by breathing in the bacteria in airborne bits of dust contaminated with one of those substances.

Specific Rickettsial Infections

Rocky Mountain spotted fever Medical professionals first recognized Rocky Mountain spotted fever in the Rocky Mountain states (such as Idaho, Montana, and Colorado), but after that they found it throughout the United States. A tick bite transmits the *Rickettsia rickettsii* bacterium. The disease is most common in children, usually in tick-infested areas, where outdoor work and play create the most risk.

Symptoms of infection include a severe headache, muscle pain, chills, fever, confusion, and a rash that appears first on the wrists and ankles before spreading. About 5 percent of Rocky Mountain spotted fever cases are fatal, usually because a person does not receive treatment quickly.

Typhus Typhus can appear in several forms, including epidemic* typhus, murine typhus, and Brill's disease (also called Brill-Zinsser disease). The bacteria that cause typhus, *Rickettsia prowazekii* and *Rickettsia typhi*, spread to people through the bites of fleas or lice. People who are infected can become very sick and often have a fever that may climb as high as 105 to 107 degrees Fahrenheit.

Murine typhus is the variety seen most often in the United States, usually in the southern and southeastern states. People who come into contact with fleas that feed on rats, opossums, and outdoor cats are at the greatest risk for the disease. Once someone becomes infected, that person may experience a headache, a rash, nausea (NAW-zee-uh), joint pain, belly pain, vomiting, and a dry cough. The disease is rarely fatal. Most people recover with few complications.

Epidemic typhus is a much more severe disease, which is associated with a drop in blood pressure and stupor* or delirium*, and it can be fatal. Epidemic typhus spreads from person to person by body lice.

Brill's disease is a recurrence of epidemic typhus and, therefore, appears in people who have had epidemic typhus in the past. People who

* **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.

* **stupor** is a state of sluggishness or impaired consciousness.

* **delirium** (dih-LEER-e-um) is a condition in which a person is confused, is unable to think clearly, and has a reduced level of consciousness.

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

HISTORICAL IMPORTANCE OF TYPHUS

Epidemic typhus most frequently appears during wars and natural disasters, when a combination of crowding and poor hygiene occurs. The disease has a long history of causing death in times of war. Poor sanitation and the presence of lice and rats in crowded living quarters have contributed to high rates of illness and death among soldiers: In fact, typhus was the cause of the French defeat of Russia in 1812 during the Napoleonic War. Conditions were no better in World War I, and thousands of soldiers had fallen victim to typhus by the war's end in 1918. During World War II (1939–1945), efforts were under way to control the disease with vaccinations, antibiotics, and more sanitary conditions.

Prior to the introduction of antibiotics, the fatality rate of epidemic typhus approached 60 percent.

Typhus is sometimes also known as “jail fever,” because epidemics in the past would periodically sweep through prisons, where filthy conditions made a home for rats and lice.

are vulnerable to Brill's disease are those whose immune system has been weakened by stress or by illness. It happens because the body's defenses are down, and this allows organisms left over from the earlier bout of illness to reactivate. Brill's disease causes mild symptoms and is not fatal.

Q fever Q fever results from the bacterium *Coxiella burnetii*, which lives primarily in farm animals, such as sheep, goats, and cattle. People who contract the infection may have no symptoms at all or may experience symptoms similar to those of the flu, such as fever, muscle and joint aches, severe headache, and dry cough. Nausea, vomiting, diarrhea (dye-uh-REE-uh), chest and belly pain, and jaundice* can also accompany Q fever. People who work with animals, such as veterinarians, farmers, and slaughterhouse workers, are most at risk for the disease, which is transmitted when they breathe in the airborne bacteria that come from the animals' bowel movements, milk, urine, or fluids from giving birth.

Ehrlichiosis Infection with the species of *Ehrlichia* (air-LIH-kee-uh) bacteria—*E. chaffeensis* and *E. phagocytophila*.—cause ehrlichiosis. Tick bites spread the bacteria to people, where the infection produces symptoms similar to those of Rocky Mountain spotted fever. Severe cases can damage many organ systems and lead to seizures*, coma*, and death.

How Do Doctors Diagnosis Rickettsial Infections?

Medical professionals diagnose rickettsial infections by finding antibodies* to the organism in the blood. These antibodies usually are not present early in the illness, so a doctor relies on the patient's history of symptoms, a physical

examination, and information about where the person lives or became sick to make the diagnosis. In some cases, doctors may order a skin biopsy* of the rash to help in making the diagnosis. To avoid potentially serious complications, doctors often begin treatment even before they have test results to confirm their diagnoses.

What Is the Treatment for Rickettsial Infections?

Medical professionals treat all of these diseases with antibiotics. Patients begin taking the medication as soon as possible, because a delay in treatment may increase the risk of complications. In more serious cases, often those in which the diagnosis has been delayed, the patient may require hospitalization and treatment with intravenous* (IV) antibiotics and fluids.

How Long Does a Rickettsial Infection Last?

The infections typically last from one week to several weeks. If they go untreated or if treatment does not begin soon after infection, the disease can linger for months.

What Are the Complications of Rickettsial Infection?

Untreated and severe cases of any of these diseases can be fatal. In addition, each rickettsial illness has its unique complications:

- Rocky Mountain spotted fever can cause paralysis*, hearing loss, and nerve damage.
- Typhus can lead to pneumonia*, and problems with the kidneys* and the central nervous system*.
- Chronic* Q fever in the elderly can cause endocarditis* and hepatitis*.
- Ehrlichiosis can damage various organs, including the lungs, kidneys, and brain.

How Are Rickettsial Infections Prevented?

People can take steps to protect themselves from infection by avoiding flea, tick, and louse bites. Medical professionals recommend that anyone who works or plays outdoors be particularly careful. Avoiding areas that are infested with lice, ticks, and fleas or using insecticides and repellents in those areas can help. Wearing long pants and long-sleeved shirts, especially in areas with thick bushes or tall grass, also can guard against bites. After spending time outside in areas where ticks live, people should examine their bodies carefully, including the hair, to make sure that they have no ticks. In addition, pet owners should check their animals regularly for ticks, because animals can carry parasites into the house.

The best way to prevent Q fever is to regularly test animals for infection and isolate any that are infected. Doctors recommend that people who work with animals wash hands and launder clothes carefully to lower their risk of infection.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **kidneys** are the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **endocarditis** (en-do-kar-DYE-tis) is an inflammation of the valves and internal lining of the heart, known as the endocardium (en-doh-KAR-dee-um), usually caused by an infection.

* **hepatitis** (heh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.



▲
The red circular rash behind the ear is an example of ringworm of the body, or *tinea corporis*. Ringworm is caused by mold-like fungi, not by a worm as the name would suggest. *John Hadfield/Photo Researchers, Inc.*

Latin Lesson

- **Capitis (KAH-pih-tis):** from the Latin word for head
- **Corporis (KOR-poor-us):** the Latin word for body
- **Cruris (KRU-ris):** from the Latin word for leg
- **Pedis (PEE-dis):** the Latin word for foot
- **Unguium (UN-gwee-um):** from the Latin word for nail

▶ See also **Ehrlichiosis • Tick-borne Illnesses • Zoonoses**

Resources

Books and Articles

Raoult, Didier, and Philippe Parola, eds. *Rickettsial Diseases*. New York: Informa Healthcare, 2007.

Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: <http://www.cdc.gov/ncidod/dvrd/branch/vrzb.htm>.

Ringworm

Ringworm, or tinea (TIH-nee-uh), is a fungal infection of the skin, scalp, or nails. It usually causes red, dry, flaky skin.

What Is Ringworm?

Despite its name, ringworm is not caused by a worm but by mold-like fungi known as dermatophytes (dur-MAH-toh-fites) that thrive in the top layer of the skin, in the scalp, and in nails. Several different but related types of fungi, including those in the *Trichophyton* and *Microsporum* species, cause ringworm infection on different parts of the body. All of these infections are known as tinea infections.

Fungal infections take their names from the part of the body where they occur, so tinea corporis is ringworm on the body; tinea unguium is ringworm of the nails; tinea capitis is ringworm of the scalp; tinea cruris is ringworm of the groin (commonly called jock itch); and tinea pedis is ringworm of the feet (also known as athlete's foot). The same fungi that infect humans can infect cats and dogs, and people can contract the disease from people and pets.

Damaged skin is more vulnerable to infection, as is skin in warm, moist areas. When the fungus takes hold, it typically causes a ring-like rash of red, flaking skin. The border of the rash may be raised, as if a worm were under the skin. The rash's shape and this raised edge led people to call the infection ringworm. When the nails are infected, they usually become yellow, thickened, and brittle.

Is Ringworm Common?

Ringworm is widespread in many countries, including the United States. Tinea corporis and tinea capitis infections most often occur in children, although they are found in people of all ages. The other types of

ringworm, especially jock itch and athlete's foot, are more common in adolescents and adults.

How Do People Contract Ringworm?

Ringworm is contagious and spreads through direct contact with an infected person or pet. People can also contract the fungus from soil or from surfaces and objects that an infected person has touched, such as toys, a pillow, or the locker room floor. Once someone is infected, that person is contagious until the telltale rash starts to shrink. The fading of the ring indicates that the fungus is no longer present.

How Do People Know They Have Ringworm?

As anyone who has had the infection knows, the symptoms of ringworm are annoying rather than serious. The most common signs are itching around the infected area, dry skin, and a red, ring-shaped rash. Over time the borders of the rash spread outward and the center clears, leaving a circle of red around normal skin. Sometimes the central patch in the rash is filled with pus*, and the borders may be dry and scaly or moist and crusty.

Ringworm on the scalp can cause a temporary bald patch or areas of scaly, flaky skin, occasionally with a red, swollen spot. Infected nails become yellow, thickened, and brittle, and athlete's foot often appears as red, cracked, peeling skin between the toes.

How Do Doctors Diagnose Ringworm?

In many infected patients, doctors can identify tinea just by looking at the affected skin, scalp, or nails. To confirm the diagnosis, the doctor may take a scraping of the suspect area to be examined under a microscope for signs of the fungus. The scraping also can be cultured* to see if any fungi grow from it. Because some types of fungi glow under ultraviolet* (UV) light, the doctor may shine a UV lamp on the rash to see if any part of it lights up. Doing so can help identify the fungus causing the infection.

How Is Ringworm Treated?

Doctors prescribe antifungal* cream, ointment, or shampoo for most cases of infection. More advanced cases may also require oral (by mouth) medicine, including all cases of tinea capitis and tinea unguium.

Patients typically need to use the cream, ointment, or shampoo for at least two weeks. However, some patients may need to use medicine for several weeks or months, depending on the extent and location of the infection. Beyond that, it may take even more time for skin to heal completely or for healthy nails and hair to grow back.

Ringworm may be irritating, but it causes almost no complications. Without treatment, the infection can linger for many months, and infected nails may fall off. Sometimes areas that have been attacked by the fungus develop infection from bacteria because the damaged skin is more vulnerable.

* **pus** is a thick, creamy fluid, usually yellow or greenish in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

* **cultured** (KUL-churd) means subjected to a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **ultraviolet** light is a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

* **antifungal drugs** (an-ty-FUNG-al drugs) are medications that kill fungi.



▲ The Rocky Mountain wood tick, *Dermacentor andersoni*, is one of the species of hard-bodied ticks responsible for spreading the bacterium that causes Rocky Mountain spotted fever. Once infected, a tick can carry the bacterium for life. Larry West/Photo Researchers, Inc. Reproduced by permission.

* **tick** is a small blood-sucking creature that may transmit disease-causing germs from animals to humans through its bite.

* **parasites** (PAIR-uh-sites) organisms such as protozoa (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

Can Ringworm Be Prevented?

The best way to prevent ringworm is to practice good hygiene, such as bathing and changing underclothes every day. Keeping the skin clean and dry discourages the fungus from taking hold. Not sharing personal items such as brushes, towels, and clothing (especially gym shoes) limits the spread of ringworm between people. In addition, washing an infected person's clothing and bedding frequently can help keep the infection from spreading to others. If a household pet develops ringworm, doctors advise the family to talk to a veterinarian and avoid direct contact with the animal, as in cuddling and patting, until the rash heals.

Athlete's foot can flourish when the skin on the feet, especially between the toes, stays moist. Removing shoes and socks to allow moisture from sweat to dry, carefully drying feet after showering, and changing socks daily can help ward off the fungus. Wearing slip-on sandals instead of going barefoot in public places such as locker rooms and gym showers can reduce the risk of picking up tinea from surfaces an infected person has touched.

▶ See also **Athlete's Foot • Fungal Infections • Skin and Soft Tissue Infections**

Resources

Organizations

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905, Web site: <http://www.mayoclinic.com/health/ringworm/DS00489>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/001439.htm>.

Rocky Mountain Spotted Fever

Rocky Mountain spotted fever is an infection transmitted by the bite of a tick. At first its symptoms are mild, but without treatment the disease can become serious and cause organ damage and death.*

What Is Rocky Mountain Spotted Fever?

Rocky Mountain spotted fever (RMSF) is the most serious of the rickettsial (rih-KET-see-ul) infections, diseases caused by bacteria from the Rickettsiaceae family. These bacteria typically spread to people through blood-sucking parasites* such as ticks and fleas. In Rocky Mountain spotted fever, the bacterium *Rickettsia rickettsii* lives and reproduces in the Ixodidae (ik-SAH-dih-day) family of hard-bodied ticks, such as the American dog tick and the Rocky Mountain wood tick, before it infects

people. Once it does infect a person, it enters cells lining the blood vessels and can cause serious disease.

Several of the disease's first symptoms can be confused with those of other infections. As the condition grows worse, it often causes a widespread rash, which led people to call RMSF "black measles" when it was described in the late nineteenth century. If the infection is not treated, it can damage several organ systems and sometimes lead to death.

How Common Is It?

Despite its name, the infection is not limited to the Rocky Mountains. It is found throughout the United States, and most cases actually occur in the southeastern part of the country. The disease also has been found in southern Canada, Mexico, some countries in Central America, and parts of South America. According to the Centers for Disease Control and Prevention, between 250 and 1,200 cases are reported in the United States each year, with most in children under the age of 15. About 5 percent of Rocky Mountain spotted fever cases are fatal, usually because a person does not receive treatment quickly.

Is It Contagious?

RMSF is not contagious from person to person. It can spread only from a tick to a person, usually through the tick's bite when it feeds. Rarely, people can become infected when they come into contact with tick droppings or dead ticks that have been crushed. The bacterium lives in the tick and survives from one generation of the parasite to the next. Female ticks can pass it to their eggs, and male ticks can pass it to females when they mate.

What Are the Infection's Signs and Symptoms?

Symptoms of infection include severe headache, fever, confusion, chills, nausea (NAW-zee-uh), vomiting, loss of appetite, and muscle pain. Many infections have these symptoms, so they may not be immediately identified as RMSF. As the disease worsens, it may cause joint pain, abdominal* pain, extreme thirst, hallucinations*, diarrhea (dye-uh-REE-uh), and a rash. The rash usually appears three to six days after the start of symptoms. It typically starts as small, pink spots that crop up on the wrists, lower part of the arms, and ankles. The rash does not itch, and over time the spots become raised. In many patients, a red, spotted rash develops that looks like dots of blood under the skin, often on the palms of the hands and the soles of the feet. Even though this rash is one of the most distinctive symptoms, it is not seen in every patient. As many as 10 percent to 20 percent of patients do not have the typical rash and the delayed diagnosis can affect the outcome of the disease.

How Do Doctors Diagnose Rocky Mountain Spotted Fever?

Doctors usually identify the infection based on symptoms seen during an examination, reports of the disease in the area, and knowledge of a recent tick bite. Fever, rash, and history of a tick bite are considered the classic



▲ The rash associated with Rocky Mountain spotted fever usually starts as small pink spots, which, over time, become raised. *Science Source/Photo Researchers, Inc.*

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

* **hallucinations** (ha-LOO-sin-AY-shuns) occur when a person sees or hears things that are not really there. Hallucinations can result from nervous system abnormalities, mental disorders, or the use of certain drugs.

How to Remove a Tick

Using thin-tipped tweezers, grasp the tick as close to the person's skin as possible.

Pull straight upward firmly and steadily until the tick lets go (do not squeeze or twist the tick body).

Clean the skin with soap and warm water, alcohol, or other antiseptic.

Save the tick for identification.

Petroleum jelly, lit matches, nail polish or other products do not help in tick removal and should not be used.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **digestive system** is the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, rectum, and other organs involved in digestion, including the liver and pancreas.

* **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

features of RMSF. The doctor also may take a blood sample to look for antibodies* to the bacteria.

What Is the Treatment?

People with RMSF often need to be in the hospital, where they can receive supportive care. The disease is treated with antibiotics, which are given as soon as a doctor suspects that a patient might have RMSF. Waiting until laboratory tests confirm the diagnosis could put the patient at greater risk because the infection can progress so quickly. Patients continue taking the medicine for at least three days after the fever goes away.

What Medical Complications Can Occur?

Treatment typically takes 5 to 10 days, but it can last much longer. Without treatment or with delayed treatment, severe cases of illness can lead to death. In addition, the disease can cause problems with the central nervous system*, the kidneys, the digestive system*, and the respiratory tract*. This worsening condition can lead to partial paralysis*, hearing loss, meningitis*, heart failure, brain damage, kidney failure, and shock*.

How Can Rocky Mountain Spotted Fever Be Prevented?

It is important to take precautions to limit the risk of tick bites: for example, by avoiding walks through brush and dense vegetation in areas with lots of ticks. When spending time outside, individuals should wear long pants, long sleeves, and socks, with the pants tucked into the socks. Light-colored clothing makes ticks easier to see, and insect repellent with DEET* can protect exposed skin. After being outside in tick-infested areas, people should remove clothing and check their body, including the hair, thoroughly for the parasites. Doctors recommend that any ticks that are found be removed with tweezers as soon as they are discovered. Generally, infected ticks have to be attached to the body for at least 24 hours before they pass on the RMSF bacterium.

DR. RICKETTS

Even if people have heard about Rocky Mountain spotted fever, they may not know the name Howard Taylor Ricketts (1871–1910). Dr. Ricketts discovered the bacterium that causes the disease and figured out that it spreads to people through tick bites. In recognition of that work, *Rickettsia rickettsii*, the RMSF bacterium, received its double Ricketts name. Dr. Ricketts also did research on typhus (TY-fis), another rickettsial infection. He died of typhus in 1910.

▶ See also Ehrlichiosis • Rickettsial Infections • Tick-borne Illnesses • Zoonoses

Resources

Books and Articles

Walker, David H. *Rocky Mountain Spotted Fever*. New York: Chelsea House, 2008.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web sites: <http://www.cdc.gov/Features/StopTicks>; http://www.cdc.gov/ncidod/dvbid/lyme/ld_tickremoval.htm.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/rockyMountainSpottedFever/default.htm>.

Rosacea

Rosacea is a chronic inflammatory skin condition affecting adults in which visible redness on the face occurs.

What Is Rosacea?

Rosacea is a chronic inflammatory skin condition affecting adults in which visible redness on the face occurs. Because it affects adults and frequently co-exists with and is mistaken for teenage acne, rosacea is sometimes called adult acne. However, this term is misleading because rosacea has little to do with acne*. The only commonality between rosacea and acne is its appearance.

In the early 2000s it was estimated that the condition afflicted about 45 million people worldwide and more than 13 million people in the United States. Most people with rosacea are adults between the ages of 30 and 60 years, but people of all ages can have it. Rosacea affects primarily fair-skinned Caucasians of Northern European descent, and more women get rosacea than men, although men usually have more severe signs of the disease. There is no cure for rosacea, but there are treatments that diminish the signs and symptoms of the condition.



▲ Rosacea is a common inflammatory condition of the skin of the face that causes redness. *Medical-on-Line/Alamy.*

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

* **DEET** (abbreviation for N,N-Diethyl-meta-toluamide) is the active ingredient in many insect repellants.

* **acne** (AK-nee) is a condition in which pimples, blackheads, whiteheads, and sometimes deeper lumps occur on the skin.

Famous People with Rosacea

People of all races and nationalities can get rosacea, but fair-skinned individuals are more prone to it. The U.S. comedian and actor W. C. Fields (1880–1946), who was popular in the first half of the twentieth century, was known for his bulbous nose, which was attributed to his fondness for alcoholic beverages. His enlarged, red nose, however, was the result of something called rhinophyma, appearing in advanced cases of rosacea.

Bill Clinton (b. 1946), the 42nd president of the United States, suffers from rosacea. Diana, Princess of Wales, (1961–1997) suffered from the condition, as does her son Prince Harry of Wales (b. 1984).

* **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

* **follicles** are tiny pits in the skin from which hair grows.

What Are the Signs and Symptoms of Rosacea?

The visible signs of rosacea vary widely among individuals; however, they commonly include the following primary symptoms:

- Erythema (flushing and redness)
- Persistent reddish (sunburn-like) areas on the face
- Small, solid red bumps (some containing pus) on the cheeks, chin, forehead, and nose, and less commonly on the chest and neck
- Dilation of superficial blood vessels on the face, especially on the cheeks and nose

Secondary symptoms include:

- A burning, itchy, or stinging sensation in the eyes (they may appear watery or bloodshot)
- Dryness of the central portion of the face
- Raised red patches of skin
- Thickening of skin portions, especially on the nose
- Swelling of the face

Rosacea is often characterized by cycles of flare-ups and remissions.

In people in whom rosacea is severe, the symptoms occur in four main phases. First, the condition begins with a tendency to blush easily. Thereafter, redness on the central portion of the face appears, especially around the nose. This phase is sometimes called the pre-rosacea phase. Superficial blood vessels are likely to become dilated.

In the second phase, called the vascular rosacea phase, symptoms and visible signs worsen. Dilated blood vessels become more enlarged and more visible. Because of these semi-permanently enlarged blood vessels, the nose and surrounding portions of the face begin to look larger than normal. Rashes on the head and the ears and oily skin are more likely.

Inflammatory rosacea, the third phase, is marked by the appearance of small, red bumps, some of them pus-filled, across the cheeks, chin, forehead, and nose. Thickening of the facial skin also develops, along with other surface irregularities and enlargements.

Phase four occurs when the inner eyelids become inflamed, swollen, or appear scaly. This appearance results in a burning sensation around the eyes—which often appear red. Tearing may also occur. The severest cases may include eye damage and loss of vision.

What Are the Causes of Rosacea?

As of 2009, the cause of rosacea was unknown. However, some professionals thought the condition was probably a result of complex environmental and hereditary factors. It was theorized that rosacea may be brought on by the overgrowth of certain types of bacteria in the gastrointestinal* tract. This would explain why rosacea usually gets better with the use of certain antibiotics. It was also suggested that mites living within hair follicles* and excessive

exposure to sunlight might contribute to the problem. It was also proposed that rosacea may be a disorder of facial capillaries, probably inherited.

How Is Rosacea Treated?

One treatment plan is not suitable for all patients because symptoms widely vary. Therefore, a combination of treatments is preferred over a single plan. The following medicinal options are available to treat rosacea:

- Topical antibiotics to fight inflammation and remove bumps, pimples, and redness, such as metronidazole
- Oral antibiotics such as tetracycline, minocycline, doxycycline, and erythromycin
- Topical azelaic acid to reduce redness and inflammation
- Isotretinoin for severe inflammation (which has serious side effects)

The doses of medications and durations of drug regimens depend on the severity of the rosacea. In most cases, drugs help to alleviate symptoms within four to eight weeks. Usually, treatment is continued for one to two years (or longer) after the diagnosis is made. Often treatment must continue throughout the life of the patient.

In some severe cases of rosacea, the blood vessels of the face become permanently enlarged and reddened. Low-level light therapies and photo-rejuvenation are used sometimes to treat rosacea. Surgical options include laser surgery, cryosurgery, and electrosurgery. All three surgery types can make improvements in an enlarged nose, while laser surgery and electrosurgery can eliminate enlarged blood vessels.

What Strategies Reduce the Symptoms of Rosacea?

Various practices can minimize the symptoms of rosacea. These include the following:

- Using sunscreen on the face, with a SPF (sun protection factor) of at least 15
- Wearing headgear to protect the face from sunlight and cold winds
- Applying a moisturizer after a topical medication has dried
- Using skin-care products that are compatible; specifically, those designed not to clog oil and sweat pores and those that do not irritate the face
- Avoiding or minimizing alcoholic beverages and caffeine (such as coffee and other hot beverages)
- Avoiding the use of facial products that contain alcohol and other irritants
- Avoiding or minimizing strenuous exercise or physical work that produces overheating
- Avoiding temperature extremes and hot weather

* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

* **mononucleosis** (mah-no-nu-lee-O-sis) is an infectious illness caused by a virus that often leads to fever, sore throat, swollen glands, and tiredness.

* **cytomegalovirus** (sy-tuh-MEH-guh-lo-vy-rus), or CMV, infection is very common and usually causes no symptoms. It poses little risk for healthy people, but it can lead to serious illness in people with weak immune systems.

* **herpes simplex** (HER-peeZ SIM-plex) is a virus that can cause infections of the skin, mouth, genitals, and other parts of the body.

- Avoiding hot baths or showers
- Reducing or eliminating stressful situations
- Avoiding spicy foods
- Avoiding wrinkle and acne treatments, such as chemical peels
- Avoiding steroids, such as those prescribed for nasal problems
- Practicing eyelid hygiene, including the use of cleansers and warm compresses

▶ See also **Skin Conditions**

Resources

Books and Articles

Brownstein, Arlen, and Donna Shoemaker. *Rosacea: Your Self-help Guide*. Oakland, CA: New Harbinger Publications, 2001.

Nase, Geoffrey. *Beating Rosacea: Vascular, Ocular, and Acne Forms*. Indianapolis, IN: Nase Publications, 2001.

Organization

National Rosacea Society. 800 South Northwest Highway, Suite 200, Barrington, IL, 60010. Toll free: 800-NO-BLUSH. Web site: <http://www.rosacea.org>.

Roseola Infantum

Roseola infantum (ro-see-O-luh in-FAN-tum) is a viral infection seen in young children that produces a rash and high fever.

What Is Roseola Infantum?

Also known as exanthem subitum (eg-ZAN-thum SU-bih-tum), roseola infantum is an acute* viral infection that mainly affects children between the ages of six months and three years and is characterized by high fever followed by a rash. The disease stems from infection with human herpesvirus (her-peeZ-VY-rus) type 6 (HHV 6) or human herpesvirus type 7 (HHV 7). Both of these belong to the same family of viruses as varicella zoster (var-uh-SEH-luh ZOS-ter), which causes chicken pox; Epstein-Barr (EP-steen BAR) virus, which causes mononucleosis*; cytomegalovirus*; and herpes simplex* virus.

How Common Is Roseola Infantum?

HHV 6 and HHV 7 affect almost all children who are between six months and three years of age, but not all of these infections produce the illness recognized as roseola infantum. Roseola rarely is seen in children over four years of age, and the illness appears most often during the spring and fall.

Is Roseola Infantum Contagious?

Roseola spreads from person to person, most likely through tiny drops of fluid expelled from the mouth and nose of an infected child when he or she laughs, coughs, sneezes, or talks.

What Are the Signs and Symptoms?

Symptoms of roseola infantum usually appear between 5 and 15 days after exposure to the virus. Children may first have a mild respiratory-tract* illness, followed by a high fever that can reach 105 degrees Fahrenheit and last from two to five days. When the fever subsides, a rash appears, starting on the trunk of the body and spreading to the limbs, face, and neck. The rash of raised red and pink splotches, which fade to white when pressed, lasts from one to three days. Additional symptoms of the infection can include tiredness, swollen eyelids, a runny nose, swollen lymph nodes* in the neck, and irritability. In up to 10 percent of children, the high fever associated with roseola infantum causes febrile seizures*.

How Is Roseola Infantum Diagnosed?

To diagnose roseola, doctors look for physical symptoms and signs such as rash and swollen lymph nodes, particularly those in the back of the scalp. A medical history may show that the child has been exposed to others with the disease at home or in a childcare setting. Because the rash appears after the fever, roseola often is diagnosed after the child has begun to recover from the illness.

How Is the Infection Treated?

Most cases of roseola infantum respond well to treatment at home. Acetaminophen* can help lower a fever, and drinking lots of clear fluids can prevent dehydration*. Children usually feel ill only while they still have a fever and probably will be less active during that time. By the time the rash appears, a child's behavior may be almost back to normal.

Are There Complications?

Most cases of infection resolve in four to six days without additional problems. Seizures are the most common complication, but this does not mean that the child will have an increased risk of a long-term seizure problem. In rare cases, the disease may lead to the development of meningitis (meh-nin-JY-tis, an inflammation of the membranes covering the brain and spinal cord) or encephalitis (en-seh-fuh-LYE-tis, an inflammation of the brain).

* **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.



▲
The characteristic rash of rubella. The rubella vaccine has greatly decreased the number of cases in the United States since it was put into use in 1969. Although rubella is generally not serious in otherwise healthy people, in pregnant women it is associated with birth defects and miscarriage. *Dr. P. Marazzi/Photo Researchers, Inc.*

* **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.

* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

* **premature delivery** is when a baby is born before it has reached full term.

* **cataracts** (KAH-tuh-rakts) are areas of cloudiness of the lens of the eye that can interfere with vision.

* **microcephaly** (my-kro-SEH-fah-lee) is the condition of having an abnormally small head, which typically results from having an underdeveloped or malformed brain.

Can Roseola Infantum Be Prevented?

There is no simple way for children to avoid exposure to HHV6 and HHV7 completely. Young children have lots of close contact with each other. Adults rarely contract this illness, possibly indicating that having roseola as a child provides lifelong immunity* to the viruses. Some children do experience a second bout of the disease, but this occurs infrequently. Like other viruses in this family, HHV6 and HHV7 can reactivate after the first infection and cause illness, which happens primarily in people who have a weakened immune system.

▶ See also **Cytomegalovirus (CMV) Infection • Encephalitis • Herpes Simplex Virus Infections • Meningitis • Mononucleosis, Infectious • Varicella (Chicken Pox) and Herpes Zoster (Shingles)**

Resources

Organization

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905, Web site: <http://www.mayoclinic.com/health/roseola/DS00452>.

Roundworm See *Ascariasis; Hookworm; Worms: Overview.*

Rubella (German Measles)

Rubella (roo-BEH-luh) is a viral illness that causes a rash. Many people know the disease by its other common name, German measles.

What Is Rubella?

Rubella is caused by the virus of the same name. The word “rubella” comes from the Latin word for “little red,” which originally described the infection’s telltale rash. It is also known as German measles and three-day measles because of its short duration.

Rubella infection usually is not serious. Most people have mild symptoms and a faint rash. However, if a woman develops rubella during the early stages of her pregnancy, it can cause miscarriage*, premature delivery*, and multiple birth defects, known as congenital (kon-JEH-nih-tul) rubella syndrome (CRS). Babies born with CRS may have cataracts* and other eye problems, microcephaly*, mental retardation, deafness, heart defects, enlarged liver or spleen, and other problems.

How Common Is Rubella?

In the United States, the disease was widespread before the rubella vaccine was introduced. A rubella epidemic* in 1964 and 1965 spawned an estimated 12.5 million cases and 20,000 cases of CRS, according to the Centers for Disease Control and Prevention (CDC). In 1969, the year the vaccine became available, 57,686 cases of rubella were reported to the CDC. After then, the number of U.S. cases each year dropped steadily. The CDC reported that most cases of rubella between about 1995 and 2000 were seen in young Latino adults who did not receive the vaccine as children. Between 2001 and 2008, there were fewer than 25 cases of rubella reported in the United States annually, versus 1,400 cases in 1991. The CDC credited global immunization efforts, particularly in Latin America, for the decline.

Is Rubella Contagious?

The illness is contagious and spreads through contact with tiny drops of fluid from the mouth and nose of someone who is infected. The drops leave the mouth and nose when the person sneezes, coughs, or talks. Then other people may inhale the drops, or the drops may land on something that other people touch. Once people get the drops on their hands, they can infect themselves by touching their mouth or nose. The virus enters through the mucous membranes* there and takes hold in the body. Pregnant women can also pass the infection to the fetus* in the womb.

What Happens When Someone Has Rubella?

Signs and symptoms Symptoms of the illness are often mild, particularly in children. In fact, between one-third and one-half of all cases may not even be identified as rubella because the symptoms go unnoticed or cannot be distinguished from those of a common, mild respiratory illness such as a cold.

Children with rubella usually develop a distinctive rash. It starts on the face as pink or light red spots and then spreads to the body. The rash is fainter than a measles rash, usually does not itch, and lasts from one to three days. Older children and adults may have symptoms of a viral illness before the rash appears, including swollen lymph nodes* (particularly in the area behind the ears and in the back of the neck), mild fever, runny nose, and conjunctivitis*. Adults also may experience joint and muscle pain and stiffness along with their other symptoms.

Making the diagnosis If a patient is suspected of having rubella, the doctor can confirm the diagnosis by taking samples of fluid from the mouth or nose with a swab. Samples of blood and, rarely, cerebrospinal fluid* may be collected as well. All of these are examined for signs of the virus. The blood sample also may be tested for antibodies* to the virus.

Treatment There is no treatment for the disease, and it is generally so mild that specific treatment is unnecessary. Over-the-counter medication

* **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.

* **mucous membranes** are the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **conjunctivitis** (kon-jung-tih-VY-tis), often called pinkeye, is an inflammation of the thin membrane that lines the inside of the eyelids and covers the surface of the eyeball. Conjunctivitis can be caused by viruses, bacteria, allergies, chemical irritation, and other conditions or diseases that cause inflammation.

* **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

- * **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.
- * **arthritis** (ar-THRY-tis) refers to any of several disorders characterized by inflammation of the joints.
- * **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.
- * **neuritis** (nuh-RYE-tis) is an inflammation of the nerves that disrupts their function.
- * **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.
- * **measles** (ME-zuls) is a viral respiratory infection that is best known for the rash of large, flat, red blotches that appear on the arms, face, neck, and body.
- * **mumps** is a contagious viral infection that causes inflammation and swelling in the glands of the mouth that produce saliva.
- * **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.

such as acetaminophen* can lower a fever and ease pain in the muscles and joints. Infants born with CRS are treated for any defect they have developed.

Recovery Most patients recover completely in one to two weeks, and in many patients the disease runs its course in as little as three days.

Complications tend to occur more often in adults than in children. Temporary arthritis*, which can last up to a month, is common in adults who have rubella. Other, rare complications include encephalitis*, neuritis*, and abnormal bleeding. If the infection occurs in a pregnant woman, it can lead to miscarriage, premature delivery, or congenital rubella syndrome.

How Can Rubella Be Prevented?

Vaccination* is the best way to prevent rubella infection. The vaccine for rubella is given as part of a combined vaccination for measles*, mumps*, and rubella called MMR. Children receive the MMR vaccine in two doses, usually at age 15 months and 5 years, before entering kindergarten. Doctors recommend that women who are old enough to have children be tested for immunity* to rubella, and if the woman is not immune to the virus, she should be vaccinated.

▶ See also **Congenital Infections • Conjunctivitis • Encephalitis • Vaccination**

Resources

Books and Articles

- Saffer, Barbara. *Measles and Rubella*. Detroit, MI: Lucent Books, 2006.
- Shmaefsky, Brian R. *Rubella and Rubeola*. New York: Chelsea House, 2009.

Organization

- Centers for Disease Control and Prevention.** 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/rubella>.
- National Library of Medicine.** 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/rubella.html>.

Rubeola See *Measles (Rubeola)*.

S

SAD See *Seasonal Affective Disorder*.

Salmonellosis

Salmonellosis (sal-mo-nel-O-sis) is a gastrointestinal disease caused by bacteria called salmonella. This type of bacterium from infected animals is usually found in foods such as poultry, milk, and eggs.

What Is Salmonellosis?

Salmonellosis is an illness caused by *salmonella* bacteria that affects the intestine, usually resulting in diarrhea. In some people, the infection spreads to the bloodstream and other areas of the body and can be life-threatening unless they receive prompt treatment.

Salmonellosis, named after the American scientist Daniel Salmon, is one of the most common causes of food poisoning in the United States. Each year, about 40,000 cases of salmonellosis are reported to the Centers for Disease Control and Prevention (CDC), and up to 4 million additional cases may go unreported. About 400 people in the United States die each year of complications related to salmonellosis. Infants, the elderly, and people whose immune system* are weakened are most vulnerable to severe infection.

How Do People Get Salmonellosis?

In the United States, people usually get salmonellosis from eating or drinking contaminated food, most often raw milk or undercooked poultry and poultry products such as eggs. Undercooked ground beef or other meat can also cause salmonellosis. In some cases, food can be contaminated by the people handling it. Salmonellosis can also be spread through the stools of some pets, especially reptiles and pets with diarrhea.

A different species of *Salmonella* bacteria causes typhoid fever, a serious disease common in developing countries in Latin America, Africa, and Asia. Typhoid fever is spread by food and water contaminated with the bacteria. Clean water, pasteurized* milk, and effective sewage systems have made typhoid fever rare in the United States and other developed countries.



▲ The structure of a *Salmonella* bacterium. The DNA (inside the nucleus) is yellow. The cytoplasm is green. The part of the cell wall shown in brown secretes the toxins that cause symptoms in salmonellosis. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **pasteurize** (PAS-cha-rise) to sterilize a substance, generally a liquid such as milk, by bringing it to high temperature and keeping it at that temperature long enough to destroy unhealthy organisms in it without changing its other characteristics.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

What Are the Symptoms of Salmonellosis?

The symptoms of salmonellosis include diarrhea, stomach cramps, pain, fever, headache, nausea, and vomiting. They occur within 12 to 48 hours of eating or drinking contaminated food.

How Is Salmonellosis Diagnosed and Treated?

Salmonellosis is diagnosed through stool cultures from people with symptoms of the infection. *Salmonella* infections usually run their course without treatment in a few days to a week after an unpleasant period of vomiting and diarrhea. Healthcare professionals suggest that people drink lots of fluids and eat a bland diet while they recover from salmonellosis. Sometimes the symptoms create other problems, such as dehydration*. In those cases, people may need to go to the hospital to receive replacement fluids through their veins (an “IV”). Antibiotics may be used if the infection spreads beyond the intestine, but salmonellosis is often resistant to drugs.

How Can Salmonellosis Be Prevented?

Thorough cooking (until poultry or meat, especially ground beef, is no longer pink and eggs are no longer runny) and regular hand washing (after using the bathroom and between handling raw meat and other foods) are the main ways to prevent salmonellosis. Only pasteurized dairy products that have been kept refrigerated should be used. Raw meat or eggs should be especially avoided.

▶ See also **Diarrhea • Food Poisoning • Gastroenteritis • Typhoid Fever**

Resources

Books and Articles

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Hirschmann, Kris. *Salmonella*. San Diego, CA: Kidhaven Press, 2004.

Pascoe, Elaine. *Spreading Menace: Salmonella Attack and the Hunger Craving (Body Story)*. San Diego, CA: Blackbirch Press, 2004.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/nczved/dfbmd/disease_listing/salmonellosis_gi.html.

Food Safety and Inspection Service. 1400 Independence Avenue SW, Room 2137 South Building, Washington, DC, 20250. Toll free: 800-336-3747. Web site: http://www.fsis.usda.gov/FactSheets/Salmonella_Questions_&Answers/index.asp.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC, 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/healthscience/healthtopics/salmonellosis>.

San Joaquin (Valley) Fever *See Coccidioidomycosis.*

* **connective tissue** helps hold the body together, is found in skin, joints and bones.

Sarcoma

Sarcoma is a type of cancer that affects the body's connective tissue (bones, muscles, fat, blood vessels, nerves, and cartilage).

What Is Sarcoma?

Sarcoma is a type of cancer that affects the body's connective tissue*, those types of tissue that provide structural support to the various organs of the body. Connective tissue all comes from the same type of embryonic tissue, called mesoderm. Examples of connective tissue include the bones, muscles, fat, blood vessels, nerves, and cartilage.



Skin biopsy of Kaposi's sarcoma. *Courtesy of the CDC.*

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

What Are the Various Types of Sarcoma?

The general term “sarcoma” includes many specific types of cancer that can affect a wide variety of tissues and areas of the body. The following are examples:

- **Liposarcoma:** Develops from fat tissues, most often found in back of the abdomen, called the retroperitoneum
- **Leiomyosarcoma:** Develops from smooth muscle tissue (the type of muscle tissue over which individuals have no voluntary control), most commonly found in the uterus or the gastrointestinal tract
- **Rhabdomyosarcoma:** Develops within skeletal muscle, most commonly within the limbs, head, neck, and the genital organs and urinary tract
- **Synovial sarcoma:** Made up of cells that resemble those that line the joints; can be found anywhere in the body, not just in joints
- **Angiosarcoma:** Made up of cells that resemble those that compose the blood vessels (veins and arteries)
- **Fibrosarcoma:** Develops in cells called fibroblasts, which are responsible for scar formation
- **Neurofibrosarcoma:** Develops in the cells that surround nerve cells
- **Osteosarcoma:** A tumor of bone cells
- **Chondrosarcoma:** A tumor of cartilage cells

Who Gets Sarcoma?

In the United States, about 10,390 people are diagnosed with soft tissue sarcoma every year; 5,720 in men and 4,670 in women. About 3,680 people die of the disease yearly. About 900 people are diagnosed with osteosarcoma (bone cancer) yearly, with 400 of these diagnoses for people less than 30 years of age. In adults, only 1 percent of all cancers are due to sarcomas; in children, 20 percent of all cancers are due to sarcoma.

People have a higher risk of developing sarcoma if they have been exposed to radiation (including during the treatment of other forms of cancer), are subject to toxic exposures (e.g., during the production of various forms of plastics or due to wood preservatives), if there is a strong family history of these types of cancers, or if they have other conditions that seem to predispose to sarcoma, such as Li-Fraumeni syndrome, or von Recklinghausen’s disease (neurofibromatosis). People with AIDS* have an increased risk of a rare cancer Kaposi’s sarcoma.

What are the Symptoms of Sarcoma?

Sarcoma often has no recognizable symptoms until it has grown fairly large. Sometimes an individual notices an unusual lump or bump. Other times, the tumor eventually expands enough to press on nerves or muscles, causing numbness, pain, tingling, soreness, or problems with normal

functioning. In the case of bone cancer (osteosarcoma), expansion of the tumor within the bone can cause the bone to weaken and fracture (referred to as a pathologic fracture).

How Is Sarcoma Diagnosed?

Sarcoma may be suspected based on the presence of characteristic symptoms, as well as due to knowledge of the individual's personal or family history. A physical examination may reveal the presence of a tumor within areas of soft tissue. Tests such as an x-ray, ultrasound*, computerized tomography* (CT scan), or MRI* may be performed in an effort to demonstrate the presence of a tumor. A biopsy may be performed in order to remove a small sample of a tumor, either with a very thin needle (fine needle aspiration), a hollow needle (core biopsy), through a tiny incision during laparoscopic surgery, or through a classical incision during an open operation. Examination of this tissue under a microscope allows identification of the specific type of cancer cell.

How Is Sarcoma Treated?

Sarcoma is treated in a number of different ways. Surgery may be used to remove tumors. If at all possible, amputation of limbs is avoided, although it may be necessary in certain advanced cases. Chemotherapy involves the use of drugs that are toxic to the cancer cells (but also often to normal cells as well). Radiation therapy uses x-rays to shrink tumors.

▶ See also **Cancer: Overview**

Resources

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Ferri, Fred, ed. *Ferri's Clinical Advisor 2008*. Philadelphia, PA: Mosby Elsevier, 2008.

Goldman, Lee, and Dennis Ausiello, eds. *Cecil Textbook of Internal Medicine*, 23rd ed. Philadelphia, PA: Saunders, 2008.

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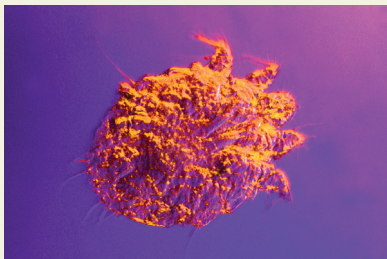
American Cancer Society. P.O. Box 22538, Oklahoma City, OK, 73123. Toll free: 866-228-4327. Web site: <http://www.aafp.org/afp/20040701/123.html>.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov/cancertopics/wyntk/liver/page6>.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.



▲
The itch mite *Sarcoptes scabiei* responsible for scabies. Kent Wood/Photo Researchers, Inc.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

Sarcoma Foundation of American. 9884 Main Street, P.O. Box 458, Damascus, MD 20872. Toll free: 212/668-1000. Web site: <http://www.curesarcoma.org/aboutSarcoma.htm>.

SARS See *Severe Acute Respiratory Syndrome (SARS)*.

Scabies

Scabies (SKAY-beez) is an itchy skin condition caused by mites that burrow under the skin.

Memories of Camp

Kelly returned from summer camp with many stories and a red, itchy rash. The skin on her wrists and thighs and between her fingers was covered with pimple-like bumps and she could see small S-shaped burrows under her skin. Kelly's neighbor, who is a dermatologist (der-ma-TOL-o-jist), or skin doctor, took one look and suspected scabies. When Kelly found out, she was embarrassed. She felt dirty even though she took a shower every day. She felt better when her neighbor told her that scabies does not discriminate. It affects young and old, boys and girls, and those who shower once a week or every day. He told her she must have picked it up at camp but that it was easy to get rid of.

What Causes Scabies?

Scabies is a skin condition caused by mites that dig under the skin. Mites are eight-legged animals related to spiders, scorpions, and ticks. They are so tiny that they require a microscope to be seen. The scientific name for the scabies mite, or "itch mite," is *Sarcoptes scabiei*. Its relatives cause mange (MAYNJ), an inflammation of the skin that results in hair loss, in dogs, pigs, horses, and cows.

Scabies is a common, contagious* skin condition that passes easily from person to person. Outbreaks of scabies, in which many people get infested at once, can occur in places such as nursing homes, childcare centers, and dormitories. The scabies mite cannot live very long away from the body. It can be spread by skin-to-skin contact or by clothing or bedding that has been used very recently by an infested person. Kelly acquired scabies from someone at camp, perhaps from borrowing a towel used recently by an infected person.

When Kelly first came into contact with the mites, females full of eggs burrowed under her skin and laid eggs. For a person who has never had scabies, it usually takes two to six weeks to develop symptoms, meaning

itching and a rash, which is an allergic reaction to the mites. People who have had scabies before usually react within days.

How Is Scabies Diagnosed and Treated?

Kelly's neighbor, the dermatologist, suspected she had scabies based on her intense itching, the location of her rash, and how the rash looked. To make sure, he scraped at the skin between her fingers. He put the scrapings on a slide and when he looked at them with a microscope, he saw several mites and eggs.

Prescription drugs called scabicides (SKAY-bi-sydz), such as permethrin (per-METH-rin) and lindane (LIN-dayn), are usually used to kill scabies mites and eggs. Because scabies is so contagious, Kelly's neighbor instructed the whole family to bathe, then apply the scabicide lotion all over their bodies from chin to toes, and to wash all the recently used clothes, bedding, and towels in hot water. They were instructed to repeat the process in a week. The dermatologist also gave Kelly an antibiotic* ointment because she had some skin infections caused by scratching. Four weeks later, Kelly's skin was back to normal.

▶ See also **Parasitic Diseases: Overview • Skin Conditions**

Resources

Organizations

American Academy of Dermatology. PO Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: http://www.aad.org/public/publications/pamphlets/common_scabies.html.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/dpd/parasites/scabies/factsheet_scabies.htm.

Scarlet Fever

Scarlet fever is a bacterial infection that causes a sore throat, rash, and chills.

Once Dreaded

The disease "scarlet fever" once was dreaded by many people. The bacteria that cause scarlet fever are easy to spread, and in the 1800s there were epidemics. Children younger than 10 years of age were especially at risk of serious complications, such as rheumatic fever, or death. Scarlet fever



▲ The scarlet fever rash is caused by the streptococcus bacterium. *Biophoto Associate/Photo Researchers, Inc.*

* **antibiotic** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

* **impetigo** (im-pih-TEE-go) is a bacterial skin infection that usually occurs around the nose and mouth and causes itching and fluid-filled blisters that often burst and form yellowish crusts.

POOR BETH

Louisa May Alcott's novel *Little Women* is based on the author's own growing-up years. It is the story of Jo March and her sisters, Meg, Amy, and Beth. Immensely popular since its publication in 1868, the novel has been made into a movie at least five times.

In the book, Beth, beloved by family and friends for her sweet nature and musical talent, develops scarlet fever when the girls' mother is away caring for their father, who has been injured in the Civil War. Alcott captures the fear and tragedy that scarlet fever caused in the 1800s in a description of the dark days in the March household. Although at first Beth seems to recover, her illness progresses to rheumatic fever and she dies of congestive heart failure.

was also a mysterious disease because it would infect only some members of a family and not others. A good example of scarlet fever's effect can be found in the 1868 book *Little Women*.

By the early 2000s scarlet fever was not as deadly because antibiotics were available to fight the streptococcal bacteria that causes the infection.

A Sore Throat that Gets Worse

Scarlet fever is caused by exposure to someone who is infected with streptococcal bacteria. People with strep infection can spread it by sneezing or coughing. It can also be spread by sharing drinking glasses or eating utensils with people who are infected.

The first signs of scarlet fever usually appear within a week of exposure to the strep bacteria. A sore throat develops, which is called strep throat. But in some people, the particular kind of strep bacteria, known as Group A streptococcus, causes a toxic reaction. A skin rash appears within one or two days of the sore throat. It looks like a sunburn on the neck, chest, and underarms. Less often the rash can appear on the face or the groin. The skin feels rough, like sandpaper. Within a week, the rash usually starts to fade, and flaking and peeling of the skin occur.

Scarlet fever also causes a fever with temperatures of more than 101 degrees Fahrenheit. Glands around the jaw and neck swell and are painful. Chills, nausea, and vomiting can result.

In rare cases, scarlet fever also can result from a skin infection known as impetigo*.

Without medical treatment, strep throat and scarlet fever can be serious. A doctor who suspects a strep infection uses a cotton swab to get a bit of the bacteria from the throat for laboratory testing to confirm that it is streptococcal bacteria. Treatment with antibiotics for 10 days usually kills the bacteria.

SCARLET FEVER IN HISTORY

The earliest description of scarlet fever and its symptoms was given by the German physiologist Daniel Sennert (1572–1637). In 1619 Sennert accurately observed and recorded the sequence of the disease's symptoms: the appearance of the rash, its decline, and scaling of the skin.

In the eighteenth century, epidemics of scarlet fever were reported throughout Europe and the United States. During this time, physicians developed their clinical understanding of the disease. The first clinical standards for differentiating scarlet fever from similar diseases were established by Armand Trousseau (1801–1867).

In 1887 the English physician Edmund Emmanuel Klein identified scarlet fever as being caused by streptococcus bacteria that were observed to grow on the tonsils and secrete a rash-producing toxin.

The American physician George Frederick Dick (1881–1967) and his wife Gladys R. H. Dick (1881–1963) isolated the toxin in the 1920s. After World War II, penicillin became available as an effective means of curing the disease.

▶ See also **Rheumatic Fever • Sore Throat/Strep Throat**

Resources

Books and Articles

Alcott, Louisa May. *Little Women, or, Meg, Jo, Beth, and Amy*. Boston: Roberts Brothers, 1868.

Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/DBMD/diseaseinfo/scarletfever_g.htm.

Schistosomiasis

Schistosomiasis (shis-tuh-so-MY-uh-sis) is an illness caused by parasitic worms. The worms must spend part of their life cycle growing in freshwater snails before they enter and cause infestations* in humans.*

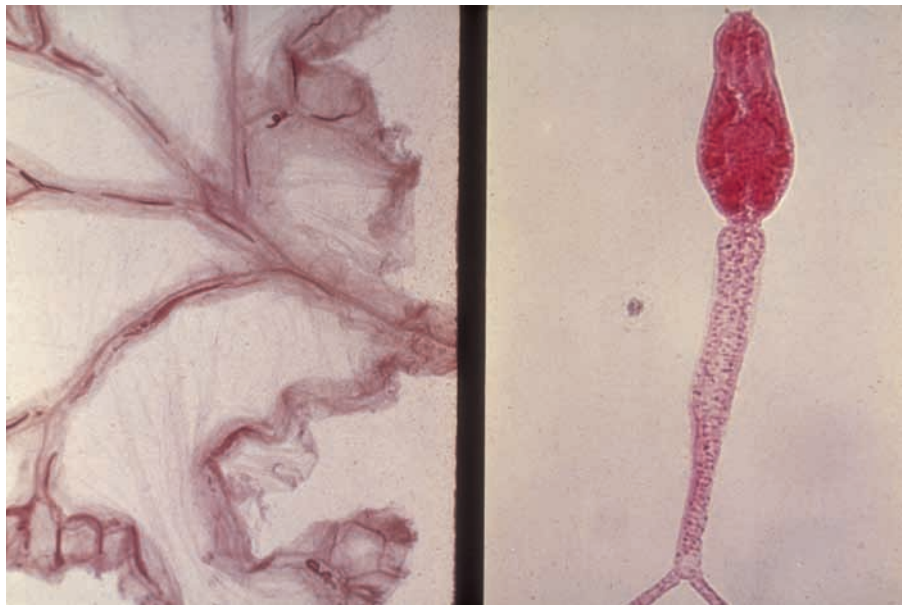
What Is Schistosomiasis?

Schistosomiasis is a parasitic disease that is not directly contagious from person to person. Five types of *Schistosoma* worm, also called blood flukes, can infest people and cause schistosomiasis: *S. mansoni*, *S. japonicum*,

* **parasitic** (pair-uh-SIH-tik) refers to organisms such as protozoa (one-celled animals), worms, or insects that can invade and live on or inside human beings and may cause illness. An animal or plant harboring a parasite is called its host.

* **infestations** refer to illnesses caused by multi-celled parasitic organisms, such as tapeworms, roundworms, or protozoa.

Schistosoma japonicum; (left) and *Schistosoma mansoni* (right). These parasites can enter the human body through the skin then develop into an adult worm in the bloodstream. *Custom Medical Stock Photo, Inc. Reproduced by permission.*



* **larva** (LAR-vuh) is the immature form of an insect or worm that hatches from an egg.

* **intestines** are the muscular tubes that food passes through during digestion after it exits the stomach.

S. mekongi, *S. intercalatum*, and *S. haematobium*. These parasites have a complex life cycle; they have to go through several separate stages on their way to adulthood, and both snails and humans play important roles in that cycle. Another name for the disease is bilharziasis (bil-har-ZYE-uh-sis) or “snail fever.”

The worm starts life as an egg in a freshwater source such as a pond, lake, or stream. It hatches into a larva*. This larva, known as a miracidium (meer-uh-SID-ee-um), swims around until it locates a certain type of aquatic snail that lives in that water (the type of snail depends on the particular species of the parasite). The miracidium then penetrates the tissue of the snail. Once inside the snail, it passes through several stages of development, eventually multiplying into numerous larvae, called cercariae (sir-CARE-ee-ay), that leave the snail and swim through the water for up to two days. During that time, one or more may come into contact with a person who is bathing, wading, swimming, or washing clothes in the water. At that point, the parasite may burrow into bare skin and enter the bloodstream. Once it is in the person’s blood, it matures into an adult worm.

The female adult worms lay their eggs within blood vessels. Where this occurs depends on the species of the worm. For instance, *S. japonicum* usually lays its eggs in vessels near the small intestine; *S. mansoni* usually lays them near the large intestine; and *S. haematobium* prefers blood vessels near the bladder. However, this pattern of behavior is not always followed, and eggs from the different species sometimes show up elsewhere in the human body. The eggs from all species gradually move to the urinary tract, liver, or intestines*, and finally leave the body in the person’s urine or feces. If feces (excreted waste) or urine from an infested person contaminate a freshwater source such as a pond, the eggs can enter the water and begin the life cycle all over again.

How Common Is Schistosomiasis?

Schistosomiasis does not occur in the United States, but it does have a major impact on millions of people who live in developing countries around the world. According to the World Health Organization, 200 million people worldwide are infested with the worms, with perhaps 20 million of those having serious symptoms, and an estimated 200,000 dying every year as a result.

The disease is most common in tropical regions, where it is a leading cause of illness. *S. japonicum* occurs in China, the Philippines and other parts of the Far East; *S. mansoni* in certain regions of Africa, the Middle East, South America and the Caribbean; *S. haematobium* in Africa and the Middle East; *S. mekongi* in Cambodia and other parts of Southeast Asia; and *S. intercalatum* mainly in the Democratic Republic of Congo and other parts of West Africa. People from the United States who travel to these areas sometimes develop schistosomiasis if they swim or wade in tainted water, but they rarely get the severe, chronic* form of the disease.

What Are the Signs and Symptoms of Schistosomiasis?

A rash and itchy skin, particularly at the spot where the parasite burrowed into the body, may develop within a few days. Symptoms vary from person to person and may not even occur in some infected individuals. The symptoms also vary depending on the species of worm that has infected the person. The most common initial symptoms, however, appear about one to two months after the initial infestation and include muscle aches, fever, chills, and cough.

Certain other symptoms are associated with infections from different species. Infection with *Schistosoma mansoni*, for instance, sometimes causes such symptoms as nausea with blood in the vomit, lesions on the spinal cord, and/or an enlarged liver and spleen. *S. haematobium* infections can cause spinal cord lesions, frequent and/or painful urination, blood in the urine, and pain in the area of the anus and genital organs. Individuals infected with *S. japonicum* may experience nausea with blood in the vomit, a certain type of seizure known as focal epilepsy, and an enlarged liver and spleen. People who are infected with *S. japonicum* often also develop a fever, called Katayama fever, that can cause the body temperature to rise to 105 degrees Fahrenheit. The fever, which is sometimes also seen in *S. mansoni* infestations, may last several weeks, but it usually subsides on its own.

How Do Doctors Diagnose and Treat Schistosomiasis?

If the doctor suspects schistosomiasis, he or she examines a urine or stool (feces) sample taken from the patient to look for the worm's eggs. The doctor may need to examine several samples to identify the worms. He or she also may take a sample of blood for testing, although the blood

The United States and the World

Schistosomiasis is a leading cause of illness in tropical regions. About 200 million people worldwide are infected, and approximately 20 million of them suffer severe consequences of schistosomiasis. WHO estimates that about 85 percent of all the people infected with schistosomiasis live in sub-Saharan Africa. The infection leads to an estimated 200,000 deaths each year. U.S. residents can get schistosomiasis when traveling to other countries where the disease occurs.

In many parts of the world, people have no way of knowing whether a particular body of water is contaminated with blood fluke larvae. Medical professionals advise people to avoid any contact with fresh water in areas where *Schistosoma* are known to occur. Swimming in ocean water and chlorinated pools is generally considered safe.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

- * **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- * **cirrhosis** (sir-O-sis) is a condition that affects the liver, involving long-term inflammation and scarring, which can lead to problems with liver function.
- * **esophagus** (eh-SAH-fuh-gus) is the soft tube that, with swallowing, carries food from the throat to the stomach.
- * **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.
- * **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

test may not show evidence of the infestation unless it is done six to eight weeks after the patient's contact with the parasite. Occasionally, the doctor will order a tissue biopsy* to check for signs of the parasite in organs such as the liver.

Doctors may prescribe the drug praziquantel to treat the infestation. Patients usually need to take pills for only one to two days. For individuals who do not receive treatment and who continue to use the same tainted water source, the illness can last for years.

Can Schistosomiasis Cause Complications?

People who become repeatedly infested with schistosomiasis over many years can experience damage to the bladder, lungs, intestines, and liver. The disease is one of the leading causes of cirrhosis* in the world. In some cases, the resulting scarring of the liver is so severe that blood flowing through the organ becomes partly blocked, causing a condition known as portal hypertension. Severe portal hypertension can make veins in the esophagus* and stomach swell and bleed, sometimes to the point that the bleeding is fatal.

Other complications of the disease arise when the worm's eggs travel through the bloodstream to the spinal cord or brain, where they can cause seizures*, inflammation of the spinal cord, or paralysis*.

How Can Schistosomiasis Be Prevented?

Travelers visiting countries where schistosomiasis occurs should avoid wading, swimming, or bathing in any body of fresh water such as ponds, rivers, or lakes. Filtering or boiling drinking water for at least one minute kills parasites, including the *Schistosoma* worms. The Centers for Disease Control and Prevention recommends heating bathing water to 150 degrees Fahrenheit for at least five minutes to make sure it is free of potential parasites.

To reduce the spread of schistosomiasis, health officials focus on educating people who live in areas where the worms are found. They teach the public how the parasites spread and encourage people not to urinate or have bowel movements in rivers and ponds. In addition, some countries have mounted extensive campaigns to reduce the worm population in their streams. A program in Japan, for instance, used several means to eliminate *S. japonicum* from the country. One method was to encourage farmers to use horses instead of water buffalo when they were tending their rice paddies. The worms can enter these animals as they do humans, but horses are much less susceptible to the worms than water buffalo are.

A program in China includes several strategies. One of these involves the mass treatment of people and susceptible animals in certain regions with praziquantel. Another one involved the lowering of water levels in many streams and ponds to reduce the snails that are hosts during part of the worms' life cycle. Some earlier programs included the application of snail-destroying chemicals to streams, but scientists later discovered that many of those chemicals had unintended consequences, such as killing

fish. China's schistosomiasis-reduction program was quite successful, but suffered a setback after extreme flooding along the Yangtze River in 1998 brought water levels up again. This rise in the water allowed the snails to repopulate and resulted in an outbreak in 2004 when about 850,000 people were infected. Control efforts in China continued as of 2008.

▶ See also **Intestinal Parasites • Parasitic Diseases: Overview • Zoonoses**

Resources

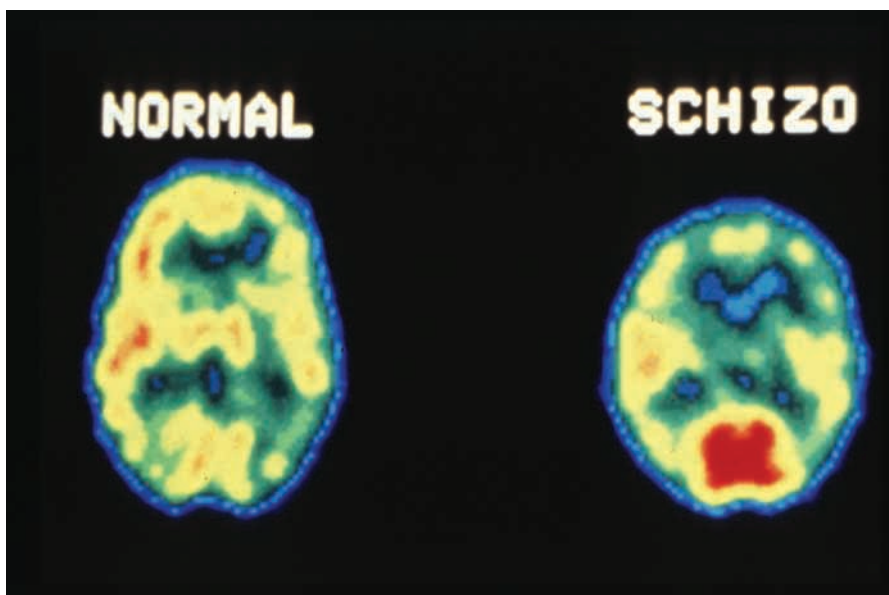
Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/parasites/schistosomiasis/default.htm>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/topics/schistosomiasis/en>.

Schizophrenia

Schizophrenia is a neurological disorder that is characterized by specific behaviors including: psychotic episodes, delusions, paranoia, and difficulty perceiving reality. Schizophrenia is treated with medication and psychotherapy.



Positron emission tomography (PET) scans are computer-generated images of brain activity. When compared with PET scans of healthy people (left), the scans of people with schizophrenia (right) show disruptions in brain activity, changes in brain structures such as the ventricles, and decreased function in the frontal cortex. The red area in the brain on the right shows intense activity. *Photo Researchers, Inc.*

* **delusions** (de-LOO-zhuns) are false beliefs or judgment that remain even in the face of proof that they are not true.

* **paranoia** (pair- α -NOY- α) refers to either an unreasonable fear of harm by others (delusions of persecution) or an unrealistic sense of self-importance (delusions of grandeur).

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **antipsychotic drugs** are medications that counteract or reduce the symptoms of a severe mental disorder such as schizophrenia.

Definition

Schizophrenia is a serious neurological disorder of unknown cause that is characterized by specific behaviors. Typical behavior seen in schizophrenia includes psychotic episodes, delusions*, paranoia*, and difficulty perceiving reality. Schizophrenia has a genetic* component, but many other factors are thought to be involved. Schizophrenia is treated with antipsychotic drugs* medication.

What Are Neurotransmitters?

The brain is a complex organ that functions through electrical and chemical signals. The substances that perform the chemical signaling are called neurotransmitters. There are many types of neurotransmitters, and they have distinct functions and locations for signaling within the brain. Neurotransmitters act on brain cells known as neurons. Neurons in different parts of the brain perform different functions and use neurotransmitters to communicate with each other. Neurotransmitters are passed from one neuron to another. The neuron receiving the chemical neurotransmitter signal has physical docks for the neurotransmitters known as neurotransmitter receptors. A neurotransmitter cannot perform its chemical signaling function without a receptor through which to act. Both proper levels of neurotransmitters and functional neurotransmitter receptors are necessary for successful signaling. Blocking a neurotransmitter from interacting with its receptor blocks that chemical signaling pathway. Blocking a neurotransmitter receptor is known as antagonizing the receptor.

Because areas of the brain need to interact with each other via these chemical signals, neuronal pathways are formed during fetal development that act as communication highways. Each neuronal pathway uses specific neurotransmitters to accomplish successful brain functioning. A disruption in the physical neuronal pathway such as the loss of neuron cells or the loss of communication between neurons may cause mental diseases such as schizophrenia. Additionally, an increase or decrease in the neurotransmitter chemical signals present in these pathways may also cause symptoms such as behavioral changes or neurological disorders and disease. Schizophrenia may be caused by both physical damage to certain groups of neurons in the brain and alteration of specific types of neurotransmitter signaling.

What Is Schizophrenia?

Schizophrenia involves a specific type of disordered thinking and behavior. It could be described as the splitting of the cognitive functions of the mind from the appropriate emotional responses. Family history of schizophrenia increases the chance of having the disease, but the exact way it is inherited is unknown. Only some schizophrenic patients have detectable anatomical brain abnormalities. The cause of schizophrenia had not been determined as of the early 2000s, yet drugs effective in its treatment had been identified. Schizophrenia is treated with antipsychotic

drugs that primarily act on receptors in the brain for the neurotransmitters dopamine* and serotonin*. By inhibiting the activity of these receptors, antipsychotics are effective at decreasing some of the bizarre behavior typical of schizophrenia. Unfortunately this medication often also has severe negative side effects, mostly affecting movement.

How Many People Develop Schizophrenia?

Schizophrenia is estimated to afflict 1 percent of the world's population. Approximately 3 million people have schizophrenia in the United States. First-degree relatives (such as siblings and parents) of a person with the disease have approximately a 10 percent chance of developing it. Fraternal twins (twins that do not have identical genes*) have approximately a 10 to 12 percent chance, and children of two schizophrenic parents have about a 40 percent chance. However, the disease is not caused entirely by genetic factors. Because identical twins* have only a 30 to 50 percent tendency to have the same schizophrenic illness, scientists know other factors determine who develops the disease. Schizophrenia occurs equally in males and females. The disease may be seen at any age, but people who begin treatment are generally between 28 to 34 years of age. Schizophrenia is associated with low economic status, probably due to a lack of proper maternal healthcare during fetal development.

What Causes Schizophrenia?

The cause of schizophrenia is unknown. Some patients have physical changes associated with the disease, including wasting of specific areas of the brain, enlargement of the ventricles* (normal spaces in the brain), and loss of neurons. Neurotransmitter signaling is often changed too, specifically regarding the neurotransmitter pathways for dopamine and serotonin. The imbalance in the activities of these pathways is complex: Overactivity in some parts of the brain and decreased activity in other areas cause different symptoms. The symptoms of schizophrenia are divided into three types, the positive, negative, and cognitive.

What Are the Symptoms of Schizophrenia?

Positive Symptoms Positive symptoms mark the presence of distinctive behaviors. There are many different positive symptoms of schizophrenia. Schizophrenic patients may experience strange or paranoid delusions. They may believe that they are being persecuted by others or having their minds controlled by others. Positive symptoms may include disturbing or frightening hallucinations. The most common hallucinations are auditory (heard), but visual hallucinations may also occur. Other positive symptoms include sensitivity to and fear regarding ordinary sights, sounds, or smells; agitation; tension; and insomnia*.

Negative symptoms Negative symptoms mark the absence of normal social and interpersonal behaviors. There are various negative symptoms

* **dopamine** (DOE-puh-meem) is a neurotransmitter in the brain that is involved in the brain structures that control motor activity (movement).

* **serotonin** (ser-o-TO-nin) is a neurotransmitter, a substance that helps transmit information from one nerve cell to another.

* **genes** (JEENS) are the functional units of heredity that are that are composed of deoxyribonucleic acid (DNA) and help to determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are segments of chromosomes found in the nuclei of the body's cells.

* **identical twins** are twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.

* **ventricle** open cavities within the brain that contain the fluid that cushions and protects the central nervous system.

* **insomnia** abnormal inability to get adequate sleep.

* **bipolar disorder** a group of mood disorders that are characterized by alternating episodes of depression and mania.

* **antidepressant medications** are used for the treatment and prevention of depression.

* **psychiatrists** (sy-KY-uh-trist) are medical doctors who have completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can diagnose mental illnesses, provide mental health counseling, and prescribe medications.

of schizophrenia. Schizophrenic patients are often less able to experience appropriate emotions or express their emotions. This reduced expression is known as a blunted affect. Because they respond less and have less desire to interact with others, these patients often withdraw from others. Other negative symptoms may also include a lack of motivation, energy, and ability to experience pleasure. Schizophrenic patients speak less and avoid speaking to others.

Cognitive symptoms Schizophrenic patients may have confused thinking and speech, which makes it difficult for them to communicate effectively with others. Fractured (broken or fragmented) thoughts and communication are considered types of disorganized cognitive symptoms. Individuals with schizophrenia often seem to lose their train of thought and combine unrelated topics in a way that prevents a coherent conversation. Disorganized behaviors such as unnecessary, repetitive movements are also common. Schizophrenics often seem restless or hyperactive. They may have difficulty paying attention or maintaining an organized lifestyle.

How Is Schizophrenia Diagnosed?

Schizophrenics often first give what are known as prodromal signs, or signs preceding a psychotic episode. Schizophrenic prodromal signs may include social isolation, odd behavior, lack of personal hygiene, and blunted emotions. The prodromal phase is followed by one or more separate psychotic episodes. Physicians examining their behavior patterns first attempt to rule out disorders of mood that respond to antidepressants, such as bipolar disorder*. Sometimes schizophrenia is diagnosed through the patient's response to different therapeutic regimens. Schizophrenic symptoms are not affected by antidepressant medications*, but they are relieved by antipsychotics.

Once other disorders have been excluded the criteria for a diagnosis of schizophrenia is that a patient be continuously ill for at least six months and that there be one psychotic phase followed by one phase of odd behavior. During the psychotic phase, one or more of three groups of psychotic symptoms must be present. The three groups are delusions, hallucinations, and a disordered or incoherent thought pattern.

How Is Schizophrenia Treated?

Schizophrenic patients are diagnosed and treated by psychiatrists*. A licensed therapist may perform rehabilitation therapy to help a schizophrenic patient function during times when they are not in a psychotic episode. Treatment teams from supportive agencies may help with everyday living. Schizophrenia is treated with antipsychotic drugs used in the lowest effective doses. The antipsychotic drugs work mainly to antagonize (inhibit) dopamine and serotonin receptors in specific areas of the brain that are in dysfunction. Earlier antipsychotic medicines functioned primarily on dopamine receptors and had more side effects than later medications that also work on serotonin receptors. The older medications sometimes

caused serious side effects such as severe, involuntary, repetitive movements of the face, arms, and legs (called tardive dyskinesia). The later medications do not have such troubling side effects. Positive symptoms of schizophrenia respond better to antipsychotic medications than the negative symptoms.

Although antipsychotic drug treatment is necessary for schizophrenic patients, it is not enough. Patients also require supportive psychotherapy*. Various psychosocial treatments are available for varying stages in the disease, and each patient requires a unique treatment regimen. Doctor and therapist appointments for medication management and psychological support are necessary in all stages of recovery, even when symptoms are under control. Peer support groups are also important. Assertive community treatment (ACT) programs are available for more severely affected patients. These programs may provide intensive services within a patient's home on a day-to-day basis. ACT teams can follow patients through all courses of their illness and assist them in normal living activities. Patients who are in the later stages of recovery and have few lingering symptoms may get involved with programs designed to help them achieve personal goals pertaining to work, education, and social interactions.

What Is the Prognosis for Schizophrenia?

The prognosis for schizophrenia varies according to each case. A diagnosis of schizophrenia does not necessarily mean that a person will experience a life-long illness. Over a period of 25 to 30 years approximately one-third of schizophrenic patients experience remission or even partial recovery. Some individuals lose their severe symptoms or learn to live acceptably with some minor symptoms. However, schizophrenia can be a severe and even dangerous disorder. A wide range of outcomes has been reported, including episodes of violence or severe incapacity. Quite a few schizophrenic patients are at risk for suicide. Suicide, accidents, and disease are common among patients with schizophrenia, along with an approximate 10-year decrease in life span. Typically, individuals have episodes of psychosis and episodes of remission*, with the outcome dependent on how effectively the medicine keep the patient in periods of remission and how well the patient is able to deal with the symptoms still associated with these periods.

What Special Concerns Exist for Schizophrenia?

One concern for these patients is that they may not go along with the treatment medical professionals say they need. Some patients may not remain in close contact with their treatment team, they may not take all their medications consistently, and they may not keep all their appointments. Schizophrenic patients are notorious for not being compliant with their necessary medications, either because they feel they have improved and no longer need medication or because they want to avoid the side effects it causes. Unfortunately, without proper and consistent drug intervention psychotic episodes are highly likely to recur.

* **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.

* **remission** is an easing of a disease or its symptoms for a prolonged period.

Resources

Books and Articles

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- Torrey, E. Fuller. *Surviving Schizophrenia: A Manual for Families, Patients, and Providers*, 5th ed. New York: Collins, 2006.
- Veague, Heather Barnett. *Schizophrenia*. New York: Chelsea House, 2007.

Organizations

- National Alliance on Mental Illness.** Colonial Place Three, 2107 Wilson Boulevard, Suite 300, Arlington, VA, 22201-3042. Toll free: 800-950-6264. Web site: <http://www.nami.org>.
- National Hopeline Network Crisis and Suicide Prevention Center.** Kristin Brooks Hope Center, 1250 Twenty-fourth Street NW, Suite 300, Washington, DC, 20037. Toll free: 800-784-2433. Web site: <http://www.hopeline.com>.
- National Institute of Mental Health.** Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov>.
- National Mental Health Association.** 2000 N. Beauregard Street, 6th Floor, Alexandria, VA, 22311. Toll free: 800-969-6642. Web site: <http://nmha.org>.
- National Mental Health Consumer Self Help Clearinghouse.** 1211 Chestnut Street, Suite 1207, Philadelphia, PA, 19107. Toll free: 800-553-4539. Web site: <http://www.mhselfhelp.org>.

School Avoidance

School avoidance occurs when children and teens repeatedly stay home from school or are repeatedly sent home from school, due to emotional problems or because of aches and pains that are caused by emotions or stress and not by medical illness.

Ben's Story

Ben missed a lot of school because of his stomachaches. His stomach felt especially bad on Monday mornings. Often, while he was getting dressed for school, he felt as if he might throw up. His mother did not want him to go to school if he was sick. On days he stayed home, Ben got back into bed, and by lunchtime he felt much better. But by the next morning, he felt miserable all over again. He managed to get himself to school sometimes, but it was getting harder and harder. He would be embarrassed if he threw up on the bus. Ben's doctor had examined him and found him to be in excellent health despite his stomach pains. Still his stomachaches continued, and Ben's mother had started to worry about how many school days he was missing.

What Is School Avoidance?

School avoidance is a condition that occurs in up to 5 percent of schoolchildren and adolescents, with boys and girls equally affected. Sometimes school avoidance is called school "phobia*" (FO-bee-a) or school refusal. School avoidance is a pattern of missing school for symptoms that are caused by emotions or stress, rather than physical illness. School avoidance is different from truancy (TROO-an-see), which is a pattern of repeated unexcused absences from school. The student who is truant, or skips school, is neither at home nor at school. In school avoidance, the student stays home.

What Causes School Avoidance?

There are two main reasons students have school avoidance. One reason is that the student feels anxiety (ang-ZY-eh-tee), fear, or worry about some aspect of going to school or about leaving home. The other reason is that there is some benefit, or a secondary gain, to staying home from school.

Anxiety-related school avoidance Most children have some anxiety about attending school for the first time, which is known as "separation anxiety." It is not surprising when separation anxiety occurs when a child is about to enter kindergarten or first grade. For many children this is the first time they are away from home or separated from their parents. But some children have separation anxiety that lasts beyond the expected age. Children who have recently been through other difficult separations, such as divorce or the death of a parent or the illness of a family member, may have an especially difficult time leaving home to go to school.

Children with school avoidance may have headaches, stomachaches, chest pain, or other symptoms brought on by the stress of separation. These pains are real, but they are caused by the body's response to stress and not by an illness. Usually, a checkup by the doctor finds the child or teen to be in good physical health. Students with anxiety-related school avoidance are often good students and like school, but because of their stress-related symptoms, they feel that they need to stay home.

Some students with school avoidance may have anxiety about school itself. They may worry about grades, about being bullied, about being called on in class by the teacher, or about having to undress for gym.

* **phobia** is an intense, persistent, unreasonable fear of (and avoidance of) a particular thing or situation.

Some schools have rules about when students may use the bathroom, and this may be a worry to children who may need to go more often. Dirty school bathrooms without enough privacy or issues about safety may be real concerns for some children.

In many cases, anxiety-related school avoidance begins with an upsetting event that happens at school, for example, being teased or experiencing something disturbing in class. Students who are shy and sensitive by nature and those who have an overprotective parent may be more likely to have anxiety-related school avoidance.

Secondary-gain school avoidance Not all children and teens with school avoidance are anxious or shy. Some may simply find that it is more comfortable staying home than attending school, which is called secondary-gain school avoidance. “Secondary gain” refers to the bonus or positive side of something unpleasant. For example, although it is unpleasant to be sick, it may be pleasant to watch television during the day and to have meals in bed. Another secondary gain of being sick might be not having to do homework or having the personal attention and care of a parent at home.

Secondary-gain school avoidance often starts with an illness that lasts for a few days and causes the student to miss school. The student may get behind in homework and begin to think about how hard it will be to catch up. To avoid the hard work ahead, the student may stretch out the illness a bit longer. Receiving the secondary gains of sympathy, the care and attention of parents, and the pleasure of watching daytime television can contribute to school avoidance. Lenient parents or parents who do not view school as important can contribute to secondary-gain school avoidance. Sometimes students exaggerate symptoms or claim to have symptoms they really do not have (such as a sore throat or leg pain) just to avoid school.

How Is School Avoidance Diagnosed?

School avoidance is diagnosed when a student has repeatedly missed school due to aches and pains or other symptoms, and a careful checkup by the doctor has found the student to be in good health. The doctor will check for school avoidance by evaluating the pattern of symptoms and asking about stresses. The doctor may explain how stress can cause certain physical symptoms and may have the student keep track of symptoms by writing them down.

Ben’s doctor asked him about recent worries he had. Ben mentioned that since his parents had divorced the previous year and his dad had moved across town, he had started to worry about his mom being lonely. He had seen her cry a lot this year, and it made him sad. He said he missed his dad and wished they could be a family again, but without the arguing. Although he looked forward to the weekends he spent with his dad, he was sad that his mom had to spend weekends alone. Ben’s doctor explained how people could get stomachaches from stress and sadness. She asked Ben to keep track of his stomachaches in a diary, and she told him to go to school anyway. She gave Ben and his mom the name of a

therapist who would help Ben talk about his feelings and about how to adjust to all the changes in his family.

How Is School Avoidance Treated?

The first step in treating school avoidance is to help the student get back to school as soon as possible. The longer a student avoids school, the harder it is to return. Students with anxiety usually need reassurance that they are in good health. Students and their parents are helped by taking a “yes but” approach. Yes, the symptoms are real, but they are not a reason to miss school. Parents are guided about what symptoms are grounds to stay home and find ways to help their student attend school despite discomfort caused by aches and pains. The treatment often includes a plan for what to do when the student begins to feel ill at school. The plan may be for the student to go to the nurse’s office to lie down for 5 to 10 minutes and then return to class, but not to go home. Psychotherapy and behavioral techniques to cope with school-related stress are often helpful.

Another part of treatment may involve working with school personnel to solve problems that are causing anxiety, such as bullying* or lack of privacy in bathrooms. Students who have separation anxiety or generalized worry may benefit from counseling to learn to cope with painful feelings or loss. The usual treatment for students with secondary-gain school avoidance is also to return to school right away. Clear limits, appropriate expectations, and support for regular school attendance are critical factors for successfully addressing the problem.

▶ See also **Anxiety and Anxiety Disorders • Conversion Disorder • School Failure • Somatoform Disorders • Stress and Stress-Related Illness**

Resources

Organizations

American Academy of Pediatrics. 141 Northwest Point Boulevard, Elk Grove Village, IL, 60007-1098. Telephone: 847-434-4000. Web site: http://www.aap.org/publiced/BK5_SchoolAvoid.htm.

School Failure

School failure is the inability to meet the minimum academic standards of an educational institution.

School Failure Defined

School failure is a process in which a student slips farther and farther behind his peers and gradually disconnects from the educational system. The end result of school failure is dropping out before graduation. Many

* **bullying** is when a person repeatedly intimidates or acts aggressively toward those with less power or ability to defend themselves.

cases of school failure occur among students who have the ability and intelligence to succeed but who are unable or unwilling to apply these abilities in the school setting.

Students can begin the slide into failing patterns at any time during their school career, but school failure is more likely to occur at transitional stages, such as when graduating from elementary to middle school or after a family move to a new school system. Failing grades typically are symptoms of emotional, behavioral, or learning problems. In the United States, an estimated 10 to 15 percent of students fail at school.

Why Do People Fail in School?

People who fail in school may feel stupid, but emotional or mental health problems and unidentified learning disorders, rather than low intelligence, often are the causes of their inability to meet the standards of a school. There are several factors that can lead to school failure, among them depression, anxiety, problems in the family, and learning disabilities.

Depression Depression is one of the most common causes of school difficulties. The condition makes people feel sad for long periods of time, have low energy, and lose interest in activities that normally give them pleasure. People with depression have continuing negative thoughts about themselves and the future, and they may experience changes in eating and sleeping patterns and in their ability to concentrate and make decisions. They may feel hopeless and may even think about suicide. Depression has been shown to be a leading cause of school failure in young people with learning disabilities. Depression can also cause school failure in students without learning disabilities.

Anxiety Anxiety is a feeling of excessive worry about a possible danger or situation that is intense enough to interfere with a person's ability to concentrate and focus. Students can have genuine reasons to be anxious. People who have been bullied at school may worry that they will be bullied again. Students may legitimately fear personal violence on the way to or from school. They might worry about their families going through a divorce or about a parent who is ill. Ordinary adolescent worries about looking right and fitting in can be blown so far out of proportion that a student may try to be absent from school just to avoid a possibly embarrassing or uncomfortable situation. This is called "school avoidance." Anxiety in any of its forms can interfere with a student's performance in school.

Problems in the family Students also may bring their problems at home to school with them. If a student's family is experiencing violence, unemployment, alcohol or drug use by a family member, problems with the law, or any other upsetting problems, the student may have difficulty concentrating on schoolwork. Many students who are having family problems might have trouble controlling their anger and frustration at school, and they may end up in trouble because of their behavior. Some

students who are overburdened at home by circumstances that make it necessary for them to “parent” siblings, hold a job, or care for an ill or impaired parent may find it impossible to keep up in school. Many times students who face overwhelming family or personal problems keep these problems to themselves. School counselors can offer help and prevent student failure if they are made aware of the problem.

Learning disabilities Learning disabilities are conditions that interfere with gaining specific academic skills, such as reading or writing. Learning disorders can hinder a person’s ability to concentrate or to process or remember information. When these difficulties are recognized early, certain teaching strategies can help a student overcome the learning disability. Unfortunately, many learning problems may go undiagnosed or may be diagnosed incorrectly as behavior problems. The frustration and depression that can result from undetected learning disabilities is a major cause of school failure or dropping out of school.

Other causes Many social factors can increase the risk of school failure. These include homelessness, poverty, frequent transfers from school to school, and the inability to speak English. Other circumstances such as truancy*, teenage pregnancy, and chronic illness* may also affect a student’s ability to perform well in school.

Helping People at Risk of School Failure

Students at risk of school failure need to be identified as early as possible in their school careers if they are to receive the necessary help. This task usually falls to the teacher, school counselor, or parents, because many failing students are hostile to or disconnected from the educational system and will not or do not know how to ask for help. Bringing failing students back to school and fostering their success requires recognizing and understanding the reasons for school failure. Parents, teachers, counselors, and mental health professionals can offer help.

Parents can help by taking the following steps:

- Taking a genuine interest in their child’s school life and attending school events
- Listening to and understanding their child’s concerns about school
- Taking seriously sudden changes in behavior, sleeping, or eating
- Intervening for the student when unsafe situations are causing anxiety or school avoidance
- Setting and enforcing appropriate standards of school behavior
- Setting realistic goals for school attendance and academic improvement
- Eliminating barriers to homework completion and school attendance
- Working as a team with teachers and counselors to get children appropriate help

* **truancy** is staying out of school without permission.

* **chronic illness** (KRAH-nik) is an illness with symptoms that last a long time or that recur frequently.

- Helping children identify their strengths and pinpointing career options that involve these strengths

- Getting help in recognizing the reasons for school failure

Teachers can help by taking the following steps:

- Developing learning plans that support the student's strengths
- Referring the student for evaluations for possible learning disabilities
- Providing referrals to programs that offer extra academic help or arranging peer tutoring
- Teaching study skills and strategies to support learning
- Encouraging students to participate in school activities, such as sports, plays, or clubs, so that they feel they are a part of the school
- Arranging a mentor for the student
- Promoting a tolerant, violence-free school environment
- Communicating concerns or changes in school performance to parents right away

Mental health professionals can help by taking the following steps:

- Screening for emotional problems and offering appropriate treatment
- Listening to the student's concerns about family and school difficulties
- Performing evaluations for learning disabilities or attention deficit hyperactivity disorder
- Working with the school to formulate appropriate learning strategies for the student
- Working with teachers and parents to help them eliminate barriers to school failure

▶ See also **Attention Deficit Hyperactivity Disorder (ADHD) • Learning Disabilities • School Avoidance**

Resources

Books and Articles

Espeland, Pamela, and Elizabeth Verdick. *Loving to Learn: The Commitment to Learning Assets*. Minneapolis, MN: Free Spirit, 2005.

How to Study for Success. Hoboken, NJ: Wiley, 2004.

Spevak, Peter A., and Maryann Karinch. *Empowering Underachievers: New Strategies to Guide Kids (8–18) to Personal Excellence*, rev. and expanded ed. Far Hills, NJ: New Horizon Press, 2006.

Organization

Center for Effective Collaboration and Practice. 1000 Thomas Jefferson Street, Suite 400, Washington, DC, 20007. Toll free: 888-457-1551. Web site: <http://cecp.air.org/resources/schfail/prevsch.asp>.

School Violence See *Violence*.

Sciatica

Sciatica (sy-AT-i-ka) is a form of lower back pain that usually moves from the buttocks down the back of the leg.

What Is Sciatica?

When something squeezes the sciatic nerve, the main nerve in the leg, people feel pain in the back of the lower body. That pain, frequently one-sided, but occasionally affecting both sides, called sciatica, usually moves down the buttocks to the leg below the knee, but it can go all the way down to the foot. Sciatica varies from mild, tingling pain to severe pain that leaves people unable to move. Some people with sciatica feel sharp pain in one part of the leg or hip and numbness in other parts. This pain gets worse after standing or sitting for a long time.

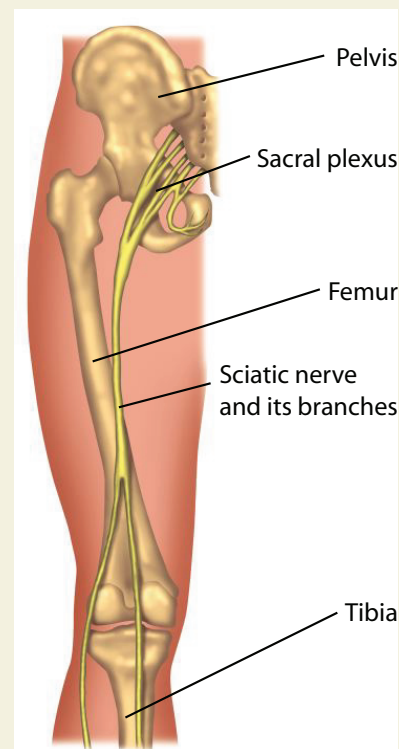
Sciatica is most common in people who are 30 to 70 years of age, and it affects about three times as many men as women. At risk are the following groups:

- people who are sedentary (not very active)
- people who exercise improperly
- people who smoke
- athletes
- people who lift, bend, and twist in awkward positions in their jobs
- pregnant women
- tall people

What Causes Sciatica?

There are many ways the sciatic nerve can become compressed, but the exact cause is often unknown. The most common causes of sciatica are a herniated disc or a tumor within the spine. Discs are the pads between the bones (called vertebrae) of the spine. They are filled with a gelatin-like substance that cushions the vertebrae from the impact of walking, running, lifting, and similar activities. A disc that has torn and has this gelatin-like material oozing out of it is said to be herniated.

Other common causes of sciatica include bony irregularities of the vertebrae such as spondylolisthesis*. Spinal stenosis* is a less common cause. In some cases, diabetes or alcoholism can cause sciatica.



▲ The sciatic nerve is the main nerve in the leg. It branches into the tibial and peroneal nerves. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **spondylolisthesis** (spon-di-lo-lis-THEE-sis) is a condition in which one vertebra slips over the other.

* **spinal stenosis** (SPY-nal ste-NO-sis) is the narrowing of the spinal canal.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

How Is Sciatica Diagnosed and Treated?

Sciatica is diagnosed through a medical history and a physical examination. Sciatica often clears up within several days to a week. It is usually treated with bed rest for a day or two (only if people cannot bear the pain), local heat, massage, pain relievers, and muscle relaxants. Sciatica tends to return and can become chronic*. Chronic sciatica is treated by trying to alleviate the cause of the pain; people with this problem are advised to lose weight, improve their muscle tone and strength, and improve their posture. Surgery may be necessary in cases in which there is no relief from pain, disc disease, or spinal stenosis.

Surgical Treatment Techniques

Several surgical interventions are available for treating sciatica. The goal of surgery is to eliminate the source of pressure on the sciatic nerve.

Laser discectomy is the removal of herniated disc material using a laser technique. During this procedure laser energy is introduced under fluoroscopic guidance to remove tissue that has been pressing on nerves and causing pain or numbness.

Microdiscectomy is the removal of herniated disc material using a surgical microscope. Because this techniques involves a microscope, the incision remains small, which helps reduce disturbance of surrounding tissue.

Radiofrequency ablation uses radiofrequency energy to heat up and break bonds of small nerve tissue areas, creating small openings and decreasing pain for months and sometimes years.

Can Sciatica Be Prevented?

Sciatica or recurrence of sciatica can sometimes be prevented by standing, sitting, and lifting properly; exercising; and working in a safe environment. People can use chairs, desks, and equipment that support the back or help maintain good posture, and they can take precautions when lifting and bending.

▶ See also **Pain • Slipped (Herniated) Disk**

Resources

Books and Articles

Fishman, Loren, and Carol Ardman. *Sciatica Solutions: Diagnosis, Treatment, and Cure of Spinal and Piriformis Problems*. New York: Norton, 2007.

Organizations

National Institute of Arthritis and Musculoskeletal and Skin

Diseases. 1 AMS Circle, Bethesda, MD, 20892-2520. Toll free: 877-226-4267. Web site: <http://www.niams.nih.gov>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/sciatica.html>.

Scleroderma

Scleroderma is a slowly progressive disease characterized by deposits of fibrous connective tissue in the skin and often the internal organs.

What Is Scleroderma?

Scleroderma is a slowly progressive disease characterized by deposits of fibrous connective tissue in the skin and often the internal organs, by hand and foot pain during exposure to cold, and by tightening and thickening of the skin. Localized scleroderma primarily affects the skin, whereas more widespread scleroderma also affects such internal organs as the lungs, liver, and heart, kidneys, and those organs in the gastrointestinal* tract.

What Causes Scleroderma?

As of 2009, scientists were not sure what causes scleroderma. It was thought to be a type of autoimmune disease*. Ordinarily, the function of the immune system* is only directed against foreign agents such as viruses, bacteria, or fungi, which threaten the body's health. However, in the case of an autoimmune disease, the immune system accidentally becomes confused about what is "foreign" and what is "self." The immune system begins to marshal its resources to attack the organs and tissues of the body, causing damage and destruction. In the case of scleroderma, it appears that

* **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

* **autoimmune disease** (aw-toh-ih-MYOON) is a disease in which the body's immune system attacks some of the body's own normal tissues and cells.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.



Scleroderma, also known as systemic sclerosis, causes red, thickened, and tough looking skin. *Dr. P. Marazzi/Photo Researchers, Inc.*

* **chemotherapy** (KEE-mo-THER-ə-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **esophagus** (eh-SAH-fuh-gus) is the soft tube that, with swallowing, carries food from the throat to the stomach.

* **biopsies** (BI-op-seez) are tests in which small samples of skin or other body tissue are removed and examined for signs of disease.

the immune system's attack on connective tissue prompts an inflammatory response and the overproduction of collagen, which is an insoluble fibrous protein and the chief component of connective tissue. The accumulation of excess collagen causes the signs and symptoms of scleroderma.

Who Gets Scleroderma?

Scleroderma tends to strike people between 30 and 50 years of age. Women are four times as likely as men to develop this condition. Only about 4 to 12 individuals per 12 million people are diagnosed yearly, although more mild cases may occur without diagnosis. People of African descent are more likely to have the disease than people of European descent, and African-Americans are also more likely to have severe lung disease as a component of their condition. Other risk factors for the development of scleroderma include exposure to silica dust, paint thinners, and chemotherapy* agents.

What Are the Symptoms of Scleroderma?

Symptoms of scleroderma include thickening, tightening, and hardening of the skin, especially the skin of the fingers and hands; the appearance of hard deposits of calcium in the skin and connective tissues; inflammation of the esophagus*, the tube through which saliva, food, and fluids move from the mouth to the stomach; a spotty red rash on the hands and face; spasms of the blood vessels in the fingers and toes (Raynaud's phenomenon), resulting in blanching (whitening) of the skin and pain. If other organs are involved, the disease may cause various other symptoms. Lung involvement can result in shortness of breath, wheezing, cough, fatigue, and difficulty with exertion. Musculoskeletal involvement can result in joint pain, swelling, and stiffness, problems with mobility, and muscle inflammation and tenderness. Involvement of the gastrointestinal system can result in heartburn, gastroesophageal reflux (washing of acid from the stomach into the esophagus, which causes burning, pain, and damage to the esophagus), trouble swallowing, constipation, and liver problems. Inflammation of the heart can lead to congestive heart failure. Kidney involvement can result in severely high blood pressure and kidney failure.

How Is Scleroderma Diagnosed?

Scleroderma may be suspected based on the presence of characteristic symptoms, coupled with knowledge of the individual's personal or family history. A physical examination may reveal red, swollen, shiny, tight skin on the hands, as well as other signs of abnormal collagen production. A number of specific blood tests may be performed in order to demonstrate the presence of an autoimmune and connective tissue disorder. Tests may include antinuclear antibody testing, rheumatoid factor, erythrocyte sedimentation rate, and tests for a variety of other auto-antibodies (antibodies that are directed against the individual's body). Other blood tests may be performed in order to assess the functioning of various organs that may be affected. Biopsies* of affected organs may also help make the diagnosis,

and specific imaging tests or function tests may demonstrate the effect that scleroderma is having on specific organ systems.

How Is Scleroderma Treated?

As of 2009, there was no cure for scleroderma. Treatments aimed at calming the overactive immune system and suppressing inflammation throughout the body. Medications used may include nonsteroidal anti-inflammatory agents, steroid drugs, and immunosuppressant agents such as those used to prevent organ rejection after transplant (methotrexate, cyclophosphamide, D-penicillamine). Medications that can dilate blood vessels may be used to treat Raynaud's phenomenon. Other treatments are focused on the specific affected organ systems. In very advanced cases of scleroderma, when lung or kidney damage is severe, lung or kidney transplant may be recommended.

▶ See also **Collagen Vascular Diseases**

Resources

Books and Articles

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Firestein, Gary S., Ralph C. Budd, Edward D. Harris, et al. *Kelley's Textbook of Rheumatology*, 8th ed. Philadelphia, PA: Saunders, 2008.

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Mayes, Maureen D. *The Scleroderma Book: A Guide for Patients and Families*. New York: Oxford University Press, 2005.

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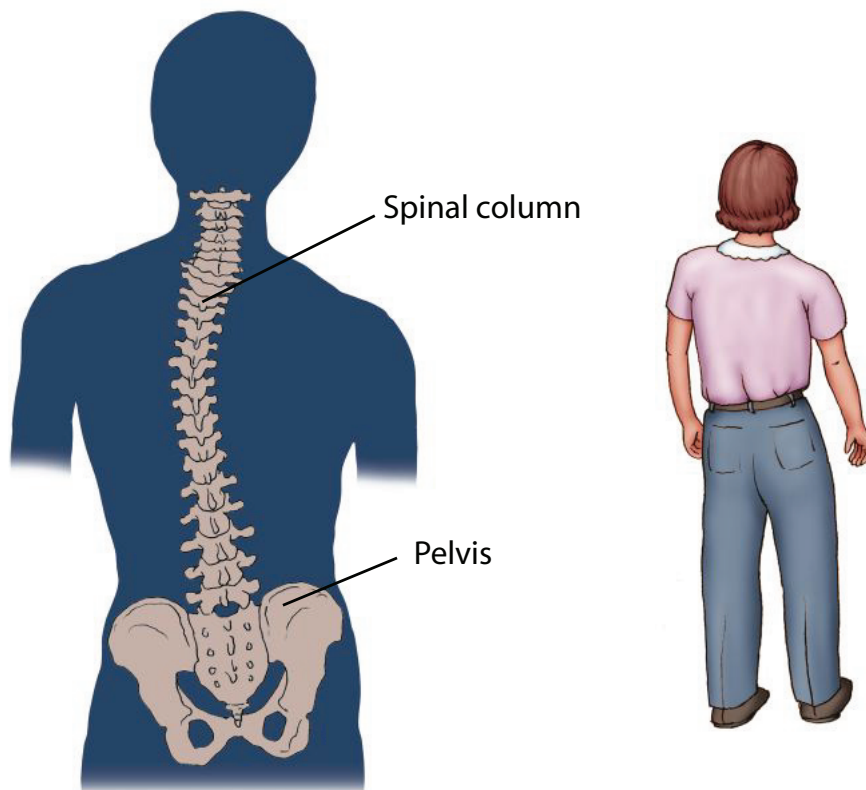
American College of Rheumatology. 1800 Century Place, Suite 250, Atlanta, GA, 30345. Telephone: 404-633-3777. Web site: http://www.rheumatology.org/public/factsheets/diseases_and_conditions/scleroderma.

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892. Toll free: 800-422-6237. Web site: http://www.niams.nih.gov/Health_Info/Scleroderma/default.asp.

Scoliosis

Scoliosis (sko-lee-O-sis) is a lateral, or side-to-side, curvature of the spine that most often occurs gradually during childhood or adolescence.

Spinal column and pelvis in an adolescent girl with scoliosis. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



What Is Scoliosis?

The word “scoliosis” comes from the Greek word meaning curvature. Everyone’s backbone curves to a significant degree when viewed from the side, which is necessary for proper movement and walking. When viewed from the front or back, however, the spine should appear as a straight line (or very nearly so). With scoliosis, the spine curves (from side to side) when viewed from the front or back, and this side-to-side curve may be S-shaped, which develops when another part of the spine develops a counterbalancing secondary curve. Depending on the degree of curvature, this condition may cause other physical problems, such as pain and breathing difficulties. The regions of the spine most commonly involved are the thoracic (tho-RAS-ik), or chest, region, and the lumbar (LUM-bar), or lower back, region.

Scoliosis is a fairly common condition. It has been estimated that about 3 out of every 100 people have this disorder to some degree. Girls are about five times more likely than boys to develop scoliosis.

Causes, Known and Unknown

The most common form of scoliosis is called idiopathic (id-ee-o-PATH-ik), which means that the cause is unknown. Usually, scoliosis becomes apparent just prior to or during adolescence, when the body’s rate of growth speeds up markedly. The curvature stops increasing after people have reached their mature height.

Rarely, scoliosis is a congenital (present at birth) abnormality of the vertebrae (VER-te-bray), or spinal bones, and continues to develop throughout childhood. Poliomyelitis* (po-lee-o-my-uh-LYE-tis) has caused scoliosis in some people by paralyzing or weakening the spinal muscles on one side of the body.

Occasionally, an injury such as a disk prolapse (slipped disk) or a sprained ligament* in the backbone can cause temporary scoliosis. When this happens, the curvature may be accompanied by back pain and sciatica*.

People who have scoliosis often have family members with the same condition. In 2007 a gene linked to adolescent idiopathic scoliosis was identified by researchers at Texas Scottish Rite Hospital for Children which confirmed a hereditary link for this type of scoliosis.

What Are the Signs and Symptoms of Scoliosis?

Because scoliosis can develop very gradually, there may be no observed signs or symptoms in its early stages. Often, the curvature is first noticed in a teenager indirectly: one shoulder may become noticeably higher than the other, or a dress or jacket may not hang straight.

Early symptoms of scoliosis may include an unusually tired or achy feeling in the lower back after standing or sitting for a long time.

* **poliomyelitis** (po-lee-o-my-uh-LYE-tis) is a condition caused by the polio virus that involves damage of nerve cells. It may lead to weakness and deterioration of the muscles and sometimes paralysis.

* **ligament** (LIG-a-ment) is a fibrous band of tissue that connects bones or cartilages (CAR-ti-lij-ez), serving to support or strengthen joints.

* **sciatica** (sy-AT-i-ka) is pain along the course of either of the sciatic (sy-AT-ik) nerves, which run through the pelvis and down the backs of the thighs.

BACK BRACES, PAST, PRESENT, AND FUTURE

In the early 1900s, teenagers who had to wear back braces for scoliosis faced some very uncomfortable choices. As if being tortured, they were strapped to racks in an attempt to straighten their backs. Later on, metal jackets that weighed up to 30 pounds were worn to try to reduce the curvature. Lighter jackets, made of plaster of Paris, came next, but often they were hot and itchy.

In the early 2000s back braces are much improved. Many are made of lightweight materials and do not have to be worn all the time. There are several different types to choose from to suit the teenager's particular requirements. Some are worn only during sleep; others can be worn under clothing, so that they are not visible. Still others are of a low-profile type that comes up under the arms and are quite comfortable.

Wearing a back brace sometimes causes emotional problems. Some teenagers may resist the idea of wearing a back brace because they fear their friends or classmates may reject or ridicule them. Counseling or support groups often are helpful in sharing experiences and problems and should be considered as part of the treatment.

Future back braces undoubtedly will be even more adaptable, as medical engineers continue to design improvements in these devices.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

For some, the curvature eventually may become more severe and easier to recognize. Severe scoliosis can cause chronic* back pain. If the curvature exceeds an angle of about 40 or 45 degrees, it can interfere with breathing and affect heart function.

How Do Doctors Diagnose and Treat Scoliosis?

Diagnosis Scoliosis is not always easy to diagnose, especially if it does not hurt or have visible signs. A physical examination of the spine, hips, and legs is the first step, followed by an x-ray if needed.

In the United States, public schools often do a simple test for scoliosis called the forward-bending test. The school nurse or another staff member has students bend over parallel to the floor with their shirts off to check for curvature. If scoliosis is suspected, the student is referred to a family doctor for further evaluation. The doctor might want to have an x-ray taken for a clearer view of the spine.

The severity of scoliosis is diagnosed by determining the extent of curvature of the spine. The curvature is the angle of slant of the spinal bones measured in degrees.

Treatment choices If the cause of scoliosis is known, such as an injury or unequal leg length, the treatment is designed to address the cause. For example, wearing a shoe with a raised heel can correct scoliosis caused by unequal leg length.

In idiopathic scoliosis, however, the choice of treatment depends largely on the severity of the condition. If the angle of curvature is slight (e.g., 10 to 15 degrees) nothing may need to be done other than having regular checkups to make sure the curvature does not worsen. Somewhat greater curvature can be treated by the person wearing any of several types of back braces. An angle of curvature of 40 degrees or more may mean that a corrective operation is needed.

Living with Scoliosis

Fortunately, much of the deformity of scoliosis can be prevented if the condition is detected early. In most instances, no lifestyle changes are needed, and people can carry on with their normal activities.

▶ See also **Genetic Diseases • Poliomyelitis**

Resources

Books and Articles

Silverstein, Alvin, Virginia Silverstein, and Laura Silverstein Nunn. *Scoliosis*. New York: Franklin Watts, 2002.

Organizations

National Institute of Arthritis and Musculoskeletal and Skin

Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-226-4267. Web site: http://www.niams.nih.gov/Health_Info/Scoliosis/default.asp.

National Scoliosis Foundation. 5 Cabot Place, Stoughton, MA, 02072, Web site: <http://www.scoliosis.org>.

Southern California Orthopedic Institute. 6815 Noble Avenue, Van Nuys, CA, 91405. Telephone: 818-901-6600. Web site: <http://www.scoi.com/scoilio.htm>.

Scurvy

Scurvy is a disease that results when people do not get enough vitamin C (also called ascorbic acid) in the diet over a period of weeks or months. Some of the effects of scurvy are spongy gums, loose teeth, weakened blood vessels that cause bleeding under the skin, and damage to bones and cartilage, which results in arthritis-like pain.

What Is Scurvy?

Scurvy was one of the first recognized dietary deficiency diseases. During the sea voyages from the 15th through the 18th centuries, many sailors suffered from scurvy. For example, the Portuguese navigator Vasco da Gama (ca 1460–1524) lost half his crew to the disease during a voyage around the Cape of Good Hope, and the British admiral Sir Richard Hawkins (1532–1595) estimated that during his career, 10,000 sailors under his command died due to scurvy. One legend maintains that men sailing with Christopher Columbus developed scurvy and asked to be left on an island to die, but when Columbus returned, he found the men healthy. He named the island, which was rich in various kinds of fruit, Curacao, meaning cure in Portuguese.

To deal with dietary deficiencies, ships began to carry all manner of remedies, including sauerkraut, mustard, and dried vegetables for soup, but nothing seemed to work consistently to prevent scurvy. In 1747, the Scottish naval physician James Lind (1716–1794) conducted experiments to find out which foods or liquids were good treatments for scurvy. Sailors had long known the benefits of lime juice, but Lind's work was the first to confirm that citrus—and in particular lemons and oranges—was an effective treatment. Eventually, all ships embarking on long voyages carried a supply of citrus fruits or juice, and a British Navy mandated daily rations of lime juice.

Seventeenth-century Scottish physician James Lind supplied oranges and lemons to sailors with scurvy. ©Bettmann/Corbis.



What Is the Role of Vitamin C in the Body?

Citrus fruits are rich sources of vitamin C, and vitamin C is necessary for strong blood vessels; healthy skin, gums, and connective tissue; formation of red blood cells; wound healing; and the absorption of iron from food. Scientists first learned about vitamin C in the late 1920s to early 1930s when an Hungarian research team and an American research team independently discovered the vitamin and identified it as ascorbic acid.

What Are the Symptoms of Scurvy?

The main symptom of scurvy is bleeding (hemorrhaging). Bleeding within the skin appears as spots or bruises. Bleeding can take place in the membranes covering the large bones and in the membranes of the heart and brain. Bleeding in or around vital organs can be fatal. Other symptoms include: slow and poor healing of wounds; swollen gums and gingivitis

HAVE YOU EVER HEARD OF A “LIMEY”?

In *Treatise of the Scurvy*, published in 1753, James Lind (1716–1794) wrote about the first example of a research experiment set up as a controlled clinical trial. To study the treatment of scurvy, Lind divided sailors who had it into several groups and then fed each group different liquids and foods. He discovered that the group fed lemons and oranges was able to recover from scurvy.

By the end of the 18th century, the British navy had its sailors drink a daily portion of lime or lemon juice to prevent scurvy. The American slang term for the English, “limeys,” originated from that practice.

(jin-ji-VY-tis), which means inflammation of the gums; nausea; muscle and joint pain; loosening and sometimes outright loss of teeth; dry skin; and a general feeling of tiredness.

Scurvy develops slowly. In the beginning, a person usually feels tired, irritable, and depressed. In an individual in the advanced stages of scurvy, laboratory tests show a complete absence of vitamin C in the person's body.

Who Is at Risk for Scurvy?

Scurvy is less prevalent in modern times than it was in the time of Vasco da Gama and Richard Hawkins, but people who are on diets that lack a diversity of foods may develop scurvy or scurvy-like conditions. This statement applies to the following groups:

- infants who depend solely on processed cow's milk for nutrition and do not receive vitamin C supplements
- elderly people, whose diets often lack citrus fruits or vegetables that contain vitamin C
- people who follow diets that limit them to very few food choices.

How Is Scurvy Treated?

A simple blood test that checks for vitamin C levels can confirm whether a person has scurvy. If so, a medical professional will recommend vitamin C supplements (vitamin pills) and a diet that includes foods rich in vitamin C. In addition to citrus fruits such as oranges and grapefruits, good sources of vitamin C include broccoli, tomatoes, raw spinach, baked potatoes, red and green bell peppers, strawberries, cantaloupe, mangoes, and other fruits and vegetables.

▶ See also **Dietary Deficiencies • Gum Disease**

Resources

Books and Articles

Bown, Stephen R. *Scurvy: How a Surgeon, a Mariner, and a Gentleman Solved the Greatest Medical Mystery of the Age of Sail*. St. Martin's Griffin, 2005.

Organization

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/000355.htm>.

Seasickness See *Motion Sickness*.

* **neurotransmitter** (NUR-o-tranz-mit-er) is a brain chemical that lets brain cells communicate with each other and therefore allows the brain to function properly. In other words, a neurotransmitter transmits (carries) a chemical message from neuron to neuron.

* **serotonin** (ser-o-TO-nin) is a neurotransmitter, a substance that helps transmit information from one nerve cell to another in the brain. It is associated with feelings of well-being.

Seasonal Affective Disorder

Seasonal affective disorder (SAD) is a form of depression that occurs at the same time each year (usually with the onset of winter) and disappears at the same time each year (typically at the start of spring). SAD is linked to the availability of daylight and occurs most often in people who live in the Northern Hemisphere.

More than the Winter Blahs

Many people get the winter blahs or cabin fever as the days get shorter and colder, but for the approximately 10 million Americans with SAD, shorter days mean a slide into true depression. SAD is a seasonal pattern of depression. Women experience this form of depression four times more often than men, and it can also occur in children and teens. The farther individuals live from the equator, the higher the risk that they will experience SAD. One study has estimated the incidence of SAD in the general population as only 1.4 percent in Florida but 9.7 percent in New Hampshire. These numbers suggest that the condition strikes people who live in the northern state of New Hampshire about seven times more frequently than it does people who live in the southern state of Florida. The study also showed that SAD affected more people in other northern states: 4.7 percent in New York and 6.3 percent in Maryland.

What Causes Seasonal Affective Disorder?

As autumn arrives, the number of daylight hours declines. The effect is greater the farther north a person travels from the equator. Daylight also declines with increasing cloud cover in specific areas of the United States, such as the Great Lakes region and northwest coastal areas of Washington.

Researchers believe that for some people, the decrease in available daylight causes a decline in the neurotransmitter* serotonin*, in the brain. A decrease in serotonin in the brain has been linked to depression, because serotonin typically is associated with feelings of well-being. In the autumn, after a few weeks of reduced serotonin levels, a person can start to show signs of depression. If left untreated, the depression may continue throughout the winter and then disappear in the spring as the number of daylight hours increases.

Medical professionals diagnose SAD in people if they become depressed in the fall and winter for two or more consecutive years with periods of normal moods in the spring and summer and if they have no other problems that might account for seasonal depression. A rare form of SAD, called summer SAD, occurs in reverse of the normal pattern. People with summer SAD become depressed during the summer and feel better in the winter.

What Are the Symptoms of Seasonal Affective Disorder?

Not everyone who has SAD experiences all of the same symptoms. Common symptoms of SAD include fatigue and oversleeping; a craving for carbohydrates, such as breads and pasta; and a tendency to gain a little weight. In addition, a person may experience other common symptoms of depression such as the following:

- Depressed mood
- Feelings of helplessness, hopelessness, or guilt
- Pessimistic thoughts
- Loss of pleasure in previously enjoyable activities
- Difficulty concentrating or making decisions

How Is Seasonal Affective Disorder Treated?

Following a correct diagnosis, a medical professional may recommend that the patient begin light therapy to treat seasonal affective disorder. People with SAD sit in front of special bright light boxes or wear light visors for a period of 30 minutes to two hours every day, glancing occasionally at the light. To be effective, the light must enter the eyes and not just fall on the skin. Occasionally, people report eyestrain or headaches from the light devices, but they usually experience no other negative side effects. When natural daylight increases, people with SAD discontinue light treatment.

In addition to light therapy, some people with SAD benefit from antidepressant medications*. Some researchers have also advocated the use of melatonin, a light-sensitive hormone* that is believed to play a role in the normal sleep-wake cycle. They believe that SAD results when the body's normal cycle becomes skewed, and the timed administration of melatonin can help restore the normal pattern.

▶ See also **Depressive Disorders**

Resources

Books and Articles

Rosenthal, Norman E. *Winter Blues: Everything You Need to Know to Beat Seasonal Affective Disorder*, rev. ed. New York: Guilford Press, 2006.

Organizations

National Mental Health Association. 2000 N. Beauregard Street, 6th Floor, Alexandria, VA, 22311. Telephone: 703-684-7722. Web site: <http://www1.nmha.org/infoctr/factsheets/27.cfm>.

Seasonal Affective Disorder Association. P.O. Box 989, Steyning, England, BN44 3HG, Web site: <http://www.sada.org.uk>.

* **antidepressant medications** are used for the treatment and prevention of depression.

* **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **Epilepsy** (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.

* **neurons** are nerve cells. Most neurons have extensions called axons and dendrites through which they send and receive signals from other neurons.

Seizures

Seizures (SEE-zhers) occur when the electrical patterns of the brain are interrupted by powerful, rapid bursts of electrical energy. A seizure may cause a person to lose consciousness, to fall down, to jerk or convulse, or simply to blank out for a few seconds. Infection, injury, or medical problems can cause a seizure. Epilepsy is a disease of the nervous system characterized by recurring seizures.*

Two Stories

Eric's story As part of his sixth grade study of self-awareness, Eric was assigned to draw the frames of a film that would show the world as he saw it. Teachers were puzzled by what Eric drew. One frame showed him pouring milk, the next frame was completely black, and the next frame showed spilled milk. In another sequence, Eric drew a teacher calling on him to answer a math problem, followed by another black frame, and then a picture of the teacher complaining that Eric was not paying attention. The teachers realized that Eric's project did show the world as he saw it. The mysterious black frames were blackouts. Doctors determined that Eric had absence seizures, a type of seizure that causes a brief loss of consciousness. Medication successfully controlled Eric's seizures.

Carol's story All the students in Carol's art class were preparing work for an art show when Carol stood up and began walking around the room. Looking like she was in a trance, Carol smacked her lips and tugged at the sleeve of her dress. About two minutes later, Carol became aware of her surroundings, only to discover that her classmates were laughing at her strange behavior. Embarrassed, she ran from the room. Carol had experienced a complex partial seizure.

What Is a Seizure?

Whether a person is sleeping or awake, millions of tiny electrical charges pass between neurons* in the brain and to all parts of body. These cells "fire," or transmit electrical impulses, in an orderly and controlled manner. Seizures occur when overactive nerve cells send out powerful, rapid electrical charges that disrupt the brain's normal function. The disruption can temporarily affect how a person behaves, moves, thinks, or feels.

Symptoms of a seizure can include combinations of the following:

- twitching and tingling in part of the body (for example, fingers and toes)
- muscle spasms spreading to arms and legs
- hallucinations

- intense feeling of fear or of familiarity (sometimes called déjà vu, which means “already seen” in French)
- a peculiar sensation, sometimes called an aura, immediately before the seizure (for example, seeing a flashing light or sensing strange odors)
- loss of consciousness.

* **cerebral cortex** (suh-REE-brul KOR-teks) is the part of the brain that controls functions such as conscious thought, listening, and speaking.

How Do Seizures Differ?

There are two kinds of seizure disorders: an isolated seizure that occurs only once and epilepsy (EP-i-lep-see). Epileptic seizures occur more than once, and they occur over a period of time. In both epilepsy and isolated seizures, the seizure may have different symptoms or characteristics depending on where it begins in the brain and how the electrical discharge spreads across the brain. Seizures can be generalized or partial.

Generalized seizures Generalized seizures affect nerve cells throughout the cerebral cortex* (the cauliflower-like outer portion of the brain), or all of the brain. Generalized seizures often are hereditary, which means they run in families. They may also be caused by imbalances in a person’s kidney or liver function or in their blood sugar.

The most common generalized seizures are:

- **Generalized tonic-clonic seizure (formerly called grand mal seizure):** In the tonic phase of this seizure, people often lose consciousness, drop to the ground, and emit a loud cry as air is forced over their vocal cords. In the clonic phase, body muscles contract all at once or in a series of shorter rhythmic contractions, causing thrashing motions. Usually, this kind of seizure lasts for about one or two minutes and is followed by a period of relaxation, sleepiness, and possibly a headache.
- **Absence seizure (formerly called petit mal seizure):** Loss of consciousness in this seizure is often so brief (usually 10 to 30 seconds) that a person does not even change positions. The person may display a blank stare, rapid blinking, or chewing movements. Facial or eyelid muscles may jerk rhythmically. Absence seizures may be inherited and usually are seen for the first time in children between the ages of 6 and 12.
- **Infantile spasms:** This type of seizure occurs in children under the age of four and may cause a child to suddenly flex the arms, thrust the trunk forward, and extend the legs. The seizure lasts only a few seconds but can recur several times per day.
- **Atonic seizures:** Also seen primarily in children, these seizures cause a complete loss of muscle tone and consciousness, which means they pose a serious risk of injury due to falling.

* **aura** is a warning sensation that precedes a seizure or other neurological event.

* **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.

- **Myoclonic seizures:** These brief seizures are characterized by quick jerking movements of one limb or several limbs. The person experiencing the seizure does not lose consciousness.
- **Febrile seizures:** These seizures occur in infancy or childhood and cause a child to lose consciousness and convulse. The seizures are accompanied by a high fever, and they are described as either simple or complex. Simple febrile seizures account for about 85 percent of febrile seizures. They occur once in 24 hours and last less than 15 minutes. Complex febrile seizures last more than 15 minutes or occur more than twice in 24 hours.

Partial seizures Partial seizures affect nerve cells contained within one region of the cerebral cortex. Types of partial seizures include:

- **Simple partial:** The seizure-related brain messages remain localized, and the individual is awake and alert. Symptoms vary depending on what area of the brain is involved. They may include jerking movements in one part of the body, emotional symptoms such as unexplained fear, an experience of peculiar smells, or nausea.
- **Complex partial:** A person loses awareness of surroundings and is unresponsive or only partially responsive. There may be a blank stare, chewing movements, repeated swallowing, or other random activity. After the seizure, the person has no memory of the experience. In some cases, the person may become confused, begin to fumble, to wander, or to repeat inappropriate words or phrases.

What Causes A Seizure?

A seizure generally is easy to recognize, but finding the cause can be extremely difficult. Doctors begin with a thorough physical examination. They try to determine if the person has experienced other seizures or has a family history of seizures. Physicians also want to know if their patient has experienced an aura* because that can help establish the location in the brain of the seizure. They also will note the person's age and the nature of the movements the person made during the seizure.

An electroencephalogram (e-LEK-tro-en-SEF-a-lo-gram), commonly known as an EEG, records electric currents in the brain and can track abnormal electrical activity. Doctors may also look for structural brain abnormalities using other types of scans, including computerized tomography (CT) and magnetic resonance imaging (MRI). In some research centers, positron emission tomography (PET) is used to identify areas of the brain that are producing seizures.

A lumbar puncture, sometimes called a spinal tap, can detect infection. The procedure requires that a physician carefully insert a thin needle between two vertebrae (bones) in the patient's spine and draw out a small amount of cerebrospinal fluid* (CSF). The fluid is analyzed for the

presence of bacterial or viral infections, tumors, or blood disorders that might provide a clue to the cause of the seizure.

Seizures are associated with the following diseases and conditions:

- Epilepsy, a disorder of the nervous system characterized by seizures that occur more than once and over a period of time
- Head trauma that damages the brain
- Loss of oxygen caused by birth trauma, carbon monoxide poisoning, or near drowning
- Brain infections, such as meningitis or encephalitis
- Brain tumor
- Stroke
- Toxic (poisonous) agents, including drug abuse or ingestion of poisons such as lead, alcohol, or strychnine
- Withdrawal from alcohol and drugs
- Metabolic imbalances such as hypoglycemia (very low blood sugar), uremia (kidney failure), or liver problems
- Eclampsia or toxemia, which may occur during pregnancy and is characterized by high blood pressure, protein in the urine, and fluid retention.

It is important to remain calm and not to panic when someone has a seizure. An adult usually asks if the person has epilepsy. If the person is unable to communicate, an adult checks for a medical identification bracelet or tag that carries information about the underlying cause of the seizure.

▶ See also **Brain Tumor • Diabetes • Encephalitis • Epilepsy • Fever • Hypoglycemia • Incontinence • Infection • Kidney Disease • Lead Poisoning • Lupus • Meningitis • Stroke • Substance Abuse**

Resources

Books and Articles

Kutscher, Martin L. *Children with Seizures: A Guide for Parents, Teachers, and Other Professionals*. Philadelphia, PA: Jessica Kingsley, 2006.

Wyllie, Elaine. *Epilepsy: Information for You and Those Who Care about You*. Cleveland, OH: Cleveland Clinic Press, 2008.

Organizations

Epilepsy Foundation. 8301 Professional Place, Landover, MD, 20785.
Toll free: 800-332-1000. Web site: <http://www.epilepsyfoundation.org>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/seizures.html>.

* **anxiety disorders** (ang-ZY-e-tee dis-OR-derz) are a group of conditions that cause people to feel extreme fear or worry that sometimes is accompanied by symptoms such as dizziness, chest pain, or difficulty sleeping or concentrating.

Selective Mutism

Selective mutism (se-LEK-tiv MU-ti-zum) is a condition in which children feel so inhibited and anxious that they do not speak in particular situations, most commonly in school. Children with selective mutism are capable of speaking and communicating normally and do so in other situations, for example, at home.

Brandon's Story

When Brandon first started kindergarten, his teacher just thought he was a very quiet boy and that he would come out of his shell in a week or two. As the weeks passed into months, though, Brandon still never spoke a word at school, even when the teacher called on him. Sometimes if he needed something, he would point or gesture, but he would not speak. His teacher was concerned, and when she called his parents, they told her that Brandon spoke easily at home and that he had always been a little shy around others. It was clear that Brandon's problem was more than normal shyness. Because it was interfering with his ability to participate in class and on the playground, his parents took Brandon to a mental health professional, who diagnosed his problem as selective mutism.

What Is Selective Mutism?

Selective mutism is a condition in which children feel anxious and inhibited and do not speak in certain situations. Children with selective mutism are capable of speaking normally and do so in other situations where they feel more comfortable. These children often talk normally at home, but they may completely stop talking around teachers, other children, or other adults. Their behavior gets in the way of their making friends and doing well in school.

Selective mutism, once thought to be quite rare, was beginning to be more widely recognized in the early 2000s. It used to be called elective mutism, because it was thought that children were purposely choosing not to talk. It was sometimes thought that a child's refusal to speak was a way to rebel against adults or a sign of anger. The problem affects at least 1 in 100 school-age children. It usually begins before the age of 5, but it may not cause problems until children start school. The condition may last for just a few months, but in some cases, if left untreated, selective mutism can last for years. Some experts believe that untreated selective mutism in children leads to social anxiety disorders* in their adult years. Experts concluded that selective mutism is an extreme form of social anxiety in a child. Social anxiety is an intense, lasting fear or extreme discomfort in social situations, and usually leads to avoidance of many social situations. With selective mutism, children seem to feel so self-conscious or anxious in certain situations that they avoid talking altogether.

What Causes Selective Mutism?

There is no single cause of selective mutism. As with other forms of anxiety, some children may be more likely to have this problem if anxiety or extreme shyness runs in the family, or if they are born with a shy nature. Beyond genetics, in some families in which adults are anxious, children may learn to feel socially anxious by watching the way adults react and behave. Upsetting or stressful events such as divorce, the death of a loved one, or frequent moves may trigger selective mutism in a child who is prone to anxiety.

What Are the Symptoms of Selective Mutism?

Many children are shy for a while when they first start kindergarten, but most eventually become comfortable in school, make friends, and talk to the teacher. Those with selective mutism remain silent and may not speak for a month or longer. Some children with selective mutism make gestures, nod, or write notes to communicate. Others use one-syllable words or whispers. Many children with selective mutism are very shy and fearful and may have nervous habits, such as biting their nails. They may cling to their parents and sulk around strangers but might throw temper tantrums and be stubborn and demanding at home. When pushed to speak, they may become stubborn in their refusal. It is sometimes hard for adults to understand that fear, not stubbornness, is at the root of selective mutism and that children with this condition experience speaking as risky, scary, or dangerous. Understood in this way, people can understand that a child's stubborn refusal to speak as a strong, but misguided, attempt at self-protection.

How Is Selective Mutism Diagnosed?

Some children with selective mutism will speak to a mental health professional, but others will not. Even if children are silent, though, a skilled professional therapist still can learn a lot by watching how they behave. The therapist can also talk to parents and teachers to find out more about the problem and possible factors that contribute to it. In addition, a number of tests may be used to exclude other possible causes for failing to speak. These include special medical tests to rule out brain damage, intelligence and academic tests to rule out learning problems, speech and language tests to rule out communication disorders*, and hearing tests to rule out hearing loss.

How Is Selective Mutism Treated?

Most children who have selective mutism want to feel comfortable talking. Although they resist efforts to help them talk at first, therapy can be effective in treating this problem. The most common treatment for selective mutism is behavioral (bee-HAY-vyor-al) therapy, which helps people gradually change specific, unwanted types of behavior. For example, after the therapist helps the child to feel comfortable, the child might be rewarded for speaking softly and clearly into a tape recorder. Once they have succeeded at this several times, they can move

* **communication disorders** affect a person's ability to use or understand speech and language.

* **systemic** (sis-TEM-ik) a problem affecting the whole system or whole body, as opposed to a localized problem that affects only one place on the body.

on to being rewarded for speaking to one child at school. Children who are selectively mute may speak to specific children. They then might be invited to participate in a group with the children to whom the selectively mute child speaks.

Often family therapy is added, which helps identify and change behavior patterns within the family that may play a role in maintaining mutism. When a child has selective mutism, it is common for the family members to speak for the child. While they begin to do this out of love and concern and the desire to be helpful, these patterns must be discontinued to help motivate reluctant children to begin to speak for themselves. Play therapy and drawing are often used to help these children to express their feelings and worries. In addition, some children with selective mutism are prescribed medications used for treating anxiety. These medications help lessen the anxiety that plays an important role in the selectively mute child's behavior, allowing the child to take the risks involved in talking.

▶ See also **Anxiety and Anxiety Disorders • School Avoidance • Social Phobia (Social Anxiety Disorder)**

Resources

Books and Articles

McHolm, Angela E., Charles E. Cunningham, and Melanie K. Vanier. *Helping Your Child with Selective Mutism: Practical Steps to Overcome a Fear of Speaking*. Oakland, CA: New Harbinger Publications, 2005.

Organizations

Selective Mutism Foundation. P.O. Box 13133, Sissonville, WV, 25360, Web site: <http://www.selectivemutismfoundation.org>.

Selective Mutism Group. 30 South J Street, 3A, Lake Worth, FL, 33460, Web site: <http://www.selectivemutism.org>.

Senile Dementia See *Alzheimer's Disease*.

Sepsis

Sepsis is a serious systemic infection caused by bacteria in the bloodstream.*

What Is Sepsis?

Sepsis is caused most commonly by bacteria in the bloodstream, a condition known as bacteremia (bak-tuh-REE-me-uh). These bacteria produce toxins* that provoke a response by the body's immune system. The effect of the toxins combined with the response of the immune system brings about the disease. Bacteremia may resolve by itself, or it can lead to sepsis if the bacteria are not removed by the immune system. Although bacteremia and sepsis frequently coexist, each can be present without the other. The bacteria may come from a local infection, such as pneumonia* or a urinary tract* infection, or they may come from the nose, skin, or intestines*, where bacteria live without causing problems unless they enter the bloodstream. The most common sources of infection that lead to sepsis are the lungs, skin, intestine, urinary tract, and gall bladder*.

Sepsis is most dangerous to people with weak immune systems, such as infants, the elderly, people with HIV/AIDS or cancer, or those who have undergone organ transplantation. In infants younger than three months, any fever may be a sign of sepsis or another serious infection. Doctors advise immediate evaluation of these infants and prompt treatment with antibiotics if sepsis is suspected. Group B streptococcus (strep-tuh-KAH-kus) bacteria passed from mother to baby during birth are a major cause of sepsis in infants. *Streptococcus pneumoniae* (strep-tuh-KAH-kus nu-MO-nye) and *Neisseria meningitidis* (nye-SEER-e-uh mehnin-JIH-tih-dis) bacteria are associated with sepsis in older children and in adults. Sepsis in adults most often is seen after surgery or some other medical procedure in the hospital, but it may occur outside the hospital, particularly associated with urinary tract infection.

How Common Is Sepsis?

Sepsis is not very common. According to the National Library of Medicine, sepsis develops in about 2 of every 10,000 people in the general population. In infants, sepsis occurs in fewer than 1 to 2 per 1,000 live births. Sepsis is a complication in about two of every 100 hospitalizations, where related intravenous (IV) lines, surgical wounds or drains, and bedsores* can be entry points for bacteria.

Is Sepsis Contagious?

Sepsis itself is not contagious, but the infectious agents that can cause sepsis can be transmitted from person to person. For example, in newborns, group B streptococcus organisms can spread from mother to baby during delivery.

What Are the Signs and Symptoms of Sepsis?

Early symptoms of sepsis may include fever, shaking chills, rapid breathing and heartbeat, confusion, delirium*, and rash. As the infection spreads, a person's blood pressure drops, leading to a condition known as shock*. Body organs that have important functions, including the liver, lungs, and

* **toxins** are substances that cause harm to the body.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **urinary tract** (YOOR-ih-nair-e TRAKT) is the system of organs and channels that makes urine and removes it from the body. It consists of the urethra, bladder, ureters, and kidneys.

* **intestines** are the muscular tubes that food passes through during digestion after it exits the stomach.

* **gall bladder** is a small pear-shaped organ on the right side of the abdomen that stores bile, a liquid that helps the body digest fat.

* **bedsores** also called pressure sores, are skin sores caused by prolonged pressure on the skin and typically are seen in people who are confined by illness or paralysis to beds or wheelchairs.

* **delirium** (dih-LEER-e-um) is a condition in which a person is confused, is unable to think clearly, and has a reduced level of consciousness.

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

- * **clotting** is the body's way of thickening blood to stop bleeding.
- * **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.
- * **dialysis** (dye-AL-uh-sis) is a process that removes waste, toxins (poisons), and extra fluid from the blood. Usually dialysis is done when a person's kidneys are unable to perform these functions normally.
- * **respiratory failure** is a condition in which breathing and oxygen delivery to the body are dangerously altered. This may result from infection, nerve or muscle damage, poisoning, or other causes.
- * **septic shock** is shock due to overwhelming infection and is characterized by decreased blood pressure, internal bleeding, heart failure, and, in some cases, death.
- * **catheters** (KAH-thuh-ters) are small plastic tubes placed through a body opening into an organ (such as the bladder) or through the skin directly into a blood vessel. They are used to give fluids to or drain fluids from a person.
- * **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.
- * **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.

kidneys, may begin to shut down. The blood-clotting* system may also be affected. Sepsis in young children may be more difficult to diagnose at first because it has fewer obvious symptoms. Children may have a fever or changing temperature, a change in heart rate, or difficulty breathing. They might also be irritable or sluggish, and they may lose interest in eating.

How Do Doctors Make the Diagnosis?

A diagnosis of sepsis is made based on a person's symptoms. Blood tests are performed to identify the bacteria and to look for a low platelet* count (an indicator of the blood-clotting problems seen with sepsis) and an abnormally low or high white blood cell count (both can occur with sepsis). Other tests can help show damage to vital organs, such as the kidneys.

Can Sepsis Be Treated?

As soon as a diagnosis of sepsis is suspected, treatment with intravenous antibiotics begins. Patients with sepsis are hospitalized in an intensive care unit, where they may be given oxygen, intravenous fluids, and medication to stabilize blood pressure, treat other symptoms, and kill the bacteria responsible for the condition. Dialysis* may be necessary if the patient's kidneys fail. If respiratory failure* occurs, patients usually are placed on a respirator, a machine that aids their breathing until they can breathe again on their own. If the patient survives, recovery from sepsis can take weeks.

What Are the Complications of Sepsis?

Septic shock* may occur in patients with sepsis. Disseminated intravascular coagulation is a complication associated with sepsis in which the body's blood-clotting system is out of control, a problem that can lead to serious internal bleeding. This complication usually improves when the cause of sepsis is treated. Sepsis can be fatal, depending on the infectious agent and on the age and overall health of the patient. Quick diagnosis and treatment can improve outcomes and save lives.

How Is Sepsis Prevented?

Sepsis may not be preventable in many cases, but an early response to symptoms may stop a bacterial infection from progressing to sepsis. Early treatment is particularly important with regard to people with weak immune systems. Among hospitalized patients, efforts are made to limit the use of intravenous and urinary catheters*, which are both common entry points for sepsis-causing bacteria. Following a recommended vaccination* schedule for children can lessen their risk of contracting certain infections that might lead to sepsis. Immunization against *Streptococcus pneumoniae* is recommended for infants and for adults and children at high risk due to age or medical problems. This vaccine is highly effective in preventing pneumonia and sepsis caused by this organism.

Pregnant women typically are tested to determine whether they are carrying group B streptococcus bacteria in their vagina*. Treating these

women with antibiotics during pregnancy may reduce the risk of passing the bacterium from mother to child. People with medical conditions, such as sickle-cell disease*, that put them at greater risk for developing serious bacterial infections are prescribed antibiotics to decrease the chance that sepsis can develop.

▶ See also **Pneumonia • Skin and Soft Tissue Infections • Streptococcal Infections • Urinary Tract Infections**

Resources

Organizations

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905, Web site: <http://www.mayoclinic.com/health/sepsis/DS01004>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/sepsis.html>.

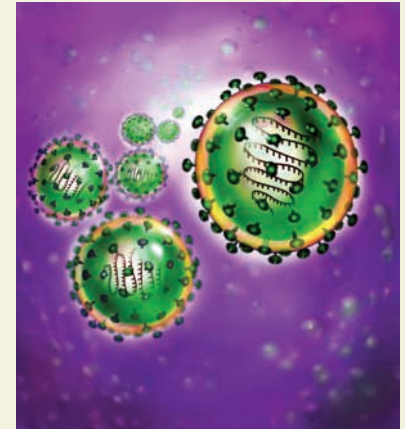
Severe Acute Respiratory Syndrome (SARS)

Severe acute respiratory syndrome* (SARS) is a highly contagious*, potentially life-threatening respiratory illness caused by a coronavirus, which is a member of a family of viruses that includes the causative agents of numerous animal and human diseases, including SARS and the common cold.*

What Is Severe Acute Respiratory Syndrome?

SARS, caused by the SARS-associated coronavirus (SARS-CoV), was the first newly emerging disease of the 21st century. It appeared in southeastern China in November 2002 and spread with lightning speed to every continent before it was contained just a few months later. It raised alarms among health officials and the general public because it underscored how rapidly a new infectious disease could spread around the world, potentially causing a pandemic*. Although SARS subsequently disappeared, it left a legacy of fear and severe economic consequences.

Coronaviruses are a group of viruses* so-named because they appear to be surrounded by a halo or corona when viewed under an electron microscope. They are large viruses carrying single-stranded RNA* as their genetic* material. In animals coronaviruses can cause serious respiratory, gastrointestinal*, liver*, and neurological* disease. However, in humans coronaviruses normally cause only mild-to-moderate upper respiratory



▲ Illustration of the SARS virus. The membrane and protein envelope (violet) surround a genome of single stranded RNA. The entire virus is surrounded by glycoproteins (orange) that suggest a corona or crown. *Jim Dowdalls/Photo Researchers, Inc.*

* **sickle-cell disease** is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.

* **respiratory** (RES-pi-ra-tor-ee) refers to the breathing passages and lungs.

* **syndrome** is a group or pattern of symptoms or signs that occur together.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

* **pandemic** (pan-DEH-mik) is a worldwide outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual.

* **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. A virus can only reproduce within the cells it infects.

- * **RNA** or ribonucleic acid (ry-bo-nyoo-KLAY-ik AH-sid), is the chemical substance through which DNA sends genetic information to build new cells.
- * **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.
- * **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.
- * **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- * **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.
- * **mammals** are warm-blooded animals with backbones, who usually have fur or hair. Female mammals secrete milk from mammary glands to feed their young. Humans are mammals.
- * **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.
- * **respiratory failure** is a condition in which breathing and oxygen delivery to the body are dangerously altered. This may result from infection, nerve or muscle damage, poisoning, or other causes.

WHERE DID SEVERE ACUTE RESPIRATORY SYNDROME COME FROM?

Within weeks of the first recognized SARS cases, scientists had identified a coronavirus as the causative agent and immediately guessed that it was an animal virus that had crossed over to infect humans. Palm civets—small Asian weasel-like mammals*—were the suspected culprit. Civets are considered a delicacy in southern China and are commonly sold in live-food markets and restaurants. Early SARS victims included a waitress at a restaurant in Guangzhou, China, that served palm civet and a customer seated close to the restaurant's animal cages. SARS-CoV was subsequently found in other animals, including domestic cats, and bats were identified as a natural reservoir for SARS-like coronaviruses. Researchers eventually came to believe that the epidemic* SARS strain evolved through a series of transmission events between humans and palm civets in Chinese markets.

tract infections such as the common cold. Therefore, health officials were taken by surprise when the death toll from the first wave of SARS approached 15 percent and exceeded 50 percent in patients over age 65. Respiratory failure* is the most common cause of death from SARS; however, heart failure* or liver failure are also potential complications.

How Common Is Severe Acute Respiratory Syndrome?

According to the World Health Organization (WHO), 8,098 people became ill with SARS during the 2003 outbreak and 774 of them died. However, scientists believe that some of the cases originally diagnosed as SARS may actually have been avian influenza* or bird flu, a potentially far more deadly disease. Most of the early victims were healthcare workers or family members of SARS patients.

In the United States, only eight people were diagnosed with confirmed SARS, all of whom had traveled to regions of the world where SARS was being transmitted. There were no SARS-related deaths in the United States.

A second outbreak of a milder strain of SARS-CoV, which occurred in December 2003 and January 2004, resulted in only four diagnosed cases. Nine cases in March and May 2004 were traced to laboratory accidents in China, Hong Kong, and Singapore. By late 2004, SARS had seemingly disappeared, almost as quickly as it had emerged.

How Is Severe Acute Respiratory Syndrome Spread?

Like most other respiratory infections, SARS is spread primarily by close person-to-person contact, in the droplets produced when an infected person talks, coughs, or sneezes. Droplets can be propelled up to about three

HOW DID SEVERE ACUTE RESPIRATORY SYNDROME MOVE AROUND THE WORLD?

In November 2002 a farmer in the Pearl Delta region of Guangdong province in southeastern China died of an undiagnosed illness. On November 27, 2002, Canada's Global Public Health Intelligence Network picked up Internet reports of a flu outbreak in China and forwarded the reports to WHO. However, the Chinese government restricted media coverage and did not inform WHO of the outbreak until February 2003.

On February 21, 2003, a Chinese doctor who had been treating patients in a Guangdong hospital checked into the Metropole Hotel in Hong Kong. On February 26, Johnny Chen, an American businessman living in Shanghai, stayed at the Metropole before catching a flight to Singapore. When he became ill on the airplane, the flight was diverted to Hanoi, Vietnam. There Carlo Urbani, an Italian WHO physician, identified Chen's illness as a new disease. Chen died of SARS after transmitting the virus to hospital workers in Hanoi. Urbani died of SARS on March 29, at the age of 46. About 80 percent of SARS cases in Hong Kong were eventually traced back to the Chinese doctor. Within a few weeks travelers who had stayed at the Metropole in February unwittingly spread the virus to Singapore, Taiwan, Europe, Africa, and North and South America.

Outside Asia, Toronto, Canada, was the city most affected by SARS. A Canadian woman died of SARS shortly after returning to Toronto from Hong Kong. Her son entered a Toronto hospital with an illness that was later identified as SARS. While waiting 16 hours in the crowded emergency room, he infected two other people. WHO advised travelers to avoid Toronto, but on May 17, 2003, the outbreak was declared over. Then on May 23, a second larger SARS outbreak was traced to another hospital. Healthcare workers accounted for 45 percent of the 375 SARS cases eventually diagnosed in the province.

feet, encountering the mucous membranes* of another person's mouth, nose, or eyes. Droplet spread also occurs when someone touches a surface contaminated with an infected droplet and then touches their mouth, nose, or eyes. The virus is believed to survive in droplets for up to six hours. It can survive up to three hours after the droplets have dried. SARS-CoV can live in stool for up to four days and may survive for months or longer in temperatures below freezing. It is possible that SARS-CoV can also be spread through airborne particles, which travel further and remain in the air longer than droplets.

SARS is thought to be contagious only while symptoms of the illness are present. It is most contagious during the second week of illness. Susceptibility* to SARS increases with age, with children least likely to become ill.

Scientists have identified a variation in an immune system* gene that may make people much more susceptible to SARS. This variation is common in people of Southeast Asian descent, but rare in other populations.

* **heart failure** is a medical term used to describe a condition in which a damaged heart cannot pump enough blood to meet the oxygen and nutrient demands of the body. People with heart failure may find it hard to exercise due to the insufficient blood flow, but many people live a long time with heart failure.

* **influenza** (in-floo-EN-zuh), also known as the flu, is a contagious viral infection that attacks the respiratory tract, including the nose, throat, and lungs.

* **mucous membranes** (MU-kus) are the moist linings of the mouth, nose, eyes, and throat, as well as the respiratory, intestinal, and genital tracts.

* **susceptibility** (su-sep-ti-BIL-i-tee) means having less resistance to and higher risk for infection or disease.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **quarantine** is the enforced isolation (for a fixed period) of apparently well people or animals who may have been exposed to infectious disease.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

* **nausea** (NAW-zha) refers to a feeling of being sick to one's stomach or needing to vomit.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **hypoxia** (hip-AK-see-ah) is when insufficient oxygen reaches the tissues of the body.

* **oxygen** (OK-si-jen) is an odorless, colorless gas essential for the human body. It is taken in through the lungs and delivered to the body by the bloodstream.

HOW DID THE WORLD RESPOND TO SEVERE ACUTE RESPIRATORY SYNDROME?

On March 12, 2003, WHO issued a global SARS alert and travel advisories were issued. Fearing a pandemic, WHO tracked and reported the disease daily until June 7, 2003. Schools were closed throughout Hong Kong and Singapore and national economies were disrupted. International cooperation and quarantine* resulted in rapid containment of the virus.

However, China was sharply criticized for its initial response to SARS. In a letter circulated in the international news media, Jiang Yanyong, a surgeon in China's People's Liberation Army, reported that at least 100 people were being treated for SARS in Beijing hospitals. At that time Chinese authorities were asserting that there were only a handful of cases in all of China. China's leaders were forced to admit that they had given WHO false information. Jiang was hailed as a hero both in China and abroad. However, Jiang used his newfound fame to demand that Chinese leaders admit their mistakes in shooting down unarmed civilians in the 1989 Tiananmen Square pro-democracy protests. Jiang was arrested. In 2007 the New York Academy of Sciences awarded him the Heinz R. Pagels Human Rights of Scientists Award. However, Chinese authorities denied Jiang permission to travel to the United States to accept the award.

How Do People Know They Have Severe Acute Respiratory Syndrome?

SARS causes flu-like symptoms, usually within two to seven days of becoming infected, although it can take up to ten days for symptoms to appear. The first symptom is usually a fever of at least 100.4 degrees F (38.0 degrees C). Headache, muscle pain, body aches, and chills sometimes appear 12 to 24 hours before the fever.

Other initial symptoms may include:

- Overall discomfort
- Fatigue
- Decreased appetite
- Diarrhea* and/or nausea* in 10 to 20 percent of people
- Occasionally, early mild respiratory symptoms such as a sore throat
A dry nonproductive cough develops between two and seven days after the first symptoms.

Most people with SARS develop pneumonia*. This may be accompanied by hypoxia*, in which oxygen* levels in the blood are low, leading to shortness of breath.

How Do Doctors Diagnose and Treat Severe Acute Respiratory Syndrome?

Diagnosis The symptoms of SARS are very similar to those of other acute* severe respiratory infections, such as influenza. SARS is only suspected in a patient with a fever who has recently traveled to a region where SARS has been reported or who has been in close contact with someone with SARS. A probable SARS case is one that meets the above criteria and has chest x-rays or computerized tomography* CT scans indicating atypical pneumonia or acute respiratory distress syndrome. Tests may be performed to rule out infection with other respiratory viruses or bacteria* that can cause pneumonia.

There are three laboratory tests that can confirm SARS:

- Reverse transcription polymerase chain reaction can detect the SARS-CoV genetic material in a patient's blood, stool, or nasal secretions.
- Serologic testing can detect antibodies* against SARS-CoV in a patient's blood.
- SARS-CoV can be cultured* from body tissue or fluid.

Other diagnostic tests may include:

- Pulse oximetry to measure the amount of oxygen in the blood
- Blood clotting*
- Blood chemistries to measure lactate dehydrogenase, creatine kinase, and C-reactive protein, all of which are sometimes elevated with SARS
- A complete blood count, because white blood cells and platelets* are often elevated with SARS

Treatment SARS requires immediate medical attention and hospitalization under isolation. There is no specific treatment. SARS is managed similarly to other community-acquired atypical pneumonias, with intensive, supportive medical care. About 10 to 20 percent of SARS patients require supplemental oxygen or mechanical ventilation with a respirator* due to breathing difficulties. Clinical studies have suggested that a combination of antiretroviral drugs used to treat AIDS* may prevent the most serious complications of SARS.

Can Severe Acute Respiratory Syndrome Be Prevented?

As with other infectious diseases, the best way to prevent SARS is frequent and effective hand washing with soap and water or a hand rub containing at least 60 percent alcohol. Unwashed hands should never touch the eyes, nose, or mouth.

The Centers for Disease Control (CDC) recommends that people traveling to parts of the world where SARS has been reported take the following precautions:

* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **cultured** (KUL-churd) means subjected to a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **clotting** is a process in which blood changes into a jellylike mass that stops the flow of blood.

* **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.

* **respirator** is a machine that helps people breathe when they are unable to breathe adequately on their own.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

- Be informed about SARS
- Pack a kit with first-aid and medical supplies, including an alcohol-based hand rub
- Identify healthcare resources in the region to be visited
- Have health insurance that covers medical evacuation
- Turn off the air vents located above the seats on airplanes and carry disposable towelettes to clean hands during flights
- Avoid areas such as healthcare facilities where SARS is more likely to be transmitted
- Avoid live-food markets and direct contact with wildlife in China
- Monitor one's health for 10 days after returning
- If symptoms develop within the 10-day period, a healthcare provider should be alerted of the symptoms and regions visited before the medical appointment, so that precautions can be taken

The CDC recommends that a person suspected of having SARS should take the following precautions for 10 days after the fever and respiratory symptoms disappear:

- Cover the mouth and nose with a tissue before coughing or sneezing
- Limit activities outside the home and avoid public places and public transportation
- Wash hands frequently and effectively, especially after blowing one's nose
- Wear a surgical mask around other people or have household members wear masks
- Minimize contact with other household members
- Avoid sharing utensils, towels, bedding, clothing, or other items until they have been washed with soap and hot water
- Avoid sharing food or drink with others
- Clean all household surfaces with a disinfectant while wearing disposable gloves

▶ See also **Influenza • Travel-related Infections**

Resources

Books and Articles

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Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/sars/index.htm>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/csr/sars/en>.

Sexual Development See *Puberty and Sexual Development*.

Sexual Disorders

The term “sexual disorders” refers to any problem with sexual performance or the function of sexual organs. Many of these problems have psychological or psychosomatic origins. Those with a physical or medical origin represent only a small percentage of all cases, but a substantial number. These cases occur more often than previously thought, probably due to underreporting.

A Story of Gender Identity

Bruce Reimer was born a healthy boy with an identical twin* brother (Brian) in 1965. When they were about eight months old, it was discovered that each brother had a small penis deformity that doctors assured their parents could be solved through a circumcision*. Although Brian's circumcision turned out all right, the doctor made a serious mistake with Bruce's circumcision and his penis was horribly disfigured. After several agonizing months, Reimer's parents saw a television program profiling John Money (1921–2006) of Johns Hopkins University in Baltimore, a psychologist and sexologist who posited that boys could successfully be raised as girls if the process was started early enough in life. The family went to see Money and Bruce was deemed a perfect candidate for this process. At the age of 21 months, doctors removed Bruce's testicles* and on discharge from the hospital, Bruce was renamed Brenda and raised as a girl. In the following years, Money wrote papers and gave talks, claiming that Bruce had adapted well to being female and was living a happy life.

In reality, Brenda had not adjusted and was not living a happy life. For many years, Bruce, living as Brenda, knew that there was something wrong, and he suffered with depression*. He had a terrible childhood, full of emotional trauma, not being able to keep up with the boys in sports yet embarrassed by not being like feminine girls. His relationships were marred by the lack of identity; he was in no way a typical girl in social

* **identical twins** are twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.

* **circumcision** is a surgical procedure in which the fold of skin covering the end of the penis is removed.

* **testicles** (TES-tih-kulz) are the paired male reproductive glands that produce sperm.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **estrogen** (ES-tro-jen) a steroid hormone that stimulates the development of female sexual characteristics and maintenance of the female reproductive system.

* **chromosomes** (KRO-mo-somz) are threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.

skills. He suffered in his psychosocial development, because he could not explain his core identity, his gender identity. Finally, at age 14, after threatening to commit suicide rather than return to see Dr. Money, he learned the truth from his father.

After hearing about the operation that turned him into Brenda, Bruce decided to live his life as a man. He stopped the estrogen* injections, which gave him female characteristics, and began testosterone injections to develop male sexual characteristics, and he changed his name to David. He worked from that point to regain his identity and his life. David later married but remained unhappy and he committed suicide at the age of 39.

At the twins' birth, Reimer's parents did not receive the counseling they needed, and it is probable that his medical care was incompetent, to say the least. This case, along with others, sensitized medical professionals to both the physical and psychological complications of surgically treating ambiguous genitalia.

What Are Pathophysiological Sexual Disorders?

Pathophysiological (physiological disruption of normal function) sexual disorder includes any sexual disorder that results from physical problems. The disorder can be as serious as structural deformities in the male or female sex organs. Further classification involves whether the disorder is congenital (existing from birth) or if it was acquired (shaped by a traumatic incident). Pathophysiological sexual disorders have similar symptoms to sexual dysfunction except the causes are different: Sexual dysfunction is often brought on by psychological or psychophysical (the influence of psychological factors on physical function) influences. Only 10 percent of sexual disorders are truly pathophysiological with a clear physical or medical origin. They include intersex (discrepancies between external genitals and internal sex organs) conditions, male pathophysiological sexual dysfunction, and female pathophysiological sexual dysfunction.

Intersex conditions The term “hermaphrodite” was historically used to describe individuals who had both male and female sexual characteristics. In Greek mythology, Hermes and Aphrodite mated and Hermaphrodite was born of that union, an individual who had both male and female sexual identity. The term continues in the 21st century to be used to describe certain plants and animals that have both male and female sexual organs. Regarding humans, however, in the 20th century, the term “intersex” began to be used to describe individuals who in various ways incorporate both female and male physical sexual traits.

Intersex conditions take many forms. Four basic ways these conditions can be categorized are as follows:

- a child with male sex chromosomes* who has what appears to be female genitalia
- a child with female chromosomes who has what appears to be male genitalia

- a child with partial genital characteristics of both sexes
- a child with a mosaic chromosomal scheme (presence of two genotypes in one individual from one egg) without a clear chromosomal gender

Although these four categories as such are discussed in medical literature, the cases within any one of these categories can be further classified according to the circumstances influencing their cause.

One of the common causes of intersex conditions in both males and females is congenital adrenal hyperplasia, a serious medical imbalance in which the adrenal glands either do not produce enough vital hormones or else produce too much of one. This imbalance interferes with normal development and growth in all parts of the body, including the sex organs. In males, an intersex condition can be caused if the adrenal glands* do not produce enough testosterone; in females, an intersex condition can be caused if the adrenal glands produce too much testosterone.

A fetus* with male chromosomes may appear to be female at birth if the hormonal deficiency is experienced in the first twelve weeks of gestation. If the deficiency is experienced later in the pregnancy, it may lead to the baby having an extremely small penis, a condition known as micropallus. Masculine features are influenced after birth by the testosterone produced in the testes. If the testes are missing or weak due to prenatal hormonal deficiencies, then they cannot produce enough testosterone for full functioning of the male sex characteristics. Another problem is if the male baby does not have a testosterone deficiency but is missing the capacity to produce an enzyme that enables testosterone to effectively influence sex development. Many individuals with this condition have been unknowingly raised as females until puberty* increased the level of effective testosterone. The adolescent then surprisingly takes on more masculine features.

A genetically female fetus may be exposed to male sex hormones from a variety of sources other than congenital adrenal hyperplasia. The mother may have been prescribed progesterone as a means of preventing a miscarriage*. This artificial hormone sometimes crosses the placenta and acts as testosterone on the developing fetus. Another source of exposure to male hormones is the lack of an enzyme that converts the sex hormones to estrogen, which develops the female sex organs and other gender-related characteristics. Another source of male hormones is a tumor* in the glands. On rare occasions, the tumor may produce the male sex hormones in a young female.

Male pathophysiological sexual dysfunction The most common sexual disorder in males is erectile dysfunction of the penis. This condition is most often caused by psychological problems or stress. However, there are several physical causes of the disorder, most of which are associated with aging. Although erectile dysfunction can happen to men of all ages for physical or medical reasons, about one-half of men over age 65 and three-fourths of men over age 80 report erectile dysfunction. Three

* **adrenal glands** (a-DREEN-al glands) are the pair of endocrine organs located near the kidneys.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

* **tumor** (TOO-mor) is an abnormal growth of body tissue that has no known cause or physiologic purpose. A tumor may or may not be cancerous.

- * **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- * **clot** is the process by which the body forms a thickened mass of blood cells and protein to stop bleeding.
- * **pituitary** (pih-TOO-ih-tare-e) is a small oval-shaped gland at the base of the skull that produces several hormones—substances that affect various body functions, including growth.
- * **vulva** (VUL-vuh) refers to the organs of the female genitals that are located on the outside of the body.
- * **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.
- * **Bartholin glands** (BAR-tha-lin) are two very small glands, inside the vagina, that are important for vaginal lubrication during sexual intercourse.
- * **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.
- * **fallopian tubes** (fa-LO-pee-an tubes) are the two slender tubes that connect the ovaries and the uterus in females. They carry the ova, or eggs, from the ovaries to the uterus.

main causes are: problems with the blood flow, problems with the nerves in the penile area, and problems with hormones.

The blood flow problems are of two types: not enough blood flows into the penis or the blood in the penis flows out too quickly. To sustain an erection, blood needs to engorge the penis. If the incoming blood vessels are too constricted, then not enough blood can flow into the penis to enlarge and stiffen the penis. However, if the outgoing blood vessels are not constricted enough, then blood cannot stay in the penis long enough to maintain an erection. These problems are caused by abnormalities in the blood vessels caused by previous surgery, diabetes*, blood clots*, or arteriosclerosis (hardening of the arteries).

Nerve damage in the penile area can interfere with the neurological communication that stimulates an erection in the penis. The nerve damage might be with the nerves sending the message from the brain to stimulate the functions that result in an erection. Alternatively, the damage may be in the nerves sending sensation to the brain diminishing the effects of sexual stimulation. This problem can be caused by spinal cord injuries from infection, external impact, or structural change. Other causes of penile nerve damage include diabetes, previous surgery, and nerve system irregularities.

Problems with hormones are related to failure of the testes to produce testosterone. The two hormones important for a balance leading to normal sexual functioning are testosterone and gonadotropin. Testosterone is responsible for all male sexual characteristics. Gonadotropin is produced by the pituitary* gland to stimulate production of testosterone. The presence of above average gonadotropin indicates that the testes are not producing enough testosterone. Too little testosterone and too much gonadotropin can lead to erectile dysfunction.

Female pathophysiological sexual dysfunction Dysparunia is the condition in which sexual intercourse is painful for women. As the pain is greater than any pleasure derived from sexual intercourse, a woman experiencing dysparunia is likely to avoid sexual relationships. The causes of this condition are varied, but they can be grouped according to whether the pain is felt during or after intercourse.

If the pain is felt during intercourse, it may be caused by infection to the vulva*, the vagina*, or the Bartholin glands*. Other causes include the after-effects of surgery from childbirth and congenital irregularities in the hymen (the membrane that covers the opening to the vagina) or the vaginal walls.

If the pain is felt after intercourse, its cause may be an infection of the cervix*, uterus, or fallopian tubes*. Most often these are the results of pelvic inflammatory disease caused by the sexually transmitted bacteria, chlamydia and gonorrhea. Other causes can be a pelvic tumor or internal scar tissue that forms after surgery or an infection.

Many women suffer pelvic pain and infertility due to endometriosis, a condition in which tissue cells similar to the ones lining the uterus are found outside the uterus in the abdominal cavity or in other organs.

When these cells line the ovaries or the fallopian tubes they can interfere with the normal functioning of these organs leading to infertility. Endometriosis can also be the cause of other sexual disorders.

Vaginismus, the involuntary contractions of vaginal muscles, is a symptom associated with many sexual dysfunctions. When this symptom occurs, the sexual act is interrupted as penetration becomes difficult or painful for the woman. It can be caused by current infections or by previous painful vaginal experience such as surgery or difficult childbirth. It is a natural reaction to anticipated pain of intercourse.

Vaginitis and vaginal atrophy are conditions resulting in irritation in the vagina. Vaginitis is usually the result of an infection. Vaginal atrophy is usually caused by the lack of lubrication associated with age.

Consistent irritation in the vulva area is referred to as vulvodynia. This condition occurs without warning and continues without relief. It is usually caused by damage to the nerves in that area. It usually occurs with (or is instigated by) a number of other conditions, including yeast infection, skin disorders, and diabetes. Vulvodynia can only be diagnosed by ruling out any other disorder as the cause.

Sexual arousal disorder is the condition in which a woman cannot be fully aroused to have sexual relations. It is often found to be caused by psychological conditions, such as fear of intimacy or loathing the current sex partner. However, there are several physical conditions that can lead to lack of sexual arousal. These include vaginitis, endometriosis, diabetes, or aging. If a woman knows that she has no psychological reason to reject sexual relations, she should have a health exam to determine if any medical problem could be the cause of her sexual arousal disorder.

How Common Is Pathophysiologic Sexual Dysfunction?

Most estimates of sexual dysfunction report that 43 percent of women and 31 percent of men experience some form of sexual dysfunction. However, less than 10 percent involve a physical cause. A survey of gynecologists found that when the doctor asked the patient about sexual problems, 12 percent reported a problem, presumably of a gynecological origin. Diabetes contributes to sexual dysfunction: 50 percent of men and 35 percent of women with Type 2 diabetes report trouble with sexual relations. One-half to two-thirds of patients with heart disease also experience sexual disorders. The occurrence of any intersex condition, regardless of how mild or severe, is estimated at 1 percent of all births.

How Do People Know They Have Pathophysiologic Sexual Dysfunction?

Many people live with a below average sexual drive and live relatively happy lives despite that fact. As many of the conditions of sexual disorders are not life-threatening, these people can lead normal lives without treatment. However, when individuals participating in a sexual relationship or anticipating a sexual relationship cannot function as they want, then

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

treatment may be required. Similarly, some people are comfortable in an intersex state and content to remain the way they were born. However, if it is interfering with adapting to life, these individuals may seek medical advice and consider or undergo a gender reassignment operation.

If adults with diabetes or heart disease experience a decrease in sexual desire, they may have a sexual disorder related to the medical condition. Adolescents who do not develop sexually at the same rate as their peers may suspect a sexual disorder and seek medical advice and examination.

How Do Doctors Diagnose and Treat Pathophysiologic Sexual Disorders?

The diagnosis of any sexual disorder begins with taking a medical history and performing a physical exam. The common causes of sexual disorders are tested, such as diabetes, heart disease, or gland disorders. Blood and urine tests are used to analyze the presence of hormones and to determine the chromosomal gender. Any irregularities in hormonal or chromosomal balance would indicate a disorder. The effort would be made to identify and treat any underlying medical conditions. Many times the sexual disorder disappears when treatment for the underlying condition is effective. Hormonal imbalances indicate the need for diagnosis and treatment of any disorders in the glands producing the hormone.

Diagnosis The beginning of the search for a diagnosis is a complete history and a physical exam. A hormonal imbalance in men would be recognized by feminine characteristics such as a high-pitched voice, and legs and arms might be unusually large for the patient's age. Other symptoms include physical size below average for age in muscles and sexual organs. For women, a hormonal imbalance would be recognized by a large clitoris resembling a penis and a missing or malformed vagina.

For someone suspected of having an intersex condition because the sexual organs are not clearly male or female, a series of tests should be conducted. Blood tests would reveal the chromosomal gender. Sexual organs that are not in the genital area, such as testes that have not descended, can be detected by x-rays or ultrasound* imaging of the pelvic area. Amniocentesis, which is the analysis of fluids drawn from the uterus of a pregnant woman, can indicate developmental abnormalities of the fetus and the irregular presence of sex hormones.

The diagnosis for sexual dysfunction in men and women begins with a medical history and a physical exam for general physical health. Any problems with blood flow can be identified through testing the blood pressure in the legs. Any problems with the nerves in the penile area can be detected through rectal exams, which would indicate if the nerves in that area are healthy and fully functional. Problems with hormonal imbalance can be indicated through blood tests. The nature of female sexual disorders needs to be diagnosed by focusing on the specific cause. Endometriosis is identified through a series of tests. An ultrasound of the area can present visual evidence of the effects of endometriosis. A blood

test analyzes the presence of a blood protein common in women with endometriosis. For men and women the doctor should do blood tests for specific diseases associated with sexual dysfunction.

Treatment Treatment focuses on resolving the specific complaint of patients with pathophysiological sexual disorder. Two well-known treatments are hormonal replacement therapy and sex reassignment surgery. Hormone replacement therapy involves prescribing synthetic hormones to imitate the effects of the normal hormonal levels. For men the synthetic hormone replaces testosterone; for women, the synthetic hormone replaces estrogen. For men and women, this treatment is fairly effective, but not without complications. Testosterone replacement in men is associated with liver disorders. Estrogen replacement in women contributes to higher risks of breast cancer.

Through much of the 20th century, doctors recommended sex reassignment operations at an early age, based on the assumption that young children can adapt to the reassigned sex and experience little trauma and discontinuity in development. Advocates also felt that early reassignment increased the effectiveness of parent/child bonding as the parents would know to treat the child as a member of the reassigned sex. The child would grow up knowing to accept the gender role of the reassigned sex. For this to be effective, the parents had to be strong in their decision from the start and had to continue with that decision through consistent behavior for the rest of the child's life.

Arguing for the contrary point of view is the case of David Reimer. David lived a traumatic childhood, partly because he thought he was a girl but did not feel like a girl. Once David found out that he was born male, he changed his life to live as a man, but he was unhappy and died early as a suicide. The Reimer case led to more criticism of early surgical sex reassignment for ambiguous genitalia and other physiological conditions of intersex. Critics point out that structural changes made surgically do not affect genetic composition.

Many serious studies of sex reassignment have found that most of the affected people do not adjust well. As much as possible, these individuals should be recognized by their chromosomal gender. If the chromosomal gender is clearly identified, minor operations may be done to reduce genital abnormalities. Also, if the sexual disorder is influenced by hormonal deficiencies, the doctor may recommend hormone treatments. If gender clarification surgery is necessary later in life, it should be at a time when affected individuals can have a voice in the decision making.

Complications Pathophysiological problems need a medical response. However, no matter what the cause, there are always psychological implications. The usual brain-to-body communication is interrupted through the physical disorder. The need to reestablish the connection may require psychotherapy. However, whereas most sexual disorders have a psychological component, without identifying and treating the physical cause, psychotherapy alone would not be effective.

- * **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.
- * **fallopian tubes** (fa-LO-pee-an tubes) are the two slender tubes that connect the ovaries and the uterus in females. They carry the ova, or eggs, from the ovaries to the uterus.
- * **epididymitis** (eh-pih-dih-duh-MY-tis) is a painful inflammation of the epididymis, a structure attached to the testicles.
- * **prostate** (PRAH-state) is a male reproductive gland located near where the bladder joins the urethra. The prostate produces the fluid part of semen.

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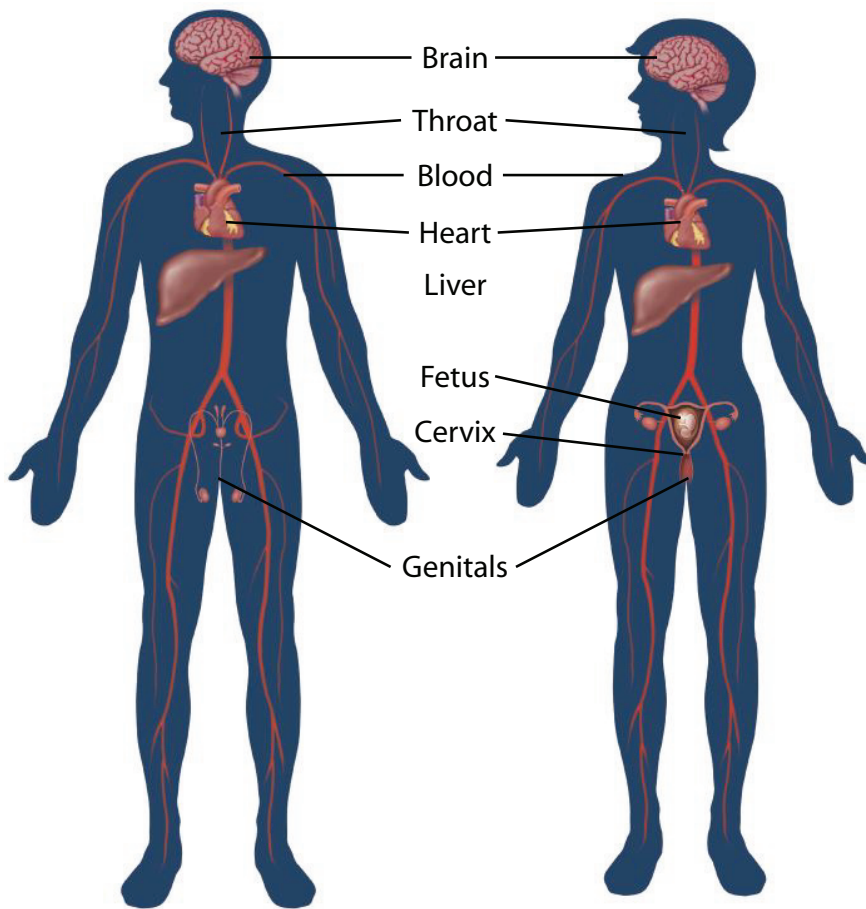
Intersex Society of North America. 979 Golf Course Drive, No. 282, Rohnert Park, CA, 94928, Web site: <http://www.isna.org>.

Sexually Transmitted Diseases (STDs)

Sexually transmitted diseases (STDs) are infections that pass from one person to another through sexual contact, which includes oral, genital, or anal intercourse.

What Are Sexually Transmitted Diseases?

STDs can be caused by bacteria, viruses, or parasites. Although the symptoms of a particular STD depend on the specific infection, many STDs cause vaginitis (vah-jih-NYE-tis), an inflammation of the vagina often accompanied by an abnormal discharge (fluid released from the body), and urethritis (yoo-ree-THRY-tis), an inflammation of the urethra (the tube through which urine passes from the bladder to the outside of the body), which can make urination painful. Several STDs can produce blisters or sores on the penis, vagina, rectum, or buttocks. In women, some STDs may spread to the cervix*, a condition called cervicitis (sir-vih-SYE-tis), or to the uterus* and fallopian tubes*, a condition known as pelvic inflammatory disease (PID). In men, STDs may spread to the testicle (causing epididymitis*) or prostate* (causing prostatitis, which is inflammation of the prostate). Sometimes, several STDs may occur in the



Sexually transmitted diseases affect many parts of the body. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

same person, and the presence of an STD can increase the risk of contracting infection with human immunodeficiency (ih-myoo-no-dih-FIH-shen-see) virus (HIV*), the virus that causes acquired immunodeficiency syndrome (AIDS), from an infected partner.

How Common Are Sexually Transmitted Diseases?

STDs are common in the United States, and medical professionals diagnose between 13 million and 15 million new cases every year. Although considerable information is available about preventing these infections and limiting their spread, the number of people infected is growing. About two-thirds of all reported cases occur in people who are younger than 25 years of age.

Are STDs Contagious?

STDs are contagious and are transmitted through sexual contact that involves vaginal, anal, or oral sex. The diseases can spread between people of the opposite sex or people of the same sex. The germs that cause many STDs move from person to person through semen (the sperm-containing whitish fluid produced by the male reproductive tract), vaginal (VAH-jih-nul) fluids, or blood. Other STDs, such as herpes and genital warts,

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).



▲ Skin abscesses caused by gonococcal infection. *Biophoto Associates/Photo Researchers, Inc.*

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

can spread by intimate skin-to-skin contact, often with the sores that the disease causes. A mother can transmit certain STDs to her baby during pregnancy or childbirth. STDs do not pass from one person to another by simply hugging, shaking hands, or sharing utensils.

What Are Some Common Sexually Transmitted Diseases?

Gonorrhea The bacterium *Neisseria gonorrhoeae* (nye-SEER-e-uh gah-no-REE-eye) causes gonorrhea (gah-nuh-REE-uh). Women who are infected may not have any symptoms. When they do, symptoms include vaginal discharge and pain during urination. Lower belly pain usually occurs when the infection has spread past the cervix and caused PID. Most men with gonorrhea have a discharge from the penis and pain during urination. Doctors prescribe antibiotics to patients with gonorrhea; the antibiotics kill the bacteria. Not infrequently, individuals with gonorrhea are also infected with Chlamydia.

Syphilis The bacterium *Treponema pallidum* (treh-puh-NEE-muh PAL-ih-dum) causes syphilis (SIH-fih-lis). Unlike many other STDs, this illness has distinct stages. In the first stage, a small, hard sore called a chancre (SHANG-ker) appears where the bacteria entered the body. In the next stage, a red or brown rash develops, sometimes on the palms of the hands and soles of the feet. In some cases, patients also may have a fever, swollen lymph nodes*, muscle aches, and headaches. If the disease goes untreated, it can progress to the third and most serious stage, when it may damage the bones, organs, and nervous system. At this point, it can result in blindness, paralysis*, dementia*, heart problems, and sometimes even death. As they do with gonorrhea, doctors can treat syphilis with antibiotics. Medical professionals reported more than 36,000 cases of syphilis in the United States in 2006, which indicates a marked increase since the beginning of the new millennium.

Herpes simplex virus Herpes simplex (HER-peeZ SIM-plex) virus causes herpes. Herpes comes in two types, one of which—type 2—usually spreads through sexual contact and causes genital herpes. In a person with genital herpes, small, painful blisters develop on the vagina, cervix, penis, buttocks, or thighs. Once infection occurs, the herpes virus remains in the body and can recur throughout a person's life. Antiviral medications may shorten outbreaks of symptoms and make them less severe, but they do not kill the virus. In the United States, an estimated 45 million people over the age of 12 have genital herpes infection.

Chlamydia Chlamydia (kla-MIH-dee-uh) results from infection with the bacterium *Chlamydia trachomatis* (kla-MIH-dee-uh truh-KO-mah-tis). In many infected people, it produces no symptoms. The most common symptoms in both men and women are discharge and pain during urination. Because infection with *Chlamydia* often goes unnoticed, it can

spread and produce other symptoms, including epididymitis in men and PID in women. The Centers for Disease Control and Prevention estimates that *Chlamydia* bacteria infect 2.8 million people in the United States each year. Medical professionals use antibiotics to treat the infection effectively.

HIV Infection with HIV damages immune system cells in the body that normally fight infections, leaving the body unable to defend itself against a variety of illnesses. A person can be infected with HIV and not have AIDS, although most people with untreated HIV infection eventually develop AIDS. The first symptoms of HIV infection are fever, muscle aches, sore throat, and, in some cases, a rash that looks somewhat like that of measles*. Other symptoms usually take much longer to appear—perhaps years—and may include rapid weight loss, recurring fever, a dry cough, night sweats, pneumonia*, white spots on the tongue or throat, long-lasting diarrhea, and skin rashes and yeast infections. A person with AIDS* may also have memory loss, depression, and extreme tiredness.

Despite significant advances in treatment, HIV infection continued in the early 2000s to be an epidemic of global proportions. The CDC estimated as of 2008 that more than one million Americans may be infected with HIV, but 25 percent of them are unaware of their infection. In the United States, estimates indicate that more than 56,000 new HIV infections occur every year. Between the early 1980s when the disease was first identified in the United States and 2008, more than 540,000 people in the United States died due to complications of AIDS. No cure for AIDS exists, but a combination of medications can help an infected person live longer and have a better quality of life.

Human papillomavirus Genital and anal warts are caused by human papillomavirus (pah-pih-LO-mah-vy-rus), or HPV, a very common virus. The warts are soft and skin-colored, and they can grow alone or in bunches on the genitals; on the skin around the genitals, rectum, or buttocks; or in the vagina or cervix. Like herpes, genital warts can reappear many times, because once this type of virus enters the body, it remains there for life. Doctors can remove genital warts by freezing, burning, or cutting them off or by coating them with medication that destroys the warts. In women, infection with HPV can affect the cells of the cervix, which may lead to cervical cancer.

Trichomoniasis A parasite causes trichomoniasis (trih-ko-mo-NYE-uh-sis), which is a very common STD. Most women with trichomoniasis have a frothy, yellow, foul-smelling vaginal discharge, along with itching and irritation in the vagina and discomfort during sex and urination. Men with this STD typically do not have symptoms; those who do have symptoms may feel irritation in the penis or a burning sensation after they urinate or ejaculate*. Medical professionals diagnose more than 2 million cases each year in the United States. Doctors use antibiotics to treat trichomoniasis.

* **measles** (ME-zuls) is a viral respiratory infection that is best known for the rash of large, flat, red blotches that appear on the arms, face, neck, and body.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **ejaculate** (e-JAH-kyoo-late) means to discharge semen from the penis.

* **vaccines** (vak-SEENS) are preparations of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

Can Sexually Transmitted Diseases Be Prevented?

The only sure way to prevent STDs is to refrain from having sexual contact with anyone. In most cases, it is impossible or very difficult to tell whether another person has an STD. People may not always tell the truth about their sexual past, or they may have an STD and not know it. For people who do have sex, the safest choices are to limit the number of sexual partners and to use latex condoms. Latex condoms lower the risk of contracting many STDs, including becoming infected with HIV. Certain STDs such as genital warts and herpes may present additional problems, because the warts or herpes blisters can be on the skin around the genitals, and condoms only protect against infection from the warts and blisters they cover. Avoiding skin-to-skin contact is the best option for preventing these kinds of STDs.

In addition, vaccines* are available against some STDs, such as hepatitis B and specific HPVs. These vaccines are most effective at the time in a person's life before he or she has engaged in any sexual contact.

▶ *See also* **AIDS and HIV Infection • Bacterial Infections • Chlamydial Infections • Fungal Infections • Genital Warts • Gonorrhea • Herpes Simplex Virus Infections • Human Papilloma Virus (HPV) • Nonspecific Urethritis • Rape • Syphilis • Trichomoniasis • Urinary Tract Infections • Viral Infections**

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- Centers for Disease Control and Prevention.** 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: <http://www.cdc.gov/std>.
- Food and Drug Administration.** 5600 Fishers Lane, Rockville, MD, 20857. Toll free: 888-INFO-FDA. Web site: <http://www.fda.gov/oashi/aids/condom.html>.
- National Institute of Allergy and Infectious Diseases.** Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-6612. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/sti>.

Shin Splints See *Strains and Sprains*.

Shingles See *Varicella (Chicken Pox) and Herpes Zoster (Shingles)*.

* **aortic aneurysm** (ay-OR-tik AN-yoo-rizm) is a weak spot in the aorta, the body's largest blood vessel. The weak spot can rupture or break, causing massive internal bleeding.

Shock

Shock is a dangerous physical condition in which the flow of blood throughout the body is drastically reduced, causing weakness, confusion, or loss of consciousness. It can result from many kinds of serious injuries and illnesses. If shock is not treated quickly, a person can suffer permanent organ damage and die.

What Is Shock?

“I studied for days, but I failed the test. I’m in shock,” says one teenager to another.

In everyday speech, the use of the word “shock” is common and sometimes even enjoyable. People line up to see horror movies because they want to be shocked. They want to feel an emotional jolt from seeing something sudden, surprising, and scary. Their hearts may beat a little faster for a moment, but when the movie ends, they are as healthy as before.

This kind of emotional shock has nothing to do with the medical condition called shock. Shock in the medical sense can also be sudden, surprising, and scary, but it is a specific physical condition that is extremely serious.

Shock occurs when the amount of blood reaching the brain and other parts of the body drops sharply. In other words, it occurs when the blood pressure falls very low. Because the blood carries oxygen needed by every cell in the body, the drop in blood flow deprives the cells of oxygen. The brain, the biggest user of oxygen, is affected, and the person becomes confused or dazed or may lose consciousness. As cells struggle to function without enough oxygen, many chemical processes in the body are disrupted. Organs, including the lungs, kidneys, liver, and heart, start to fail. Unless the blood flow is restored quickly, the damage may be fatal.

What Causes Shock?

Shock has underlying causes. Often, a case of shock involves two or all three of these types of underlying problems. They are as follows:

- The bloodstream does not contain enough fluid. This kind of shock is called hypovolemic (hy-po-vo-LEEM-ik) shock. Its causes include heavy bleeding from an injury, such as a gunshot wound or wounds suffered in a car crash, or from severe bleeding due to a medical condition, such as an aortic aneurysm* or bleeding stomach ulcers.

Electrical Shock

An electric current that passes through the body is called a shock. Although such a shock is often dangerous (electrical accidents kill about 1,000 people per year in the United States), electrical shock is different from the medical shock discussed in this entry.

Medical shock is a reduction in blood flow. Electrical shock, by contrast, primarily causes internal burns and disruption of heart rhythms. In some cases, an electrical shock can cause medical shock.

This situation occurs if the burns lead to rapid loss of fluid and the heart problems prevent adequate pumping of blood.

* **blood clot** is a thickening of the blood into a jelly-like substance that helps stop bleeding. Clotting of the blood within a blood vessel can lead to blockage of blood flow.

* **leukemia** (loo-KEE-me-uh) is a form of cancer characterized by the body's uncontrolled production of abnormal white blood cells.

* **blood transfusion** is the process of giving blood (or certain cells or chemicals found in the blood) to a person who needs it due to illness or blood loss.

It can also result if a person loses large amounts of fluids other than blood. This situation can occur, for instance, if a person has severe vomiting and diarrhea or has experienced bad burns over a large part of the body.

- The blood vessels dilate (expand) too much, which causes the blood pressure (the pressure within the blood vessels) to become so low that it cannot push along enough blood to reach vital tissues. The most common example of this kind of shock is septic (SEP-tik) shock, which results from a severe bacterial infection.
- The heart fails to pump the blood strongly enough, which is called cardiogenic (kar-dee-o-GEN-ik) shock. It can result from many heart problems, including a heart attack, an abnormal heart rhythm, a blood clot* in the heart, or a buildup of fluid around the heart that presses on the organ. Severe damage to a heart valve can also cause cardiogenic shock.

What Is Septic Shock?

Septic shock occurs when a person becomes infected with bacteria that get into the bloodstream and produce a dangerous level of toxins (poisons). Even when treated, it is sometimes fatal.

It is most common among hospitalized people who have recently had surgery or who have had drainage tubes, breathing tubes, or other devices inserted into their body. Such devices increase the chances that bacteria will get into the bloodstream.

Other people at risk for septic shock are those with weakened immune systems, including those who have diabetes, cirrhosis, leukemia*, or AIDS. Newborns and pregnant women are also at risk.

Toxic shock syndrome is a form of septic shock that experts originally linked to the use of certain tampons.

What Is Anaphylactic Shock?

Anaphylactic (an-a-fi-LAK-tik) shock is a severe allergic reaction. Depending on the individual, the trigger may be a certain medication, a blood transfusion*, a bee sting, or particular foods, such as peanuts. During anaphylactic shock, fluid leaks out from the blood vessels and the blood vessels dilate. This type of shock is sometimes fatal.

What Are the Symptoms of Shock?

Whatever its cause, people with shock have rapid and shallow breathing, cold and clammy skin, a weak but rapid pulse, low blood pressure, and weakness all over the body. They are dizzy, confused, and may become unconscious.

How Is Shock Treated?

People in shock require immediate transport by ambulance to a hospital. Until the ambulance arrives, a friend, family member, or other onlooker should take on the role of caregiver and have the person lie down on the

back with the feet raised about a foot higher than the head. This position helps get the blood flowing to the brain and heart. The caregiver should also cover the person with a coat or blankets to keep the individual warm.

Medical workers will try to raise the blood pressure by giving fluids intravenously (through a needle into a vein). If the shock was caused by blood loss, they may also start a blood transfusion. If the blood pressure still remains dangerously low, they may use drugs known as pressors to raise the blood pressure. For anaphylactic shock, medical professionals give the drug epinephrine (ep-i-NEF-rin), also called adrenaline*, to constrict (narrow) the blood vessels. For septic shock, doctors may give a drug called drotrecogin alpha, and in some cases they may prescribe corticosteroids but only at low dosage. Several studies of high-dosage corticosteroid therapy have shown it is not beneficial and may even be damaging.

Another common treatment for shock is oxygen. Medical professionals routinely administer oxygen, and in some cases they may put the patient on a ventilator (a breathing machine) to increase the amount of oxygen getting to the cells. If septic shock is suspected, they may also give intravenous antibiotics.

Once the person is out of immediate danger, doctors can try to treat the underlying cause of the shock.

How Can Shock Be Prevented?

Individuals can reduce their chances of experiencing shock by following safety rules to prevent fires and serious accidents, including car crashes. To avert bacterial infections that can cause septic shock, hospitals have rules about sterilizing equipment and washing hands. To prevent anaphylactic shock, people with allergies must take care to avoid the foods or other substances that trigger them.

▶ See also **Burns • Heart Disease • Toxic Shock Syndrome**

Resources

Organization

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/000039.html>.

Shyness See *Social Phobia (Social Anxiety Disorder)*.

Siamese Twins See *Conjoined Twins*.

* **adrenaline** (α-DREN-a-lin), also called epinephrine, (ep-e-NEF-rin), is a hormone, or chemical messenger, that is released in response to fear, anger, panic, and other emotions. It readies the body to respond to threat by increasing heart rate, breathing rate, and blood flow to the arms and legs. These and other effects prepare the body to run away or fight.

* **hemoglobin** (HE-muh-glo-bin) is the oxygen-carrying pigment of the red blood cells.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

Sickle-Cell Anemia

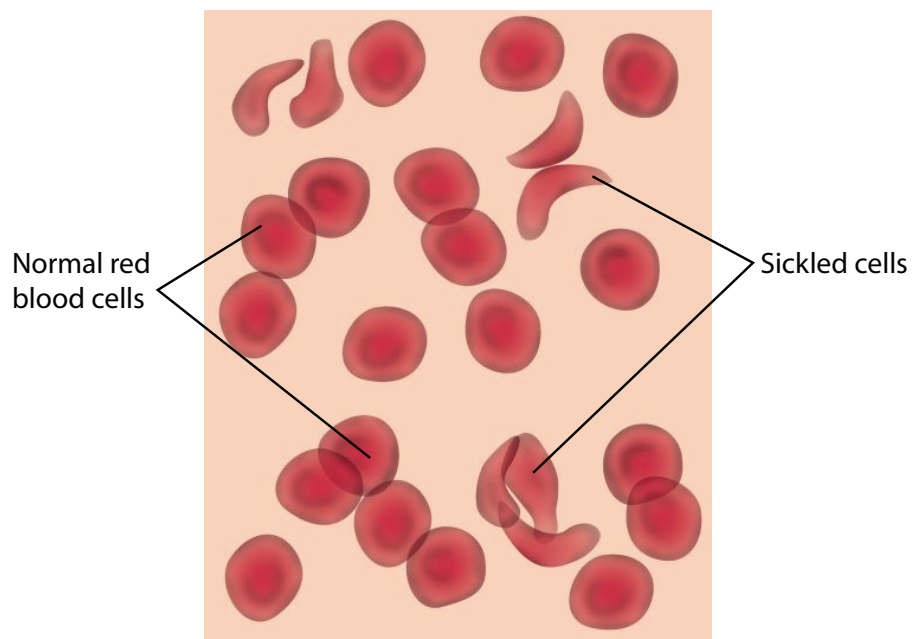
Sickle-cell anemia, also called sickle-cell disease, is a hereditary disorder in which abnormal hemoglobin within the red blood cells (RBCs) causes the cells to take on abnormal sickle (crescent) shapes. This shape decreases the ability of the hemoglobin to transport oxygen throughout the body. The sickled cells tend to bunch up and clog the blood vessels, and they tend to break apart more easily than normal RBCs, which may cause inflammation*, pain, tissue damage, and anemia*.*

What Are the Sickle-Cell Trait and Sickle-Cell Disease?

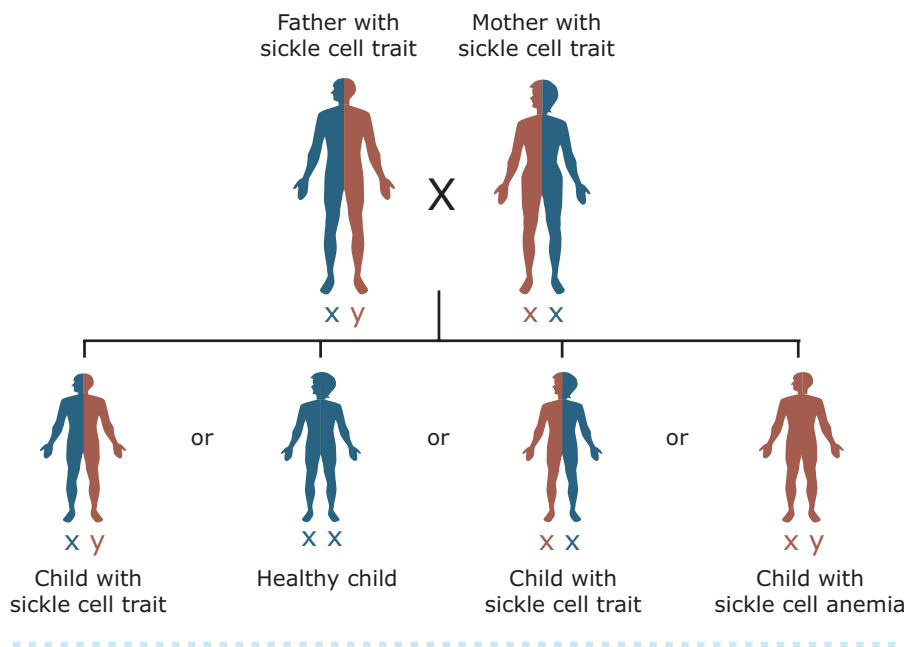
Normally, red blood cells (RBCs) are round and flat, like a saucer. They pass easily through the tiniest blood vessels. Red blood cells sickle or take on the crescent shape when they carry an abnormal form of hemoglobin called hemoglobin S. The abnormality in hemoglobin S occurs due to the presence of a faulty gene*.

People inherit one set of genes from each parent. They can inherit either two normal hemoglobin genes (HbA), one normal hemoglobin gene and one gene for the abnormal hemoglobin gene (HbS), or two abnormal HbS genes, depending on the composition of their parents' genes.

When a person carries one HbS and one HbA gene, the presence of the normal gene is sufficient to override the effects of the HbS gene so the symptoms of sickle-cell disease do not develop. These people, however,



The shape of sickled red blood cells compared to normal red blood cells.
Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



The inheritance pattern for the sickle-cell gene HbS. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



are said to have the sickle-cell trait or to be carriers of the sickle-cell trait, and they may pass it on to their children. Prospective parents who are likely to carry the HbS gene may wish to be tested for its presence and receive genetic counseling before having children.

When people inherit two abnormal HbS genes, one from each parent, they have sickle-cell disease, and they show symptoms of that disease. They have only abnormal HbS genes to pass on to their children.

Sickle-cell disease is a genetic* disorder, and its frequency varies in different populations worldwide. It is found most frequently in Africa, where in some locations up to 40 percent of the population has at least one HbS gene. The gene is also found in people in Mediterranean and Middle Eastern countries, such as Italy, Greece, and Saudi Arabia. There are groups of people in India, Latin America, the Caribbean, and the United States in which the HbS gene is also found.

Among people of African ancestry in the United States, about 8 in every 100 individuals carries at least one HbS gene (has the sickle-cell trait) and about 40,000 people carry two copies of the HbS gene and have sickle-cell disease.

What Are the Effects of Sickle-Cell Disease?

People who have sickle-cell disease get infections more frequently than other people. In 1987 the National Institutes of Health recommended that all babies, regardless of ethnic or racial background, be tested at birth for the presence of the HbS. Babies with sickle-cell disease are often given antibiotics* to prevent infections. Before this screening became common, many babies born with sickle-cell disease died in infancy. Later the use of preventive antibiotics significantly reduced the number of babies who died.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

Infants, older children, and adults with sickle-cell disease periodically experience bouts of critical illness called crises. They also suffer from complications of anemia.

Because sickle-cell disease is hereditary, people are born with it and will have it all their lives. There is no way one person can catch sickle-cell disease or sickle-cell trait from another person, and there is no way the disease can be cured.

Crises Sickle-shaped red blood cells clump more easily than normal RBCs. Sickle-cell crises start suddenly when clumping of sickled RBCs in the blood vessels obstructs the normal flow of blood, depriving various tissues and organs of oxygen. The first crises usually appear in early childhood.

Crises may be brought on by respiratory infection, by a loss of body fluids from vomiting or diarrhea, by situations in which the body's need for oxygen is increased, or they may occur for no obvious reason. They may last for several days and cause fever and sharp, intense pain in the back, abdomen, chest, arms, and legs. In infants, the hands and feet may become swollen and painful.

Crises may damage nearly any part of the body, but especially the bones, kidneys, intestines, lungs, liver, spleen, and the central nervous system*, including the brain. There may also be eye damage, stroke,

IN THE FOREFRONT OF MEDICAL SCIENCE

In 1949, Linus Pauling (1901–1994) and associates published an article in *Science* magazine (“Sickle-Cell Anemia, a Molecular Disease”). This paper explains how protein electrophoresis was used to show how sickle-cell hemoglobin differed in structure from normal hemoglobin. Hemoglobin S (sickle-cell) differs from normal adult hemoglobin (called hemoglobin A) only by a single amino acid substitution (a valine replacing a glutamine in the 6th position of the beta chain of globin).

This breakthrough concept marked the birth of molecular biology as a field of study. Medical science entered the era of molecular biology, a time in which the focus is to try to understand health and disease in terms of the structure of molecules.

In the 1970s the understanding began to grow that sickle trait conveys a survival advantage to people in malarial areas, which represented a breakthrough concept in the field of human genetics. It explained that clustering and concentration of hemoglobin S genes in certain areas of the world and constituted an example of human evolution in action.

In the 21st century, with the development of genetic engineering, it became possible to remove the gene for sickle hemoglobin from the genome of families with sickle-cell anemia so that their children will not carry the disease.

convulsions*, or paralysis. The damage is caused because the clumping of RBCs in a blood vessel deprives tissues of oxygen.

Many people with sickle-cell disease go for long periods during which they may feel relatively well and engage in most normal activities and are free of crises (in remission). Others may experience pain on a daily basis, and some need to be hospitalized as a result of crises several times per year.

Anemia Sickle cells are more easily broken down and destroyed than normal RBCs. Sickle cells have a lifespan of 10 to 20 days compared to 90 to 120 days for a normal RBC. People with sickle-cell anemia thus cannot keep up a normal level of oxygen-carrying hemoglobin in their blood. This situation exists despite the fact that they make red blood cells faster than people without the disease. The result is that they are anemic.

The anemia may become so severe that a person will need to have a blood transfusion*. The long-term effect of anemia is that the heart has to work harder to pump more blood through the body. Over time the heart enlarges, increasing the risk of heart attack and heart failure.

Other complications of sickle-cell disease People who have sickle-cell disease are more susceptible to all kinds of bacterial and fungal infections. They are more likely to have strokes* and to experience kidney failure. In some people, the liver enlarges, and by age 30, 70 percent of people with sickle-cell disease have developed gallstones.

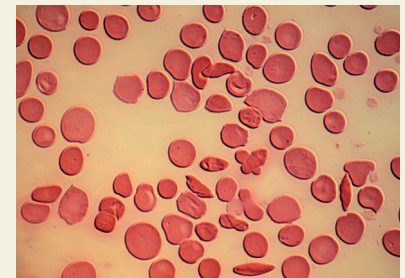
Modern medicine has increased the survival of people with sickle-cell disease. About half the people with sickle-cell disease live beyond 50 years of age. Still, living with the pain and complications of this condition can cause emotional stress on both the person with the disease and the family.

How Is Sickle-Cell Disease Diagnosed?

Sickle-cell disease and sickle-cell trait can be diagnosed by a blood test, which detects the presence of HbS and other abnormal hemoglobins. A complete blood count (CBC) counts the number of RBCs and checks for abnormal shapes.

How Is Sickle-Cell Disease Treated?

There is no cure for sickle-cell anemia. Much treatment is preventive and directed toward symptoms. Antibiotics may be given to prevent infections. Fluid intake is important to prevent dehydration*, a major cause of sickling. Folic acid may be given daily to lessen the anemia by helping to make new red cells. Children are given a complete set of immunizations. Lifestyle habits that can help sickle-cell patients stay healthy and have fewer crises include drinking plenty of water, avoiding extremes of heat and cold, avoiding stress and overexertion, getting enough sleep, and having regular medical check-ups.



Both normal red blood cells and deformed cells can be seen in this sample of blood taken from a person with sickle cell anemia. *Dr. David M. Phillips/Visuals Unlimited/Getty Images.*

A Possible Benefit of the Sickle-Cell Trait

Sickle-cell disease is especially prevalent among people of African or African American descent. No one knows for sure why this is so. However, it is believed that the gene that causes sickle-cell disease also provides natural resistance to malaria, an often-fatal disease. The parts of Africa where malaria is most prevalent, such as Ghana and Nigeria, are also the areas where the incidence of sickle-cell anemia and sickle-cell trait is greatest. It is believed that the gene that causes the sickle-cell trait gives these people some advantage in surviving malaria, which allows them to live and reproduce, thereby passing the gene along to later generations. However, people with sickle-cell disease (two copies of the HbS sickle-cell gene) do not have this advantage and are more likely to die of malaria.

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

* **blood transfusion** is the process of giving blood (or certain cells or chemicals found in the blood) to a person who needs it due to illness or blood loss.

* **strokes** are events that occur when a blood vessel bringing oxygen and nutrients to the brain bursts or becomes clogged by a blood clot or other particle. As a result, nerve cells in the affected area of the brain cannot function properly.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **bone marrow** is the soft tissue inside bones where blood cells are made.

Treatment in a sickle-cell crisis may require oxygen therapy, pain relieving medications, antibiotics, and intravenous fluids to offset dehydration. Blood transfusions may also have to be performed. Treatment of pain is a major concern. The benefits of different pain relievers and their unwanted side effects must be balanced for each patient.

Research is ongoing to find better ways to treat people with sickle-cell disease. Some of these research efforts are directed at stimulating the production of fetal hemoglobin, a form of hemoglobin found in infants, even those with sickle-cell disease. Other research is directed toward the development of drugs that block dehydration in cells. Gene therapy and the transplantation of healthy bone marrow* that makes normal red blood cells are also under investigation.

▶ See also **Anemia, Bleeding, and Clotting • Genetic Diseases**

Resources

Books and Articles

Jones, Phill. *Sickle Cell Disease*. New York: Chelsea House, 2008.

Peak, Lizabeth. *Sickle Cell Disease*. Detroit, MI: Lucent Books, 2008.

Peterson, Judy Monroe. *Sickle Cell Anemia*. New York: Rosen, 2009.

Silverstein, Alvin, Virginia Silverstein, and Laura Silverstein Nunn. *The Sickle Cell Anemia Update*. Berkeley Heights, NJ: Enslow, 2006.

Organizations

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: http://www.nhlbi.nih.gov/health/dci/Diseases/Sca/SCA_WhatIs.html.

Sickle-Cell Disease Association of America. 200 Corporate Pointe, Suite 495, Culver City, CA, 90230-7633. Toll free: 800-421-8453. Web site: <http://www.sicklecelldisease.org>.

Sickle Cell Information Center. Grady Memorial Hospital, P.O. Box 109, Atlanta, GA, 30303, Web site: <http://www.scinfo.org>.

SIDS See *Sudden Infant Death Syndrome*.

Silicosis See *Pneumoconiosis*.

Sinusitis

Sinusitis (sy-nyoo-SY-tis) is an inflammation of the sinuses (SY-nuh-ses), the hollow chambers or cavities located in the bones of the face that surround the nose.

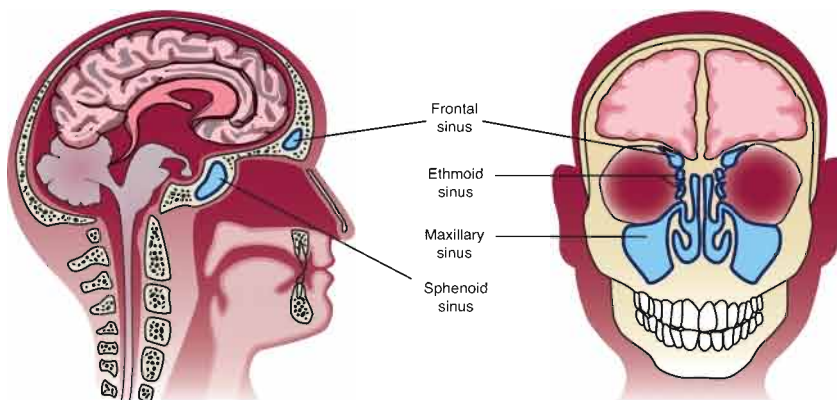
What Causes Sinusitis?

People have four pairs of paranasal sinuses (the sinuses surrounding the nose):

- Frontal sinuses, located in the forehead and over the eyebrows
- Ethmoid (ETH-moyd) sinuses, located between the eyes at the bridge of the nose
- Sphenoid (SFEE-noyd) sinuses, located behind the ethmoid sinuses
- Maxillary (MAX-ih-lary) sinuses, located in the cheekbones

The sinuses and the narrow tube-like structures that link them to the nasal passages are lined with the same mucous membranes* that line the nose. Colds, allergies*, and exposure to some chemicals can cause swelling and inflammation in the lining of the sinus passages and block sinus drainage. Bacteria* (such as *Streptococcus pneumoniae*, strep-tuh-KAH-kus nu-MO-nye), viruses*, and fungi* that live in the body may become trapped, multiply, and invade the inflamed sinuses.

People with allergies, asthma*, and cystic fibrosis* are more likely to have sinus infections. Other candidates for sinusitis are people with a weakened immune system, such as those who have AIDS* or cancer; people with narrow sinus passages or with growths or blockages in the nasal area, such as tumors* or polyps*; and people with previously broken or deformed nasal bones. The risk of sinusitis also is higher when people swim or dive, due to the pressure this activity puts on the sinus cavities.



- * **mucous membranes** are the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.
- * **allergies** (AL-uhr-jeez) are immune system-related sensitivities to certain substances, for example, cat dander or the pollen of certain plants, that cause various reactions, such as sneezing, runny nose, wheezing, or swollen, itchy patches on the skin, called hives.
- * **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.
- * **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. A virus can only reproduce within the cells it infects.
- * **fungi** (FUNG-eye) are microorganisms that can grow in or on the body, causing infections of internal organs or of the skin, hair, and nails.
- * **asthma** (AZ-mah) is a condition in which the airways of the lungs repeatedly become narrowed and inflamed, causing breathing difficulty.
- * **cystic fibrosis** (SIS-tik fy-BRO-sis) is a disease that causes the body to produce thick mucus that clogs passages in many of the body's organs, including the lungs.

◀ The four pairs of paranasal sinuses in the human skull. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



On the right side of this x-ray is an example of the inflammation associated with sinusitis. If the patient's sinusitis is severe, the doctor may recommend surgery to help drain the sinus cavities. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **polyps** (PAH-lips) are bumps or growths usually on the lining or surface of a body part (such as the nose or intestine). Their size can range from tiny to large enough to cause pain or obstruction. They may be harmless, but they also may be cancerous.

* **acute** describes an infection or other illness that comes on suddenly and usually does not last very long.

What Are Different Types of Sinusitis?

Physicians classify sinusitis in three ways:

- Acute* sinusitis often develops after a person has had a cold, with symptoms lasting less than three weeks.
- Chronic* sinusitis can last three to eight weeks or longer. It often occurs in people who have allergies or asthma.
- Recurrent sinusitis consists of several acute episodes of sinusitis in one year.

How Common Is Sinusitis?

The National Institute of Allergy and Infectious Diseases estimates that every year 37 million people in the United States have sinusitis.

Is Sinusitis Contagious?

No one can catch a sinus infection from another person, but the viruses and bacteria that cause colds and other respiratory tract* infections that can trigger sinusitis may spread from person to person in drops of fluid from the nose or mouth. When people who have sinusitis cough, sneeze, laugh, or talk, they can transmit germs to their hands, to the surfaces around them, and into the air. Others can then breathe in the germs or touch contaminated surfaces with their hands and spread the germs to their noses and mouths. Such infections sometimes develop into sinusitis.

What Are the Symptoms of Sinusitis?

Symptoms of a cold (runny nose and low fever) often give way to pain and pressure in the sinuses, which are usually the first signs of sinusitis. Other symptoms of sinusitis include pain or puffiness around the eyes; a bad-smelling, yellow-green discharge from the nose; bad breath; a headache in the morning; aching in the upper jaw and the back teeth; weakness or extreme tiredness; and coughing, especially at night. People with sinusitis occasionally develop earaches, neck pain, or a sore throat caused by mucus* draining into the throat.

Some other conditions have similar symptoms to sinusitis, but they are not the same condition. Many people confuse nasal congestion with sinusitis. In addition, considerable confusion exists about people call "sinus headaches," and some studies have indicated that up to 90 percent of these headaches are actually not related to the sinuses.

How Is Sinusitis Diagnosed?

To diagnose sinusitis, doctors look for the signs and symptoms of the condition in the patient. They suspect sinusitis if a patient has cold symptoms that last for more than 10 days, or if the patient has other sinusitis symptoms. A doctor may, for example, tap the patient's face to determine if sinuses are tender. If a patient has complicated or repeated cases of sinusitis, a doctor may order x-rays or a computerized tomography* (CT) scan to determine whether the sinuses are inflamed.

How Is Sinusitis Treated?

Bacterial sinusitis usually clears up after treatment with antibiotics. Most cases of acute sinusitis, however, result from viruses. Because antibiotics have no effect on viruses, the initial treatment of acute sinusitis generally does not involve antibiotics. Rather, it includes decongestants and pain medications. However, some patients still demand antibiotics. Such overuse of antibiotics is ill-advised because it can contribute significantly to antibiotic resistance*. Medical professionals typically only consider antibiotic use in treating acute sinusitis if the patient has no improvement in 48 hours after using decongestants and pain medications.

Beyond these treatments, individuals can try to relieve the symptoms of sinusitis in several ways. They can take acetaminophen* to help ease the pain and use nonprescription decongestants (dee-kon-JES-tents), taken by mouth or in sprays, to lessen stuffiness. Using a decongestant nasal spray for more than a few days, however, may itself cause swelling of the sinuses and slow recovery. Saline or salt sprays may also reduce swelling in the sinuses. Some patients find relief by placing a warm compress over the infected sinuses, using a steam vaporizer*, or sitting in a warm, steamy bathroom. Doctors may prescribe special nasal sprays or oral (by mouth) medications for people with chronic sinusitis who have allergies that contribute to the infection. Chronic sinusitis sufferers often benefit from sinus irrigation or flushing, and many different devices are available for this purpose. For chronic or recurrent sinusitis, doctors may refer the patient to an ear, nose, and throat specialist.

In some cases, people with severe chronic sinusitis may undergo surgery to enlarge their sinus passages, to remove a polyp, or to fix a deviated septum* that might be blocking sinus drainage.

Does Sinusitis Have Complications?

Complications of sinusitis are rare, but they do occur. Sinusitis can cause osteomyelitis* when the infection from the sinus spreads into the bones of the face or skull. Sinusitis can also lead to an infection of brain tissue or meningitis (inflammation of the meninges*). In addition, a sinus infection can spread to invade the tissues surrounding the eyes.

Can Sinusitis Be Prevented?

Because no practical way exists to prevent all colds or to eliminate all allergies, sinusitis is not entirely preventable. People can limit their exposure to the viruses and bacteria that cause the infections by washing their hands thoroughly and frequently, and by only using their own, rather than sharing, eating or drinking utensils. Individuals should also avoid smoking as well as exposure to tobacco smoke to help limit the risk of sinusitis. People with allergies should avoid whatever triggers their allergy symptoms and control their allergies with the treatment recommended by their doctors. Drinking plenty of fluids and keeping the air in the house moist by using a vaporizer can help thin mucus and prevent its buildup in

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **respiratory tract** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

* **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many x-rays of the body to create a three-dimensional picture.

* **antibiotic resistance** occurs when bacteria evolve to withstand attack by antibiotics.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **vaporizer** is a device that converts water (or a liquid medication) into a vapor, a suspension of tiny droplets that hang in the air and can be inhaled.

* **deviated septum** is a condition in which the wall of tissue between the nasal passages, the septum, divides the passageways unevenly, sometimes causing breathing difficulties and blockage of sinus drainage.

* **osteomyelitis** (ah-stee-o-my-uh-LYE-tis) is a bone infection that is usually caused by bacteria. It can involve any bone in the body, but it most commonly affects the long bones in the arms and legs.

* **meninges** (meh-NIN-jeez) are the membranes that enclose and protect the brain and the spinal cord.

* **congenital** (kon-JEH-nih-tul)
means present at birth.

the sinuses. Limiting alcohol consumption also may help, because alcohol can cause nasal membranes to swell. In addition, air travel and underwater diving can cause significant discomfort in individuals with acute or chronic sinusitis, so they may consider using decongestants prior to these activities.

▶ See also **Antibiotic Resistance • Common Cold • Fever • Headache • Infection • Influenza • Osteomyelitis**

Resources

Books and Articles

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Hirsch, Alan R. *What Your Doctor May Not Tell You about Sinusitis: Relieve Your Symptoms and Identify the Real Source of Your Pain*. New York: Warner Books, 2004.

Wynn, Rhoda, and Winston C. Vaughan. *100 Questions & Answers about Sinusitis and Other Sinus Diseases*. Sudbury, MA: Jones and Bartlett, 2008.

Organizations

American Academy of Otolaryngology, Head and Neck Surgery. 1650 Diagonal Road, Alexandria, VA, 22314-2857. Telephone: 703-836-4444. Web site: <http://www.entnet.org>.

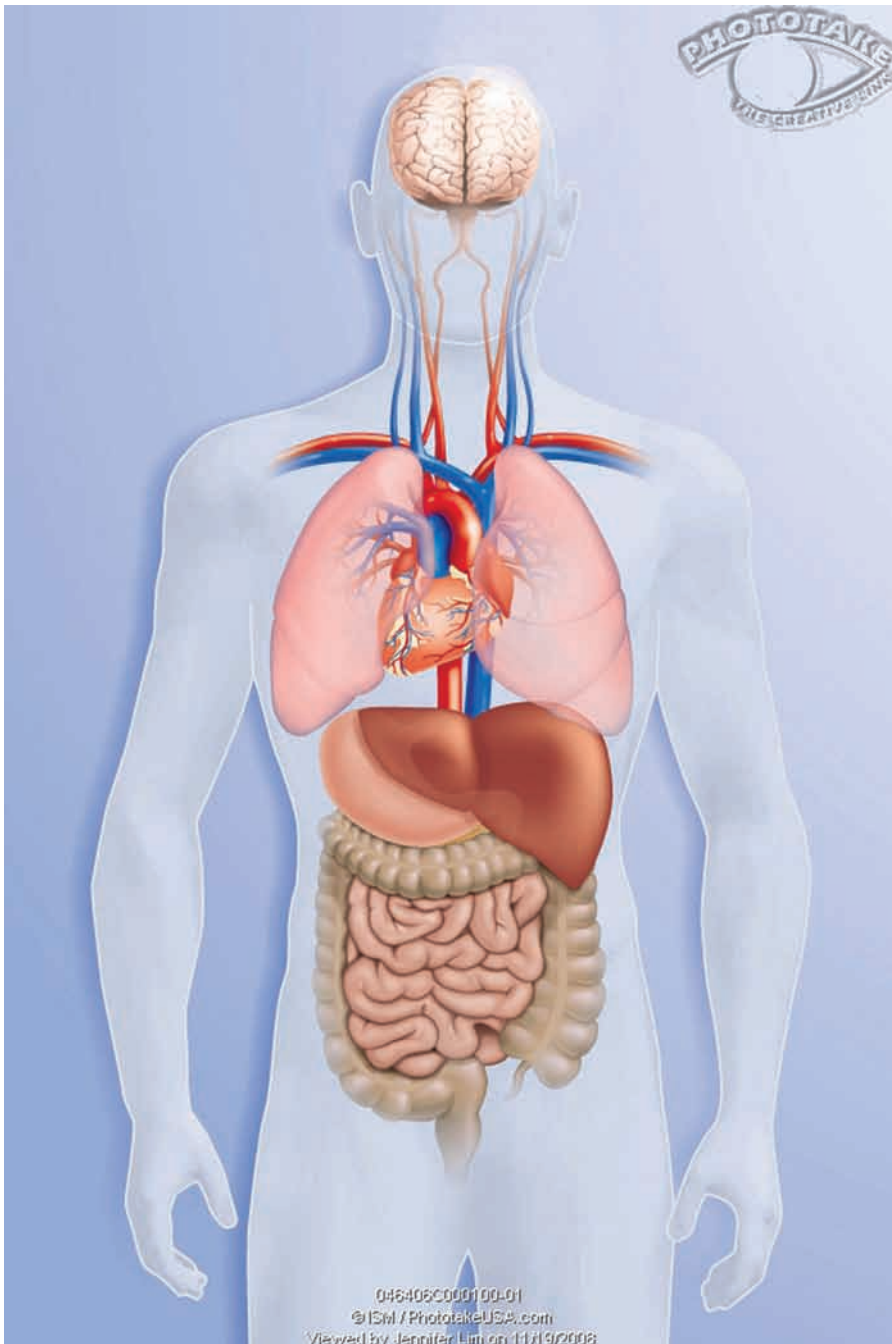
American Rhinologic Society. P.O. Box 495, Warwick, NY, 10990-0495. Telephone: 845-988-1631. Web site: <http://www.american-rhinologic.org/patientinfo.phtml>.

Medical College of Wisconsin. 8701 Watertown Plank Road, Milwaukee, WI, 53226, Web site: <http://healthlink.mcw.edu/article/924452495.html>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC, 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/sinusitis>.

Situs Inversus

Situs inversus (SI-tus in-VER-sus) is a congenital condition in which major organs in the body are in reversed or mirrored position.*



A total visceral inversion (situs inversus) where the visceral organs are reversed—the heart is on the right, the liver is on the left, etc. ©ISM/Phototake. *Reproduced by permission.*



Marlowe's Story

Marlowe was a normal, happy girl of 18. Suddenly, she started to experience diffuse pain under and around her belly button (navel or umbilicus). Over the next few hours, the pain became worse and started to move to the left side of Marlowe's abdomen. When the pain continued to worsen, she called her family doctor to ask for advice. The doctor was initially stumped but then remembered a comment from his anatomy class in medical school.

- * **dextrocardia** mirror image rotation that is confined to the heart.
- * **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.
- * **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.
- * **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.
- * **appendicitis** (ah-pen-dih-SY-tis) is an inflammation of the appendix, the narrow, finger-shaped organ that branches off the part of the large intestine in the lower right side of the abdomen.
- * **appendix** (ah-PEN-diks) is the narrow, finger-shaped organ that branches off the part of the large intestine in the lower right side of the abdomen. Although the organ is not known to have any vital function, the tissue of the appendix is populated by cells of the immune system.

The doctor told Marlowe to report to the hospital for an examination. The doctor made two diagnoses: appendicitis and situs inversus.

What Is Situs Inversus?

The normal position of internal organs of the thorax (THOR-ax) and abdomen (AB-do-men) is known as situs solitus (SI-tus so-LEE-tus). Situs inversus is a congenital condition in which some or all of the major organs of the thorax and abdomen are in reversed or mirrored positions compared to normal. The prevalence of situs inversus is less than one in 10,000 people. It is usually an autosomal recessive disorder, although cases of X-linked transmission have been described.

Problems with rotation or mirrored position of body organs have been known for several centuries. A variant of situs inversus dextrocardia* (the heart is positioned on the right side of the thorax) was first described in the 17th century. Full or complete situs inversus (totalis) was first described by the Scottish physician Matthew Baillie at the end of the 18th century.

In situs inversus totalis, all major organs are positioned as the exact mirror opposite to the usual location. The heart is located on the right side of the thorax, the liver is on the left side of the abdomen, whereas the stomach and spleen are on the right side. In situs inversus the right lung has two lobes, and the left lung has three lobes (the exact opposite of normal). In addition, all of the blood vessels, intestines, nerves, and lymph vessels are transposed. If all these organs are transposed as described, and in the absence of any congenital heart defects, no functional problems should be present in affected individuals. Individuals with situs inversus can live normal lives.

However, when there is dextrocardia without situs inversus, or situs inversus with levocardia (mirror image rotation of the heart in which the direction of rotation is opposite that of normal cardiac development), there is a much higher rate of significant congenital cardiac abnormalities. Many people with complete situs inversus are not aware of their unusual anatomy. The condition is often discovered during an unrelated medical examination.

Situs inversus is often discovered accidentally by a radiologist evaluating an x-ray, CT scan*, MRI* image or an image produced by ultrasound*. It is also discovered by a physician making a diagnosis in which the bodily position of the problem does not match with the doctor's expectation. Marlowe had appendicitis*. Normally, the appendix* is in the right lower portion of a person's abdomen. The normal pattern of pain associated with appendicitis is to become localized in the appendix. Marlowe's history was consistent with appendicitis. The explanation for the incorrect position is that Marlowe also has situs inversus.

On an x-ray of the large intestine, the cecum (initial portion of the large intestine) is on the left side instead of the right. The ascending colon is also on the left, the descending colon is on the right, and the sigmoid colon (the final portion of the large intestine) curves to the right as it connects with the rectum.

Correct labeling of x-ray images is important. Situs inversus may be overlooked if labels are incorrectly applied by an x-ray technician. Such errors occur but they are uncommon.

Is Situs Inversus Serious?

Generally, situs inversus is not serious. As noted, situs inversus with levocardia is associated with a much higher rate of significant congenital cardiac abnormalities. People with known situs inversus should inform physicians and other medical personnel about their condition, as this will expedite medical care and prevent unnecessary confusion.

What Causes Situs Inversus?

Situs inversus results when events of twisting and folding embryonic development occur in a direction that is opposite to normal. Although the affected organs are mirror images of usual, they function in a normal manner.

Living with Situs Inversus

People with situs inversus have a normal life expectancy. When situs inversus is accompanied by anomalies involving the heart, life expectancy is reduced. The degree of reduced life expectancy depends on the severity of the defect. Not recognizing situs inversus may lead to problems during surgical procedures.

Males and females experience situs inversus in about the same proportion. It occurs with the same frequency in people of all races throughout the world.

Resources

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org>.

American Academy of Pediatrics. 141 Northwest Point Boulevard, Elk Grove Village, IL, 60007-1098. Telephone: 847-434-4000. Web site: <http://www.aap.org/default.htm>.

American College of Physicians. 190 N. Independence Mall West, Philadelphia, PA, 19106. Toll free: 800-523-1546. Web site: <http://www.acponline.org>.

Donny Osmond and Situs Inversus

Donny Osmond was not aware of his situs inversus until he had appendicitis. His doctor initially missed the diagnosis because Donny had pain on the left side of his abdomen and the appendix is normally on the right side. Like Marlowe, people with situs inversus are usually unaware of their condition until a medical problem develops but is not in its expected location.

Skin and Soft Tissue Infections

Skin and soft tissue infection is an infection involving the layers of the skin and the soft tissues directly beneath it.

- * **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. A virus can only reproduce within the cells it infects.
- * **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.
- * **fungi** (FUNG-eye) are microorganisms that can grow in or on the body, causing infections of internal organs or of the skin, hair, and nails.
- * **antifungal drugs** (an-ty-FUNG-al drugs) are medications that kill fungi.
- * **pus** is a thick, creamy fluid, usually yellow or ivory in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

What Causes Skin and Soft Tissue Infections?

Viruses*, bacteria*, and fungi* generally cause skin and soft tissue infections by entering the body at a spot where a cut, scrape, bite, or other wound has broken the skin; some infections are even the result of bacteria that normally live on the body. These infections can affect the layers of the skin or deeper tissues, such as muscle and connective tissue (the interlacing framework of tissue that forms ligaments, tendons, and other supporting structures of the body), and they may bring about symptoms in other parts of the body.

Many infections such as varicella (chicken pox) and measles (rubeola) affect the skin, but these infections involve the whole body and do not primarily arise within the skin or soft tissues.

What Are Some Types of Skin and Soft Tissue Infections?

Dermatophyte infections Dermatophytes (dur-MAH-toh-fites) are fungi that live on the dead outer layer of skin. Sometimes they can produce symptoms of infection. Tinea (TIH-nee-uh) infections, commonly called ringworm (although they have nothing to do with worms), usually are caused by the *Trichophyton* group of these organisms. They include tinea pedis (PEE-dis), or athlete's foot; tinea cruris (KRU-ris), or jock itch; tinea capitis (KAH-pih-tis), or ringworm of the scalp; tinea unguium (UN-gwee-um), or ringworm of the nails; and tinea corporis (KOR-poor-us), or ringworm of the body. Damaged skin is more vulnerable to infection, as is skin in warm, moist areas of the body. When the fungus takes hold, it typically causes a ring-like rash of red, flaking skin. The border of the rash may be raised, as if a worm were under the skin. The rash's shape and this raised edge led people to call the infection ringworm. When the nails are infected, they usually become yellow, thickened, and brittle.

Tinea versicolor, or pityriasis (pih-tih-RYE-uh-sis) versicolor, is caused by the fungus *Malassezia furfur*. Symptoms include scaly patches of skin, ranging in color from light to dark. The patches occur on the chest, neck, back, underarms, and upper arms. Hot, humid weather encourages the growth of tinea versicolor. These fungal skin infections typically are treated with antifungal creams or ointments. In severe cases or when the infections do not improve with this therapy, several antifungal* medications are available that may be given by mouth.

Impetigo Impetigo (im-pih-TEE-go) is a skin infection in which red blister-like bumps develop that contain a yellowish fluid or pus*. After the blisters break open, they crust over. Impetigo is most common on the face, especially around the nose and mouth. Usually, either streptococcus (strep-tuh-KAH-kus) or staphylococcus (stah-fih-lo-KAH-kus) bacteria are the cause of the infection. Impetigo can spread easily, especially among children, who may scratch the lesions and then touch other areas of their

skin or another person. People also can contract impetigo from handling clothing or blankets that have been in contact with infected skin.

Doctors prescribe antibiotics to treat impetigo. The infection generally clears without leaving permanent skin damage.

Skin abscesses Skin abscesses (AB-seh-sez) may occur in areas of the skin where the body has been fighting a bacterial infection. To isolate the infection, the body forms a wall of tissue around the collection of pus, and this area is the abscess. Abscesses are usually round, raised, and red, and they may feel warm and tender. A furuncle (FYOOR-ung-kul), or boil, is an abscess that forms at the base of a hair follicle*. A carbuncle (KAR-bung-kul) forms when the infection spreads to include several follicles and the surrounding skin and deeper tissues. Like furuncles, carbuncles are red, raised, and painful to the touch.

Most skin abscesses eventually burst to allow the pus to drain out, but treatment with antibiotics may be needed to clear up the infection in some cases. When a skin abscess does not improve on its own, it likely needs to be lanced (punctured and drained) by a doctor.

Cellulitis Cellulitis (sel-yoo-LYE-tis) is an inflammation of the skin and/or the tissues beneath it. The culprits behind the infection are almost always group A streptococcus or *Staphylococcus aureus* (stah-fih-lo-KAH-kus ARE-ree-us) bacteria. Cellulitis may occur in people with diabetes* or those who have immune system problems even if they do not have a skin injury. The infection can occur anywhere on the body, but it is found most frequently on the face and lower legs. It appears as tender, red, swollen areas of skin. The skin in the infected area may feel stretched and warm. A few days after the first symptoms, patients may experience fever, chills, and muscle aches. Red streaks also may appear on the skin, signaling the spread of the infection into the lymphatic vessels. Some people call these streaks “blood poisoning,” but they do not really involve the blood.

Antibiotics are used to treat cellulitis. Even after the infection is gone, the skin may look different for several weeks. Complications are rare, but they can include sepsis*, gangrene*, and lymphangitis*. Cellulitis may involve infection of deeper tissue called the fascia (FAY-she-uh). Infection in this layer can be very serious or even life threatening and often requires surgery to remove the infected tissue.

Bites Any type of bite that breaks the skin (cat, dog, human) puts an individual at very high risk of skin and soft tissue infection. Dog bites tend to be particularly damaging to the skin and underlying tissues and muscle, but cat bites and human bites have a higher rate of infection, usually occurring several days after the actual biting incident. Signs of infection include redness, swelling, warmth of the skin overlying and surrounding the wound, pain, and pus oozing from the wound. These signs can develop within several hours following a cat bite, much quicker than the usual one or two days. Rodent bites and the bites of wild animals (especially raccoons,

* **hair follicle** (FAH-lih-kul) is the skin structure from which hair develops and grows.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **sepsis** is a potentially serious spreading of infection, usually bacterial, through the bloodstream and body.

* **gangrene** (GANG-green) is the decay or death of living tissue caused by a lack of oxygen supply to the tissue and/or bacterial infection of the tissue.

* **lymphangitis** (lim-fan-JIE-tis) is inflammation of the lymphatic system, the system that carries lymph through the body. Lymph is a clear fluid that contains white blood cells.

* **rabies** (RAY-beez) is a viral infection of the central nervous system that usually is transmitted to humans by the bite of an infected animal.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

* **hepatitis** (heh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.

skunks, bats, and foxes) or domestic animals of unknown rabies* vaccine status put the bite victim at high risk of contracting the potentially fatal viral infection called rabies. In most instances, when rabies status of the biting animal cannot be confirmed, the individual is given a series of six shots to prevent the development of this life-threatening infection. A tetanus booster shot is also given to people who suffer an animal or human bite, and who have not had a tetanus booster within the previous five years. Additionally, human bites put the recipient at risk of contracting other infections, such as HIV* or hepatitis*.

Methicillin-resistant staphylococcus aureus While the staphylococcus bacterium has long been implicated in skin and soft tissues infections, a later strain that is resistant to methicillin and other antibiotics exists. Whereas in the past this type of infection tended to affect only already-ill, hospitalized patients, a later form, called community-associated methicillin-resistant staphylococcus aureus (MRSA), is of particular concern because it may be more contagious via contact between previously healthy individuals than other forms of staph infections. People who have close physical contact are vulnerable to this type of infection, which includes children in daycare or other close school settings, people participating in contact sports, prisoners, military personnel, homeless people, homosexual men, and illegal intravenous (IV) drug users. Because of the unusual destructiveness and virulence of MRSA, it is important to maintain a high level of suspicion when an infection does not respond immediately to treatment or when an infection spreads unusually rapidly. Infections caused by this type of bacteria will not respond to the usual types of antibiotics, although there are some oral antibiotics that can be effective. More severe infections require IV antibiotics. In some severe cases, a wide-excision of all infected tissue is required in order to rid the body of the organism and lower the risk for systemic spread of this virulent organism.

Necrotizing fasciitis Necrotizing fasciitis (NEH-kro-tie-zing fash-e-EYE-tis), also called flesh-eating disease, is a rare but potentially fatal disease, which can be caused by group A streptococcus bacteria infection. It affects the deeper layers of skin and tissues beneath the skin. Necrotizing fasciitis starts with sudden painful swelling and discoloration (red, purple, or bronze) of the skin. Often, the appearance of the affected skin does not reflect how far the infection has spread into the deeper layers of tissue. The disease can spread rapidly, with the infected area growing larger and darker. The ability to feel in the infected area disappears as the skin tissue dies. As the infection quickly progresses, the patient can become very ill. Early treatment with antibiotics and surgery to remove the damaged tissue is extremely important. Recovery may take several months.

Molluscum contagiosum Molluscum contagiosum (moh-LUS-kum kon-tay-jee-O-sum), caused by a virus, produces small, solid, dome-shaped bumps on the surface of the skin. They are flesh-colored and pearly with a

dimple in the center. The growths are similar to warts. Viruses cause both conditions: poxvirus in the case of molluscum contagiosum and human papillomavirus in the case of warts. Growths can be single, but they most often appear in groups on the trunk, arms, legs, and genitals*, and occasionally on the face.

The disease usually clears up by itself over several months, although new growths may arise on the skin if the virus spreads through contact with infected areas. Doctors may recommend home treatment with over-the-counter medications or removal of the growths by freezing, surgery, laser therapy, or acid treatments.

Herpes simplex virus There are two types of the herpes simplex virus (HSV): HSV-1 and HSV-2. Both can show up as skin infections. HSV-1 can cause small, clear blisters (also known as cold sores, fever blisters, or oral herpes) around the lips on the face, and HSV-2 can cause similar looking blisters in the genital area. These blisters can break and form ulcers and then crust over. When the crust falls off red spots of healing skin are seen.

There is no cure for either HSV-1 or HSV-2. As of 2009, antiviral medications could help control outbreaks of herpes virus and were used to treat genital herpes or sometimes recurrent cold sores from HSV-1.

Warts Warts are caused by human papillomavirus (pah-pih-LO-mah-vy-rus), or HPV. They can be skin-colored, pink, tan, or white, and they may appear anywhere on the body. Common warts usually are seen on the hands (especially around the nails), feet, and face, because the virus spreads most easily to those areas. Common warts are rough and raised, but plantar warts, found on the soles of the feet, are flat. Unlike other warts, plantar warts can be painful.

Many warts disappear by themselves after months or even years. Treatments are available for those that do not, including over-the-counter medications or professional treatment by freezing, surgery, laser therapy, or acid treatments.

Are Skin and Soft Tissue Infections Contagious?

Necrotizing fasciitis, cellulitis, and abscesses are not contagious from person to person, but the bacteria that can cause these infections can spread between people. Dermatophytes, warts, and molluscum contagiosum spread fairly easily through skin-to-skin contact.

How Are Skin and Soft Tissue Infections Diagnosed?

A doctor examines the size, shape, and color of the affected area and checks it for tenderness and warmth. The doctor may order blood tests for cellulitis to assess the extent of the infection; tests of skin scrapings for suspected fungal infections or molluscum contagiosum; or tests on a tissue sample for necrotizing fasciitis. Doctors can use a special type of filtered ultraviolet*

* **genitals** (JEH-nih-tuls) are the external sexual organs.

* **ultraviolet** light is a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

light to check for tinea capitis because the fungi that cause it glow a characteristic color when the light is shined on the infected area.

Can Skin and Soft Tissue Infections Be Prevented?

The best way to prevent skin and soft tissue infections is to avoid getting cuts, scrapes, bites, or any kind of open wound. Frequent hand washing can curb the spread of bacteria. Doctors also advise keeping any opening in the skin clean and dry. It is wise to consult a doctor if the area around the wound becomes red, hot, or painful or if the infected person develops a fever. Dermatophyte infection is best avoided by keeping the skin dry, such as in areas where sweating occurs.

▶ See also **Abscesses • Fungal Infections • Gangrene • Impetigo • Ringworm • Sepsis • Skin Parasites • Staphylococcal Infections • Streptococcal Infections • Warts**

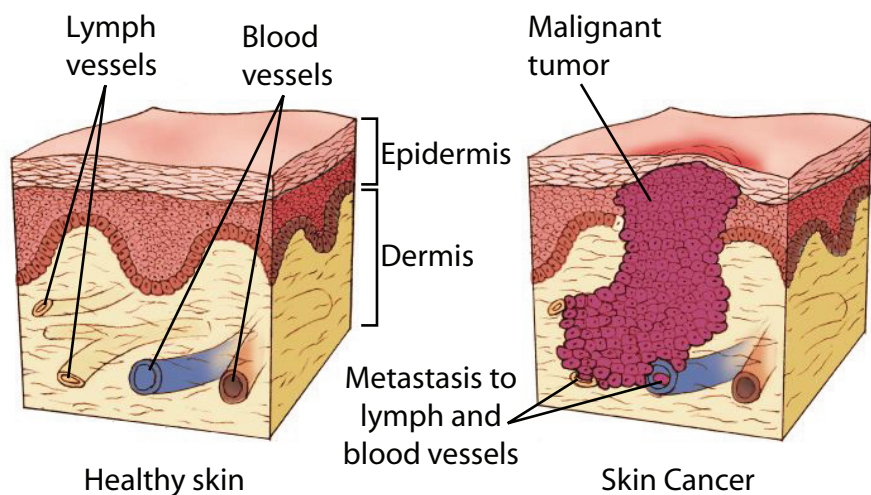
Resources

Organization

American Academy of Dermatology. P.O. Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: <http://www.aad.org>.

Skin Cancer

Skin cancer is a disease in which rapidly multiplying, abnormal cells (cancer cells) are found in the outer layers of the skin.



Healthy skin cells protect the body (left), but cancer cells grow and divide uncontrollably (right), crowding out the healthy cells nearby. Melanoma is particularly dangerous because it can spread throughout the body. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

What Is Skin Cancer?

In 1985, former president Ronald Reagan had a growth called a basal (BAY-zuhl) cell carcinoma removed from the side of his nose. The president had often been described as looking tanned and healthy, and when the news broke, it raised public awareness of skin cancer and the dangers of overexposure to the sun. Each year, about one million Americans are diagnosed with skin cancer.

The skin is the largest organ of the body. It protects people by keeping water and other fluids inside the body, by helping to regulate body temperature, by manufacturing vitamin D, and by performing a range of other complex functions. The skin also is a critically important barrier between people and such foreign invaders as bacteria. The skin is a basic part of physical appearance; it is the surface of the body that people present to the world.

Skin cancer is the most common of all cancers. It accounts for 50 percent of all cases of cancer. Cancers of the skin are divided into two general types: melanoma (mel-a-NO-ma) and nonmelanoma. Nonmelanoma are the most common cancers of the skin. They are also the most curable. Melanoma is much less common, but it is far more aggressive and causes 75 percent of all skin cancer deaths.

What Are the Types of Skin Cancer and Their Development?

Melanoma The outer layer of the skin, the epidermis (ep-i-DER-mis), consists of layers of flat, scaly cells called squamous (SQUAY-muss) cells, under which are round cells called basal cells. The deepest part of the epidermis consists of melanocytes (MEL-a-no-sites), which are the cells that give skin its color. Melanoma begins in the melanocytes.

Nonmelanoma The two main types of nonmelanoma are basal cell carcinoma and squamous cell carcinoma. These cancers develop in different layers of the skin, but they both appear more commonly on sun-exposed areas of the body. Squamous cell carcinomas grow more quickly than basal cell carcinomas.

How skin cancer develops Skin cancer begins with damage to the DNA* of the cells in skin. DNA is information people inherit from their parents that tells the cells of the body how to perform all the activities needed for life. DNA is contained in genes*, and each cell has an identical set of genes. Some of these genes carefully control when cells grow, divide, and die. If a gene is damaged, the cell receives the wrong instructions or no instructions at all. When that happens, the cell can begin to grow and divide uncontrollably, forming an unruly cluster that crowds out its neighbors and forms a cancerous growth, or tumor. Melanoma is potentially serious because it has the ability to spread to other places in the body. Nonmelanoma, however, tends to stay put and is less likely to spread.

ABCDs of Melanoma Screening

The American Academy of Dermatology recommends checking the skin on a regular basis for changes in moles, freckles, and beauty marks. Their ABCD system for recognizing changes is as follows:

A: asymmetrical shape

B: border with ragged, blurred, or irregular shape

C: color variations

D: diameter greater than 6 millimeters (size of a pencil eraser)

Moles that match any of the ABCDs should be seen by a doctor.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **ultraviolet** light is a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

What Causes Skin Cancer?

Certain kinds of risk factors suggest who might be likely to develop cancer. A risk factor is anything that increases a person's chances of getting a disease.

Melanoma One risk factor is having certain types of moles. Another risk factor is having fair skin. The risk of melanoma is about 20 times higher for light-skinned people than it is for dark-skinned people. But dark-skinned people can still get melanoma. A person's chances of getting melanoma are greater if one or more close relatives have gotten it. People who have been treated with medicines that suppress the immune system (the body's defenses against infection) have an increased risk of developing melanoma. Exposure to ultraviolet* radiation—for example, sunlight, tanning lamps, and tanning booths—also is a risk factor for melanoma. Studies have shown no protective benefit of sunscreens in preventing melanoma.

Nonmelanoma Most cases of nonmelanoma are caused by unprotected exposure of the area that has the cancer to ultraviolet radiation. Most of this radiation comes from sunlight, but it may also come from artificial sources. Although children and young adults usually do not get skin cancer, they may get a lot of exposure to the sun that could result in cancer later on. Other risk factors for nonmelanoma include having fair skin and having a weakened immune system as a result of medical treatment for other conditions. In addition, exposure to certain kinds of chemicals increases a person's risk of getting nonmelanoma.



Large red, blistery irregular-shaped growth of basal cell carcinoma. *M. Abbey/Photo Researchers, Inc.*

SUNSHINE AND SKIN CANCER

Cumulative Effects of Tanning

Long-term exposure to the ultraviolet (UV) rays of the sun damages the body's skin cells and can lead to cancer. For example, repeated sunburn and tanning cause the skin to wrinkle and to lose its ability to hold its shape. Dark patches called lentigos (len-TEE-goes) (age spots or liver spots) may appear, along with scaly precancerous growths and actual skin cancers. The sun's UV radiation also increases a person's risk of developing eye problems, including cataracts, which can cause blindness.

Burning and Peeling

Burning and peeling are signs that a person's skin has been damaged. The sun can also damage the DNA of cells, and if a person is exposed to the sun (or other forms of UV light) over many years, skin cancer may result.

Sunglasses

Sunglasses are an effective way of preventing sun damage to the eyes. But not just any sunglasses will do. The right sunglasses are wrap-around UV-absorbent sunglasses, which block 99 to 100 percent of ultraviolet radiation. If the label on the glasses reads, "UV absorption up to 400 nm," or "special purpose," or "meets ANSI UV requirements," then the glasses block at least 99 percent of UV rays. Whether the glasses are dark or light does not matter. The protection comes from an invisible chemical that is applied to the lenses. Any type of eyewear can be treated to make it UV-absorbent.

How Is Skin Cancer Diagnosed?

Melanoma may show up as a change in the size, color, texture, or shape of a mole or other darkly pigmented area. Bleeding from a mole that is not the result of a scratch or other injury may also be a warning sign of cancer. Nonmelanoma can be hard to tell from normal skin. The most important warning signs are a new growth, a spot or bump that seems to be growing larger (over a few months or a year or two), or a sore that does not heal within three months.

When either melanoma or nonmelanoma is suspected, the doctor will take a sample (biopsy) of the abnormal tissue for examination under the microscope.

How Is Skin Cancer Treated?

The first step in treating skin cancer is to stage it, that is, to determine whether and how far it might have spread. Staging a cancer is an important step in choosing the best treatment. It also helps to determine the

patient's prognosis (outlook for survival). The most common system for describing skin cancer, assigns five stages: 0, I, II, III, and IV. So, for example, stage 0 means the cancer has not spread beyond the tissue beneath the skin; stage IV means that the cancer has spread to other organs such as the lung, liver, or brain, and is less likely to be curable.

Fortunately, most nonmelanoma can be completely cured by a variety of types of surgery depending on the size of the cancer and where it is. If a squamous cell cancer appears to have a high risk of spreading, surgery may sometimes be followed by radiation, which uses high-energy rays to kill cancer cells, or chemotherapy (kee-mo-THER-a-pee), which uses anticancer drugs that can be injected into a vein in the arm or taken as tablets. For some precancerous conditions, chemotherapy may simply be placed directly on the skin as a cream.

Treatment for melanoma includes surgery and chemotherapy. Radiation therapy is not usually used to treat the original melanoma that developed on the skin.

How Is Skin Cancer Prevented?

A popular anti-skin cancer slogan in Australia states: "Slip on a shirt. Slap on a hat. Slop on some sunscreen. Seek shade." The most important way of lowering the risk of nonmelanoma is to stay out of the sun. Sunscreen does not seem to prevent melanoma. This is especially important in the middle of the day, when sunlight is most intense. Because no one wants to stay indoors all day, children and adults can protect their skin by covering it with clothing and by using a sunscreen. The sunscreen should protect users from both UVA and UVB radiation. It should have a skin protection factor (SPF) of at least 50 on areas of the skin that are exposed to the sun. Wide-brimmed hats and wrap-around sunglasses with 99 to 100 percent ultraviolet absorption help to protect the eyes. Tanning booths should be avoided.

What Skin Cancer Research Has Been Conducted?

Scientists have made enormous progress in understanding how ultraviolet light damages DNA and how DNA changes cause normal skin cells to become cancerous. In addition, researchers have explored ways of treating skin cancers by enlisting the patient's immune system (the body's defenses against tumors and infection) to fight cancer cells.

One possible treatment involves the immune system. The goal of this approach is to recognize and then attack cancerous cells. Other immunotherapies were anticipated to treat melanoma. As of 2009, much more work remained before therapies could be used by the general public. In June 2008, researchers in Israel announced they had developed a new vaccine that decreases recurrence of melanoma in prior sufferers and increases survival among the current ones. Plans were in place for further tests on this treatment.

Living with Skin Cancer

The most important fact to remember about skin cancer is that most of it is preventable. It is never too late for people to begin to protect their skin. Because a person who has had one skin cancer is at risk for another one, monthly self-examinations should become part of a routine. Cancer is most likely to recur (that is, to come back) in the first five years after treatment. Individuals who love being in the sun must take steps to protect their skin from more exposure. But except for staying out of the sun, almost everyone with skin cancer can go back to the life they had before they got cancer.

▶ See also **Cancer: Overview • Skin Conditions • Tumor**

Resources

Books and Articles

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- McClay, Edward F., Mary-Eileen T. McClay, and Jodie Smith. *100 Questions & Answers about Melanoma and Other Skin Cancers*. Boston, MA: Jones and Bartlett, 2004.
- Poole, Catherine M. *Melanoma: Prevention, Detection, and Treatment*, 2nd ed. New Haven, CT: Yale University Press, 2005.
- So Po-Lin. *Skin Cancer*. New York: Chelsea House, 2008.

Organizations

- Abramson Cancer Center of the University of Pennsylvania.** 3400 Spruce Street, Philadelphia, PA, 19104. Web site: <http://www.oncolink.upenn.edu>.
- American Academy of Dermatology.** P.O. Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: <http://www.aad.org>.
- American Cancer Society.** 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-227-2345. Web site: <http://www.cancer.org>.
- National Cancer Institute.** Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892. Toll free: 800-4-CANCER. Web site: <http://cancernet.nci.nih.gov/cancertopics>.
- Skin Cancer Foundation.** 149 Madison Avenue, Suite 901, New York, NY, 10016. Telephone: 212-725-5176. Web site: <http://www.skincancer.org>.

Did You Know?

- The average adult body has two square yards of skin, which make up about 15 percent of the body's total weight.
- A one-inch square of skin contains millions of cells as well as many special nerve endings for sensing heat, cold, and pain.
- The average thickness of skin is one-tenth of an inch, but it ranges from very thin on the eyelids to thick on the soles of the feet.

* **allergens** are substances that provoke a response by the body's immune system or cause a hypersensitive reaction.

Skin Conditions

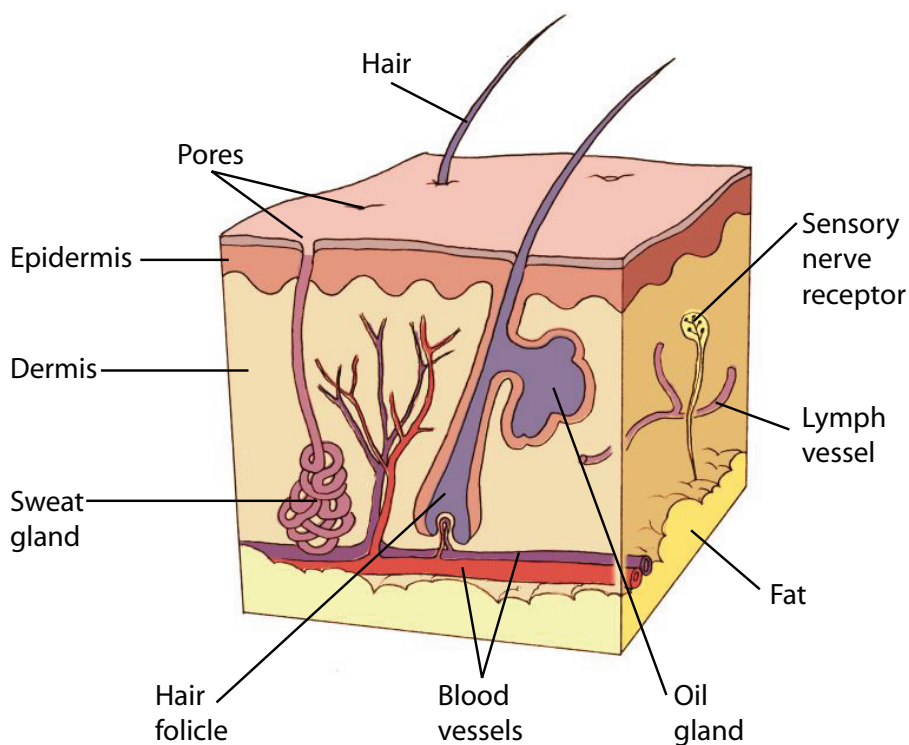
Skin conditions include various rashes, diseases, infections, injuries, growths, and cancers that affect the skin.

Leaves of Three, Let Them Be

Alison loved to take long walks in the woods in the summer, but one day she developed a streaky rash two days after she had gone on a hike. At first, her skin was red and swollen in spots. Soon, however, little blisters formed and began to itch intensely. Alison had developed contact dermatitis (derma-TY-tis), an allergic response to touching the oily resin urushiol (u-ROO-she-ol), an allergen* in poison ivy. Cool showers and a soothing lotion helped relieve the intense itchiness. Within a few days, the blisters began to scab over. It took about 10 days for the rash to heal completely. Afterward, Alison was careful to wear long-sleeved shirts and long pants when walking in the woods and to stay away from poison ivy, identifiable by its clusters of three, deep-veined leaves, with the center leaf on a short stalk.

What Does the Skin Do?

The skin is the largest and most visible organ of the body. It also is one of the most complex, because it has so much to do. The main job of the skin is to protect a person's inside parts from harmful factors in the outside



Anatomy of the skin. Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

world. It acts as a shield against sun, wind, heat, cold, dryness, pollution, and fluids. All of these can injure the skin over time. In addition, the skin comes into contact with and helps protect the body from germs; allergens, which are substances that can cause allergic reactions; and irritants, which are harsh chemicals that can hurt the skin. In addition, special nerve endings in the skin alert the brain to heat, cold, and pain.

What Can Go Wrong?

It is not surprising that many things can go wrong with an organ so big and complicated. Allergens and irritants can make the skin break out in a rash. Dermatitis is a general term for red, inflamed skin from a variety of causes.

There can also be problems in the way the skin functions. For example, it can make too much oil, leading to acne*. If the skin makes too many new cells, the result can be psoriasis (so-RY-a-sis). If the skin makes too little or too much coloring matter, called pigment, the result can be patches of abnormally light skin (hypopigmentation) or dark skin (hyperpigmentation).

The skin can also be injured, as in sunburn, and by viral infections, such as cold sores. Other kinds of skin infections are caused by bacteria and fungi. In addition, the skin can be affected by both non-cancerous growths, such as birthmarks, and skin cancers.

What Are Some Common Skin Problems?

The following are some of the most common skin problems seen by dermatologists (der-ma-TOL-o-jists), doctors who specialize in treating skin problems:

- **Acne:** a rash of pimples, blackheads, whiteheads, and deeper lumps, mostly on the face. Almost all teenagers have at least a little acne, and some adults have the problem as well. Acne develops when the skin makes too much oil and sheds dead cells too fast. Bacteria also play a role.
- **Athlete's foot:** a fungal infection that may cause the skin on the foot and between the toes to look red and peel, crack, flake, or even blister. Sweaty feet and tight shoes provide the perfect setting for a fungus to grow. Athlete's foot is most common among people who engage in sports and wear socks that are moist with sweat or who walk on pool decks and locker-room floors that are contaminated with the fungus.
- **Atopic (ay-TOP-ik) dermatitis, also called eczema (EK-zem-ah):** a red, itchy rash that often runs in families and accompanies allergies. In babies, it typically leads to itching, oozing patches with scabs, mainly on the face. In older children, the patches tend to be dry, and the affected skin may flake and thicken. In teenagers, the patches usually occur on the inside of the arm at the elbow bend, on the backs of legs at the knees, ankles, wrists, face, neck, and upper chest.

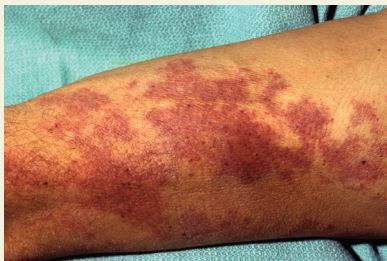


▲ Girl with a poison ivy rash on her face, which she is treating with calamine lotion. *Scott Camazine/Alamy.*

Names for Certain Skin Abnormalities

The following are medical terms for some common skin spots and bumps:

- **Comedo (KOM-ee-do):** a blackhead, whitehead, or pimple. Example: acne.
- **Macule (MAK-yool):** a small, flat, colored spot. Example: freckles.
- **Papule (PAP-yool):** a small solid elevation of the skin that usually occurs in clusters and often accompanies rashes.
- **Plaque (PLAK):** a large, raised patch of skin. Example: psoriasis.
- **Pustule (PUS-tyool):** a pimple filled with pus. Example: acne.
- **Wheal (WEEL):** a short-lasting, swollen bump. Example: hives.



▲
A “port wine stain” birthmark. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **acne** (AK-nee) is a condition in which pimples, blackheads, whiteheads, and sometimes deeper lumps occur on the skin.

* **benign** (be-NINE) refers to a condition that is not cancerous or serious and will probably improve, go away, or not get worse.

* **virus** (VY-rus) is a tiny infectious agent that can cause infectious diseases. A virus can only reproduce within the cells it infects.

* **histamine** (HIS-tuh-meen) is a substance released by the body during inflammation. It causes blood vessels to expand and makes it easier for fluid and other substances to pass through vessel walls.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

- **Birthmarks:** a skin mark that develops before or shortly after birth. Several kinds of common birthmarks are caused by overgrowth of blood vessels. Such marks are painless and benign*.
- **Cold sores:** an infection caused by the herpes (HER-pee-z) simplex virus* that leads to sores, usually around the mouth and nose. Some sores are barely noticeable, but others hurt. Cold sores are common among children and are easily spread from person to person by kissing or sharing dishes or towels.
- **Contact dermatitis:** a red, itchy rash that occurs when the skin comes into contact with an allergen or something else to which the skin is sensitive. Examples include poison ivy and sensitivities to nickel, rubber, and skin care products.
- **Dandruff:** flaking of the skin on the scalp. Some flaking is part of the normal process by which the outer layer of skin cells is regularly shed. If the flaking becomes obvious on a person’s hair and clothes, it is called dandruff. If the scalp is red or if there are large flakes along with flaking elsewhere, the problem may be something else.
- **Hives:** pale red, swollen bumps that occur in groups on the skin. Hives are usually itchy, but they may also burn or sting. They are caused when the body releases a chemical called histamine* as part of a reaction to substances such as foods, medications, and insect stings.
- **Irritant dermatitis:** a red, itchy rash that occurs when the skin comes into contact with a harsh chemical. Examples of irritants include strong soaps or detergents and industrial chemicals.
- **Moles:** growths that can appear anywhere on the skin, alone or in groups. They are usually brown and can have various shapes and sizes. Everyone has at least a few moles, and some people have forty or more. Most moles are not cancerous, but some may turn into a serious form of skin cancer called malignant melanoma (mel-a-NO-ma).
- **Poison ivy:** a common type of contact dermatitis that occurs when a sensitive person comes into contact with the oily resin in the sap of poison ivy plants. Poison oak and poison sumac (SOO-mak) plants can have the same effect. The result is a streaky rash with redness and swelling, followed by blisters and itching. About 85 percent of all people have this kind of allergic reaction to poison ivy.
- **Psoriasis:** a long-lasting skin disease caused when too many new cells are made, resulting in patches of red, thickened skin covered with silvery flakes. Four to 5 million Americans have psoriasis. It may result from a problem with the immune system*, which normally fights germs and other foreign substances in the body.
- **Ringworm:** a skin infection caused by a fungus (not a worm). Ringworm is marked by red, itchy, ring-shaped patches that may flake or blister. It commonly affects the feet, scalp, trunk, nails, and groin.

- **Rosacea (ro-ZAY-she-a):** a skin disease that causes redness and swelling on the face that may gradually spread on the cheeks and chin. Small blood vessels and tiny pimples may appear on or around the red area. Fair-skinned adults, especially women, are most likely to get rosacea.
- **Seborrheic (seb-o-REE-ik) dermatitis:** a common condition that causes red skin and greasy-looking flakes, mainly on the scalp, on the sides of the nose, between the eyebrows, on the eyelids, behind the ears, or on the chest. In babies, this condition is called cradle cap. In adults, it often occurs in people with oily skin and hair, and it may occur in those with acne or psoriasis.
- **Shingles:** a skin eruption caused by the same virus that causes chickenpox. It starts with pain or tingling on one side of the body or face, followed by a red rash with small blisters. After a person has chickenpox, the virus may live on in the nerve cells and come out years later as shingles. An episode of shingles may last weeks.
- **Skin cancer:** the most common of all types of cancer, including various kinds of growths on the skin. About 700,000 Americans get skin cancer each year. The main cause is the sun's harmful rays.
- **Sunburn:** the immediate result of getting too much sun. The skin is injured, just as if it had been burned by heat, and becomes red and painful. If the sunburn is severe, blisters may form. The long-term effects of sun damage include wrinkles, certain skin bumps and spots, and skin cancer.
- **Vitiligo (vit-i-LY-go):** a condition that causes white patches of skin due to a loss of pigment in the cells and tissues. It affects one or two out of every 100 people. Although vitiligo strikes people of all races, it is particularly noticeable in individuals with dark skin.
- **Warts:** small, hard bumps on the skin or inner linings of the body that are caused by a virus. Most are skin-colored, raised, and rough, but some are dark, flat, or smooth. Warts are common on the fingers, hands, arms, and feet. Some warts occur on the genitals and can be spread during sex.
- **Wrinkles:** a common sign of skin aging. The main cause of wrinkles is getting too much sun over a lifetime. Cigarette smoking also plays a major role.

How Are Skin Conditions Diagnosed?

Nearly everyone has a skin problem at some time. Such problems can affect anyone, from newborns to older adults. A doctor can identify many skin problems just by looking closely at the skin. The doctor may also ask about the person's current symptoms, past illnesses, and family history.

In some cases, the doctor may need to do a biopsy*. This procedure involves removing a small bit of tissue so that it can be looked at under a microscope. If an infection caused by a fungus is suspected, the doctor

Botox and Wrinkle Relief

One of the drugs in the fight against wrinkles is Botox. The name is short for botulism toxin type A, a byproduct produced by the bacterium *Clostridium botulinum*. In food, the bacterium causes a potentially fatal type of food poisoning known as botulism. To remove wrinkles, a small amount of Botox is injected into the muscles under the wrinkled skin. The Botox temporarily paralyzes the muscles. The result, after three to five days, is that the wrinkles temporarily disappear. This treatment is controversial.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **ultraviolet** light is a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

may scrape off some skin flakes, which can be checked at a lab for signs of fungus. Another way to check for an infection caused by bacteria or a fungus is with a culture, which involves taking a sample from the site of possible infection and placing it in a nourishing substance called a medium to see what kind of bacteria or fungi grow.

If contact or allergic dermatitis is suspected, the doctor may do patch testing to find out what allergens are to blame. Doing so involves putting tiny amounts of different substances on the skin under a patch. The skin is checked two days later to see which substances, if any, caused a reaction.

How Are Skin Conditions Treated?

Following are various ways to treat skin conditions:

- **Medicines:** Many medicines used to treat mild skin conditions are sold without a prescription in creams, lotions, gels, pads, and shampoos. Stronger medicines that are put on the skin, taken by mouth, or given in a shot are available only from a doctor or with a doctor's prescription.
- **Surgery:** Doctors use several kinds of surgery to remove or destroy abnormal skin tissue. Excision involves removing a skin growth by cutting. Cryosurgery involves destroying a skin growth by freezing it with an extremely cold liquid such as liquid nitrogen. Electrosurgery involves destroying a skin growth by burning it with electricity. Laser surgery involves destroying skin tissue with a laser, a tool that produces a very narrow and intense beam of light. Surgery is used for such problems as warts, skin cancer, moles, and birthmarks.
- **Light therapy:** Doctors treat certain skin problems with lamps that give off ultraviolet* rays. In some cases, the person also takes a drug that makes the skin more sensitive to ultraviolet light. This therapy is used for such problems as psoriasis and vitiligo.

Skin Care Suggestions

These tips can help keep a person's skin feeling healthy and looking its best:

- Protect the skin from the sun's harmful rays. Avoid the midday sun, cover up with clothing, and use a sunscreen with an sun protection factor (SPF) of around 45.
- Wash the face gently with lukewarm water, a mild soap, and a washcloth or sponge to remove dead cells.
- Reduce dry skin by keeping baths short and using warm water. Use moisturizing soap for dry or sensitive skin.
- Use a light moisturizer after bathing or showering if prone to dry skin.
- Dry off the skin after bathing by brushing it lightly with the hands or patting it with a towel.

▶ See also **Acne • Athlete's Foot • Herpes Simplex Virus Infections • Hives • Psoriasis • Ringworm • Skin Cancer • Vitiligo • Warts**

Resources

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Organizations

American Academy of Dermatology. P.O. Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: <http://www.aad.org>.

American Society for Dermatologic Surgery. 930 N. Meacham Road, Schaumburg, IL, 60173. Toll free: 800-441-2737. Web site: <http://www.asds-net.org>.

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-226-4267. Web site: <http://www.niams.nih.gov>.

Skin Parasites

Skin parasites (PAIR-uh-sites) are tiny organisms that invade the skin, often causing irritation and itching.

What Are Skin Parasites?

Parasites live off other living beings (including people), often feeding and reproducing on them. Some parasites thrive on human blood and cannot live long without it. Parasites may lay their eggs on people's skin. Before long, that person could become the host (an organism that provides another organism, such as a parasite or virus, with a place to live and grow) for hundreds or more of the parasites.

Skin parasites are found worldwide and infest large numbers of people. For example, as many as 6 to 12 million people worldwide contract head lice every year, according to the Centers for Disease Control and Prevention. Head lice most often affect children in school and daycare settings.



▲ Magnification of an egg laid by head lice. These eggs, called “nits,” are visible to the naked eye. The term “nit-pick,” which means to be concerned with insignificant details, derives from the process of taking the tiny eggs out of the hair by hand, a method used for centuries before more effective treatment became widely available. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **hair follicles** (FAH-lih-kulz) are the skin structures from hair develops and grows.

* **hives** are swollen, itchy patches on the skin.

What Are Some Common Skin Parasites?

There are many parasites that infest human skin, but lice, scabies (SKAY-beez), and chiggers are among the most common.

Head lice Also known as *Pediculus humanus capitis* (peh-DIH-kyoo-lus HYOO-mah-nus KAH-pih-tis), head lice are six-legged parasites with tiny claws that cling to hairs. They are found on the scalp, neck, and behind the ears. Lice lay visible, whitish eggs called nits. In about seven days, the nits hatch into young called nymphs (NIMFS). Nymphs grow up fast, and in just one week they have matured into adult lice that must feed on blood to stay alive. Head lice may not cause any symptoms immediately, but as with other insect bites, the body reacts to the invaders, leading to itching and sores from scratching.

Pubic lice Pubic lice, or *Phthirus pubis* (THEER-us PYOO-bus), invade the pubic hair and sometimes other body hair such as beards, eyebrows, eyelashes, and armpit hair. They often are called “crabs” because of their crab-like appearance. Pubic lice cause intense itching, especially at night, when they feed by burying their heads into hair follicles*. The nits or adult lice can be seen on pubic hairs or surrounding skin.

Scabies Microscopic *Sarcoptes scabiei* (sar-KOP-teez SKAY-be-eye) mites cause an infestation called scabies. The mites work their way under the top layer of skin and lay their eggs. Most people are not even aware of the intruders until intense itching begins two to six weeks later. Red, pimple-like bumps appear on the skin, and there may be wavy lines on the skin tracing the mites’ paths, especially in the webbing between the fingers and in the skin folds at the back of the knees and the inside of the elbows.

Chiggers Chiggers are mites that tend to live in weeds, tall grass, or wooded areas. The chigger larvae (LAR-vee, immature mites) feed on a variety of animals, including humans. The larvae crawl onto the skin of passersby and can use their tiny claws to grab onto human hair. They then attach to the skin, usually at the ankles or waist or in skin folds, with hooked mouthparts and feed on skin cells. Unlike lice and scabies, chiggers only feed on their host for a couple of days, then let go and fall off. Chigger bites can cause a red bump that continues to grow in size, a skin rash, hives*, and severe itchiness. Sometimes the larvae are visible in the center of the bump.

How Are Skin Parasites Spread?

Despite what many believe, people do not get skin parasites because of poor hygiene. Instead, skin parasites tend to spread in situations where they can walk or fall from one person to another (or in the case of chiggers, from vegetation to human skin). The parasites often require relatively prolonged and close contact to move between people, and they spread most easily in crowded conditions, from sharing personal items, and from skin-to-skin contact.

Head lice in particular fall easily onto their next victims in close quarters. They also can infest hairbrushes, barrettes, hats, and sometimes clothes or bed linens. Other people become infested by using these items. Pubic lice spread mostly through sexual contact, but people also can get them from bed linens and clothes.

Scabies spread quickly in crowded living conditions or in places with lots of skin-to-skin contact (such as daycare centers and nursing homes). Like lice, scabies can be passed through sexual contact and by sharing clothes, towels, and bed linens.

How Are Skin Parasites Diagnosed and Treated? Doctors often diagnose skin parasite infestations just by spotting the parasites, their eggs, larvae, or characteristic red bumps on the skin. With scabies, a skin scraping might be taken to check for mites, eggs, and mite feces (FEE-seez, or bowel movements). However, this test is not always accurate because the mites may have moved from the spot that was scraped.

Over-the-counter and prescription lotions and shampoos (known as pediculicides, peh-DIH-kyoo-lih-sides) can be used to kill head lice. In some cases, treatment may need to be repeated or replaced with stronger medications because lice are becoming resistant to some treatments. Other people living in the same house with the infested person may be treated at the same time.

Pubic lice also are treated with a pediculicide, similar to the treatment of head lice. If the infestation includes the eyelashes, petroleum jelly is applied several times a day to the eyelids for a week or more.

Patients with scabies are given medicated lotions to apply over the entire body, and the lotion must stay on for 8 to 12 hours. Chigger bites do not require any special treatment to heal, but antihistamines* may ease itching.

Infestation with lice and scabies can persist until they are treated properly. Once treatment begins, patients usually are no longer contagious after a day or two, but sores and itching may continue for several weeks. Chigger bites heal quickly.

Can Skin Parasites Cause Medical Complications?

Complications of skin parasites are rare. Frequent or rough scratching of bites or sores can lead to bacterial infections, such as impetigo*. If lice spread to eyebrows or eyelashes, the eyelids may become infected. Norwegian or crusted scabies is a form of scabies that can be severe in people with weak immune systems*, such as those with a chronic* illness and elderly people.

How Infestation with Skin Parasites Be Prevented?

To avoid skin parasites, experts recommend that people take the following precautions:

- shower daily, wash hands frequently, and wear clean clothes
- avoid anyone who has lice or scabies until that person is treated

* **antihistamines** (an-tie-HIS-tuh-meens) are drugs used to combat allergic reactions and relieve itching.

* **impetigo** (im-pih-TEE-go) is a bacterial skin infection that usually occurs around the nose and mouth and causes itching and fluid-filled blisters that often burst and form yellowish crusts.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

- never share brushes, hats, bed linens, or clothes
- practice abstinence (not having sex); birth control does not prevent pubic lice or scabies
- avoid chigger-infested areas and wear socks, long pants, and long sleeves in wooded or grassy areas

To prevent the spread of parasites in a home when a family member has been diagnosed with an infestation, it is wise to do the following:

- wash bed linens, towels, and clothes in hot water, then dry them on high heat
- vacuum the entire house, then throw the vacuum cleaner bag away
- disinfect combs and hair items
- seal items that cannot be cleaned in airtight plastic bags for two weeks; at the end of that time, any parasites on those items will have died

In addition, children who have skin parasites should stay home from school or daycare until a day or two after they begin their treatment.

▶ See also **Lice** • **Scabies**

Resources

Organizations

Bohart Museum of Entomology, University of California. 1124 Academic Surge, Davis, CA, 95616, Web site: <http://delusion.ucdavis.edu>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

Slapped Cheek Syndrome See *Fifth Disease*.

Sleep Apnea

Sleep apnea (AP-nee-a) is a disorder in which a person temporarily stops breathing while sleeping.

Will He Snooze or Snore?

James loved his grandfather, but he was dreading this year's visit. Sharing his room with Grandpa last year, James had not slept all week. Sometimes his grandfather's snoring would stop, but then James had to hop out of

bed to make sure his grandfather was breathing. Each time, Grandpa started breathing again after about 10 seconds, but he would choke and gasp for air before starting to snore again. In the morning, Grandpa had no memory of the night's noisy events.

When Grandpa arrived, he announced he would be a better roommate this year. His snoring had been caused by sleep apnea, and his doctor had given him a device to wear in his nose at night to make it easier for him to breathe.

What Is Sleep Apnea?

While sleeping, a person with sleep apnea stops breathing briefly, usually for about 10 seconds at a time. This interruption in breathing can happen hundreds of times a night. The result is that the body does not get enough oxygen* or a restful night's sleep. People with sleep apnea often are very tired during the day, have trouble concentrating, and may feel anxious at night and have difficulty falling asleep. Sometimes, they wake up in a panic because they think they are choking, and many wake up with headaches and are depressed and moody during the day.

Obstructive sleep apnea (OSA) is the most common type of sleep apnea; it affects an estimated 12 million Americans. It occurs when something in the throat, such as the tongue or tonsils*, blocks the airway. Central sleep apnea is another type of sleep apnea that occurs when the brain temporarily “forgets” to tell the body to breathe. Mixed apnea is a combination of OSA and central sleep apnea.

Sleep apnea can affect people of all ages, but it is most common in older individuals. OSA occurs most often in men who are 50 or older, and many people with OSA are overweight. People with sleep apnea often do not know that they have it. Family members, however, are well aware of the problem because the most common symptom is loud snoring.

Living with Sleep Apnea

In some people, sleep apnea is just an annoying problem; in others, it can lead to heart problems and stroke*. Many people with OSA also have hypertension, which can also be dangerous. To determine if someone has sleep apnea, doctors may check how long it takes for the person to fall asleep, and they may monitor different body functions while the individual sleeps. Sometimes, these tests occur at sleep clinics, which are special places where researchers can measure such factors as brain waves, heart rate, eye movement, body muscle tone, breathing, snoring, and blood oxygen levels during sleep.

Because sleep apnea can be dangerous, individuals who suspect they have sleep apnea should visit a doctor to learn more about their particular condition. In general, people with sleep apnea should not drink alcohol or take sleeping pills before bed, and they should try to lose weight if they are overweight. For many people, sleeping on their sides eliminates, or at least lessens, snoring. Various prescription drugs relieve apnea in some

Snoring

One of the symptoms of sleep apnea is snoring, but snoring can have other causes, including alcohol consumption, sedative medication use, chronic nasal congestion, or obstruction caused by enlarged adenoids and tonsils.

In most cases, medical professionals do not know what causes snoring: Some people just snore. Sometimes, however, they can find a cause. If a patient's snoring is punctuated by extended quiet periods before snoring resumes, a doctor may identify the snoring as a symptom of sleep apnea and then suggest treatment options.

* **oxygen** (OK-si-jen) is an odorless, colorless gas essential for the human body. It is taken in through the lungs and delivered to the body by the bloodstream.

* **tonsils** are paired clusters of lymphatic tissue in the throat that help protect the body from bacteria and viruses that enter through a person's nose or mouth.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

people. Special devices worn in the nose or mouth can keep the airways clear as well. In some cases, doctors may recommend surgery to remove tissues, such as tonsils and adenoids, that block the airway.

▶ See also **Insomnia • Obesity • Sleep Disorders**

Resources

Books and Articles

Chokroverty, Sudhansu. *Questions and Answers about Sleep Apnea*. Sudbury, MA: Jones and Bartlett, 2009.

Pascualy, Ralph A. *Snoring and Sleep Apnea: Sleep Well, Feel Better*, 4th ed. New York: Demos Health, 2008.

Organization

American Sleep Apnea Association. 6856 Eastern Avenue, NW, Suite 203, Washington, DC, 20012. Telephone: 202-293-3650. Web site: <http://www.sleepapnea.org>.

Sleep Disorders

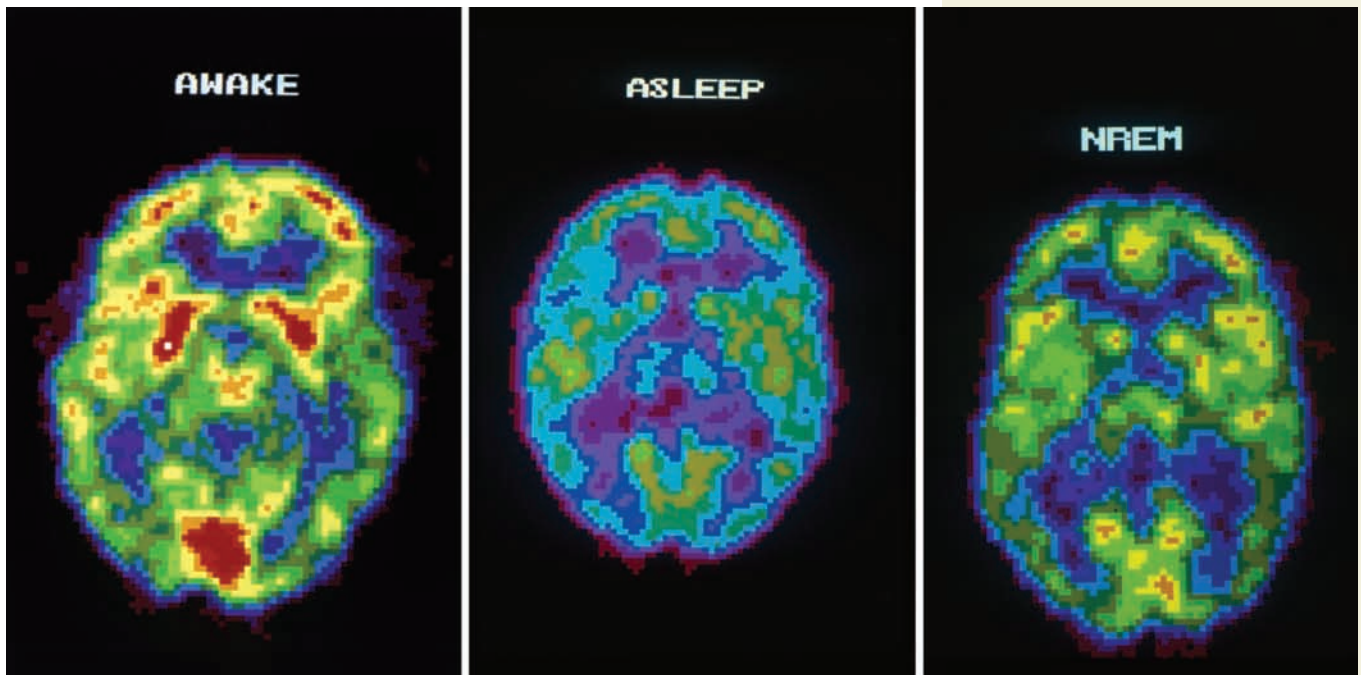
A sleep disorder is just what its name implies: something abnormal about the way individuals sleep. It might be that these people cannot get enough sleep, as is the case in insomnia (in-SOM-nee-a). In hypersomnia (HY-per-SOM-nee-a), individuals sleeps too much. In still other kinds of sleep disorders, events such as night terrors or restless leg syndrome may interfere with sleep.

Why Are Sleep Disorders Important?

When people do not get a normal refreshing sleep, they are not at their best. They may be impatient or careless, or they may show poor judgment in their actions. They may also be irritable with family and friends. Sleeplessness can cause serious accidents, as when someone “nods off” while driving a car or operating machinery.

An estimated 30 million to 40 million Americans have serious sleep problems that can be damaging to their health. In the case of insomnia alone, estimates of the cost in terms of lost productivity reach many billions of dollars.

In order to understand sleep disorders, it is necessary to understand something about sleep itself and the wide range of normal variations in the way people sleep.



What Is Normal Sleep?

On average, about one-third of a person's life is spent sleeping. However, the amount and timing of sleep vary considerably in different people, based on their age and lifestyle. Newborn infants may sleep up to 20 hours per day. Young and middle-aged adults sleep about eight hours on average. Elderly people tend to get less sleep at night but may take naps during the day.

The timing of sleep often is determined by such factors as work schedules, but it is affected by lifestyle as well. Some individuals seem to be morning people, or "early birds," by nature, whereas others are "night owls," preferring to stay up late.

What Are the Types and the Stages of Sleep?

Scientists at sleep laboratories have discovered that there are two distinct types of sleep. One is called rapid eye movement, or REM, sleep, because the eyes can be seen moving rapidly beneath the closed eyelids. Dreaming takes place during REM sleep, and the brain waves of someone in REM sleep look much like those of someone who is awake when the waves are measured on an electroencephalogram (EEG)*.

The other type, non-REM sleep, consists of four stages in which the brain waves progressively become deeper and slower but then speed up again until the REM stage occurs. This cycle normally is repeated with some variation at approximately 90-minute intervals, with REM sleep usually taking up about 25 percent of the total.

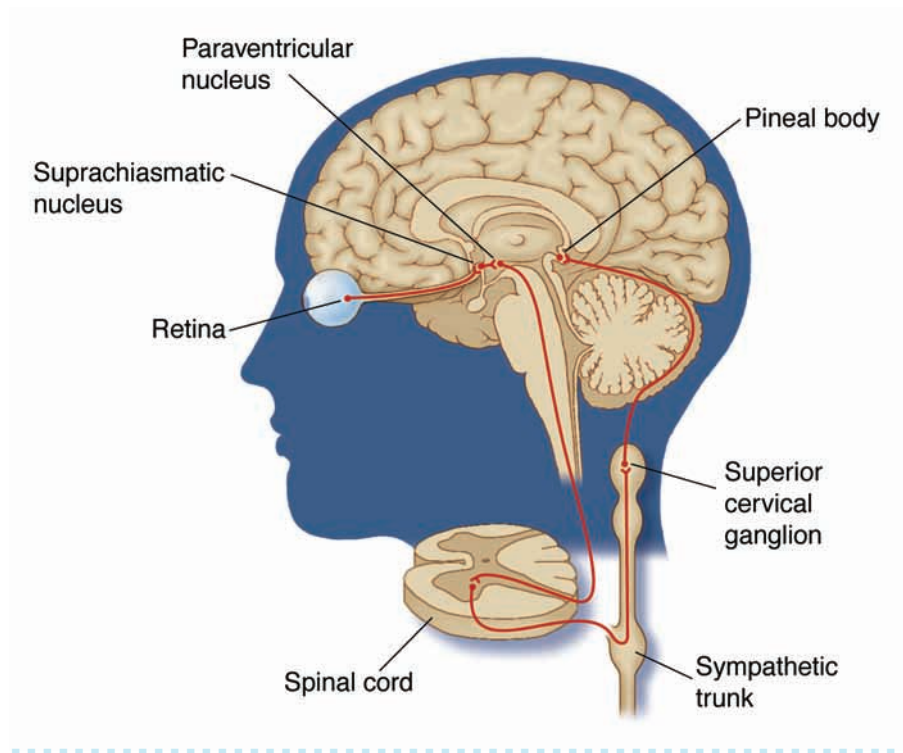
Studies conducted at sleep laboratories have contributed greatly to the diagnosis and treatment of sleep problems. The following are some of the more common sleep disorders.

▲ Researchers use electroencephalograms (EEGs) and positron emission tomography (PET scans) to study sleep disorders. These PET scans show various stages of sleep and wakefulness. When awake (left), the brain shows active areas in red and yellow, with inactive areas in blue. During normal sleep (center), the brain is less active, and most areas show as blue. During deep sleep and non-REM sleep (right), the brain is active but not as active as during REM sleep (not shown) or wakefulness. *Hank Morgan/Photo Researchers, Inc.*

* **electroencephalogram** instrument that records the electrical activity of the brain.

Researchers believe that the body's daily "clock," also called its circadian rhythm, is linked to the pineal gland and to the suprachiasmatic nucleus region of the hypothalamus. These structures within the brain receive information from the eye's retina about daylight and darkness, and send signals about regulating body responses to the spinal cord and elsewhere in the nervous system.

Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

* **hallucinations** (ha-LOO-sin-AY-shuns) occur when a person sees or hears things that are not really there. Hallucinations can result from nervous system abnormalities, mental disorders, or the use of certain drugs.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

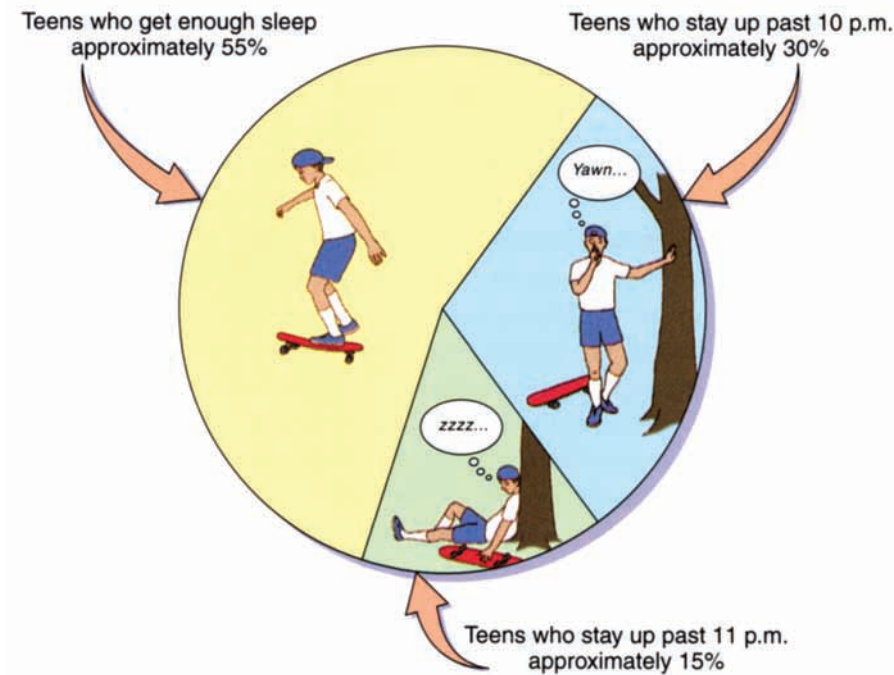
Sleep Disorder Conditions

Sleep disorder conditions include insomnia, sleep apnea, narcolepsy, hypersomnia, restless leg syndrome, and situational sleep loss.

Insomnia is a general term for trouble sleeping ("somnia" comes from the Latin *somnus*, which means sleep). People with insomnia may have difficulty falling asleep, or they may wake up too early in the morning. Some wake up frequently during the night and then find it hard to go back to sleep.

A person with sleep apnea (AP-nee-a) stops breathing intermittently while asleep, for periods of about 10 seconds or more. The most common and severe type is obstructive sleep apnea. In this disorder, the muscles at the back of the throat relax and sag during sleep until they obstruct the airway. The pressure to breathe builds up until the sleeper gasps for air. These episodes may occur hundreds of times a night and are accompanied by awakenings so brief that they usually are not remembered. People with sleep apnea typically complain of being very tired during the day. Severe sleep apnea can induce high blood pressure and increase the risk of stroke*, heart attack, and even heart failure.

Narcolepsy (NAR-ko-lep-see), like sleep apnea, involves excessive daytime sleepiness. In narcolepsy, however, the person cannot resist falling asleep. Some people with narcolepsy also experience frightening hallucinations* or sleep paralysis*, an inability to move or speak, while falling asleep or waking up. Research has shown that during a sleep attack, the REM stage of sleep intrudes suddenly into the waking state. It is a lifelong condition of unknown cause. Narcolepsy runs in families.



Research shows that the brain makes proteins essential for neuron function at a faster rate during sleep than during waking hours. But close to half of all teens do not get as much sleep as they need, leading to feelings of “burn out,” possibly because the brain is burning through proteins faster than it can replace them. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Sometimes socially embarrassing or inconvenient, this disorder can also be severely disabling and cause injury.

People with hypersomnia may sleep excessively during the day or longer than normal at night. Drowsiness or sleep periods last longer than with narcolepsy. Psychological depression* is often the main cause.

Restless leg syndrome is characterized by frequent leg movements due to discomfort inside the legs such as aching or prickling sensations that prevent individuals from falling asleep. In some individuals, sleep is then disrupted by involuntary leg jerking, which in some women is more troublesome during pregnancy.

Situational sleep loss (also known as situational insomnia) occurs as a result of a stressful event such as a family, work, or financial issue. When the worries surrounding the specific event are resolved the insomnia usually dissipates as well. Patients with situational sleep loss may benefit from relaxation techniques and/or pharmacologic treatment options from their physician, counselor, or therapist.

Nightmares, night terrors, and sleepwalking Almost everyone has nightmares occasionally. These unpleasant, vivid dreams occur during REM sleep, usually in the middle or late hours of the night. Upon awakening, the dreamer often remembers the nightmare clearly and may feel anxious. Nightmares are especially common in young children. In adults, they may be a side effect of certain drugs or of traumatic events, such as accidents.

A night terror is quite different from a nightmare. It occurs in children during deep non-REM sleep, usually an hour or two after going to bed. During an episode, they may sit up in bed shrieking and thrashing about with their eyes wide open. Typically, the next day they remember nothing

Melatonin

Some over-the-counter sleep aids contain melatonin (mel-a-TO-nin). Melatonin is a hormone secreted during darkness by the pineal (PIN-e-al) gland, a small structure located over the brain stem (the part of the brain that connects to the spinal cord and controls the basic functions of life, such as breathing and blood pressure).

Melatonin appears to be part of the system that regulates sleep-wake cycles in humans. Some research studies have shown that a small dose of melatonin at night helps make falling asleep easier and that melatonin may be beneficial to travelers who have jet lag.

Melatonin is available for sale without a prescription, but the Food and Drug Administration does not regulate its production or sale. Studies continued on this product to determine whether melatonin is safe for use.

Did You Know?

- People's eyes move when they dream much as they do when they are awake.
- A person who lives to be 70 has spent about six years dreaming.
- In one sleep disorder, apnea, people can stop breathing hundreds of times each night.
- In another, narcolepsy, someone can fall asleep while having a conversation.
- Night terrors are different from nightmares.
- People who sleepwalk are not acting out their dreams.

* **depression** (de-PRESH-un) is a mental state characterized by feelings of sadness, despair, and discouragement.

* **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.

of the event. Night terrors occur chiefly in preschool children. Although frightening, they generally are harmless and are soon outgrown.

Sleepwalking also occurs during non-REM sleep. It was once believed to be the acting out of dreams, but such is not the case. It takes place most commonly in children. The sleepwalker wanders about aimlessly, appearing dazed and uncoordinated, and remembers nothing of the episode afterward.

How Do Doctors Diagnose and Treat Sleep Disorders?

Most sleep disorders can be treated successfully if diagnosed properly. Anyone who sleeps poorly for more than a month or has daytime sleepiness that interferes with normal activities may wish to consult a doctor or be referred to a specialist in sleep disorders.

At a sleep clinic, patients are first asked questions about their medical history and sleep history. A polysomnogram (pol-ee-SOM-no-gram) is sometimes used to measure brain waves, muscle activity, breathing, blood oxygen level, and other body functions during sleep.

Many sleep disorders, such as jet lag, short-term insomnia, and most nightmares, do not need treatment. Some others, such as night terrors, are outgrown.

Chronic insomnia often is treated successfully with behavior therapy, which involves various relaxation techniques and reconditioning to change poor sleeping habits. Sleeping pills may be used temporarily, but their long-term use is controversial due to unwanted side effects.

Obstructive sleep apnea is often treated with dental appliances or one of two devices: the CPAP (continuous positive airway pressure) or the BiPAP (bi-level positive airway pressure). These devices keep the airway open. Operations (to widen the area at the back of the throat or to provide a new opening into the windpipe below the Adam's apple) sometimes are performed to treat severe obstructive sleep apnea.

For restless leg syndrome, people can alter their routines, incorporating stretching, walking, and regular exercise into their daily patterns. Massage may also be helpful. If the problem requires medical treatment, physicians can prescribe various types of drugs, for example, a dopamine agonist such as ropinirole (Requip) or some kind of sedative, such as zolpidem (Ambien).

Hypersomnia due to depression is often helped by psychotherapy*.

There is no cure for narcolepsy and restless legs, but medications can help control or ease symptoms.

Guidelines for Prevention

Most sleep disorders can be prevented or minimized by making a few changes in one's lifestyle. The following are some simple guidelines:

- Avoid excessive amounts of caffeine or alcoholic beverages, especially soon before bedtime. The same goes for smoking cigarettes.
- Avoid frequently disrupted sleep-wake schedules.

- Avoid excessive napping in the afternoon or evening.
- Exercise regularly, but not just before retiring.

▶ *See also* **Depressive Disorders • Insomnia • Jet Lag • Narcolepsy • Sleep Apnea**

Resources

Books and Articles

- Colligan, L. H. *Sleep Disorders*. New York: Marshall Cavendish Benchmark, 2009.
- Epstein, Lawrence J., with Steven Mardon. *The Harvard Medical School Guide to a Good Night's Sleep*. New York: McGraw-Hill, 2007.
- Marcovitz, Hal. *Sleep Disorders*. San Diego, CA: ReferencePoint Press, 2008.
- Wilson, Sue, and David Nutt. *Sleep Disorders*. New York: Oxford University Press, 2008.

Organizations

- Center for Narcolepsy, Sleep, and Health Research.** College of Nursing, Suite 208, University of Illinois at Chicago. 845 South Damen Avenue (M/C 802), Chicago, IL 60612. Telephone: 312-996-5176. Web site: <http://www.uic.edu/nursing/CNSHR/index.html>.
- National Heart, Lung, and Blood Institute.** P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: <http://www.nhlbi.nih.gov/health/dci/Browse/Sleep.html>.
- National Sleep Foundation.** 1522 K Street NW, Suite 500, Washington, DC, 20005. Telephone: 202-347-3471. Web site: <http://www.sleepfoundation.org>.

Slipped (Herniated) Disk

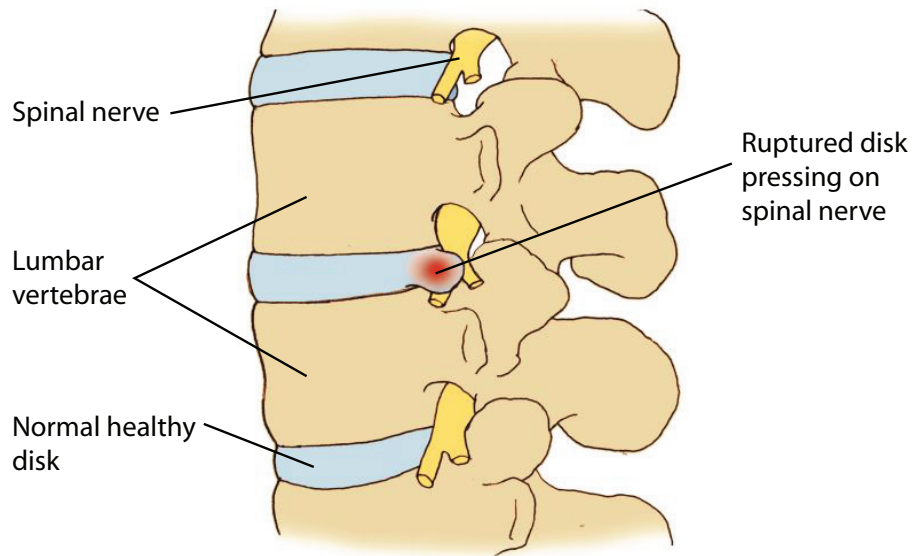
Slipped disk is a condition in which a disk in the spinal column moves out of its correct position in the spine and presses on the spinal nerves, causing pain and sometimes muscle weakness.

What Is a Slipped Disk?

The spine is made up of bones called vertebrae (VUR-te-bray) that protect the delicate spinal cord. These vertebrae are separated from each other and cushioned by disks. The disks contain a soft inner layer and a tough outer layer. If the outer layer tears, the soft inner layer can push out and

Slipped (Herniated) Disk

Healthy disk between vertebrae (bottom) compared to slipped disk pressing on spinal nerve (middle). *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



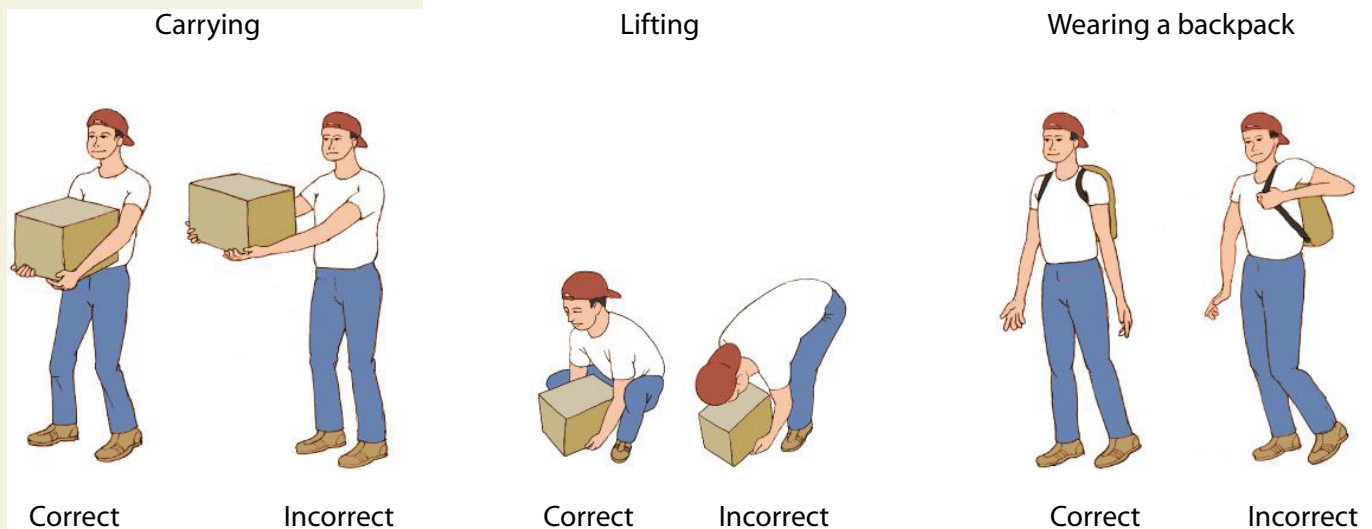
put pressure on the spinal nerves. This condition can cause severe pain as well as muscular weakness. Slipped disks are also described as “herniated,” “protruded,” and “bulging.”

Most slipped disks occur in the lower back. However, slipped disks can occur in any part of the spine, including the neck.

What Causes Slipped Disks?

In most cases, the condition develops gradually over a number of years. A person may be totally unaware that anything is wrong, until the disk begins to cause pain. There are a small number of cases of slipped disk that occur to people who have made a sudden difficult movement, such as lifting a heavy object or making a sudden awkward movement. Slipped disks can also be the result of normal wear and tear on the disks due to aging.

The correct posture when carrying loads, lifting, or wearing a backpack can prevent back injuries. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



How Common Is Slipped Disk?

Slipped disk is a fairly common. It happens mainly to people between the ages of 30 and 40. However, it can occur in younger people and even in children. After the age of 40, disks become more stable because extra tissue forms around them. Between the ages of 30 to 40, disks tend to lose fluid and become less resistant to pressures put on them. Slipped disk is more common in men than in women. People of either sex, however, who sit for long periods of time are more susceptible to the condition.

How Is Slipped Disk Diagnosed?

Individuals suffering from severe, sudden back pain should be evaluated by a physician to determine if they have a slipped disk, particularly if there is muscular weakness or pain and numbness in the legs or feet. The doctor administers nerve-reflex and muscle-strength tests after taking a personal history of the patient.

Among the tests used to locate and confirm a diagnosis, x-rays and other imaging tests may be performed. A test called an electromyogram (e-LEK-tro-MY-o-gram) can measure the amount of electrical activity in the muscles and help determine how much muscle or nerve damage the patient has.

What Is the Treatment for Slipped Disk?

Total bed rest used to be prescribed for two weeks. Doctors later came to believe that this much bed rest does not help, and patients may be told to stay in bed two to three days. Medications are given to help relax muscle spasms and to relieve pain. After their initial symptoms have improved, patients are given certain exercises to strengthen the muscles of the back and abdomen, and they are told to avoid twisting the spine. Lifting should be done by bending the knees first and keeping the spine upright. Most patients recover within three months.

However, if these treatments are not successful, surgery may be necessary. Disk surgery involves removing a part of the disk that has slipped against a nerve. Exercise, weight management, and lifestyle changes are recommended following surgery to avoid a recurrence of the injury.

▶ See also **Sciatica**

Resources

Organizations

Emory Orthopaedics, Spine Center & Sports Medicine Center.

59 Executive Park South, Atlanta, GA, 30329, Web site:
http://www.emoryhealthcare.org/departments/spine/sub_menu/herniated_disk_.html.

Spine-health.com. 790 Estate Drive, Deerfield, IL, 60015. Telephone:
312-224-4150. Web site: <http://www.spine-health.com>.

A Smallpox Death and Its Results

On September 11, 1978, Janet Parker, a medical photographer, died from smallpox. She is the last known person to do so. She contracted the virus from a research laboratory at the University of Birmingham Medical School in Birmingham, England.

After Parker's death, the World Health Organization (WHO) ordered all known stocks of smallpox to be destroyed or transferred to one of two WHO reference laboratories: the Centers for Disease Control and Prevention (CDC) in the United States and the State Research Center of Virology and Biotechnology VECTOR in Russia.

* **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

* **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.

* **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.

Smallpox

Smallpox is a contagious and often fatal infection caused by the variola (ver-e-O-luh) virus.

What Is Smallpox?

What do Queen Mary II of England, King Louis XV of France, and Czar Peter II of Russia have in common? Other than being royalty, they all died from smallpox, one of the deadliest diseases in history. This devastating illness first surfaced thousands of years ago, and many believe smallpox killed more people than all other diseases combined before it was wiped out in the late 1970s. The variola (from the Latin word “svarus,” meaning “spotted”) virus causes two types of smallpox: variola major and variola minor. Variola major (the type discussed in this entry) is extremely serious and can be fatal in up to 30 percent of cases. The milder variola minor is fatal in less than 1 percent of patients.

How Common Is the Disease?

Thanks to the vaccine* developed by Edward Jenner in 1796 and the intensified immunization program begun in 1967 by the World Health Organization (WHO), smallpox is no longer found in the world; the last naturally occurring case was reported in Somalia in Africa in 1977. Before this successful eradication program, the illness affected millions of people of all ages every year. Those who survived the severe period of infection often were left scarred or blinded.

Is It Contagious?

Smallpox is so contagious that just one infected person can launch an epidemic*. As soon as the first symptoms of the disease appear, an infected person can spread the virus by coughing, sneezing, or even talking. These actions expel tiny virus-packed drops of moisture into the air. When a healthy person breathes in these drops, the virus finds a new home. Less often, touching patients' sores or even just their bed linens or clothes can spread the infection. Smallpox is typically most contagious during the first week of illness. Outbreaks of the disease in a community tended to occur at two- to three-week intervals.

What Are the Signs and Symptoms of Smallpox?

Once the virus enters the body, it quickly reproduces and takes over healthy cells. An infected person usually is not even aware of the viral intruders for at least a week. Then the first wave of smallpox symptoms appears, often resembling those of a cold or the flu: fever, extreme tiredness, headache, backache, and, occasionally, nausea (NAW-zee-uh) and vomiting. These symptoms can last up to a week. About two to three days after the onset of symptoms, a rash of red blisters or lesions* appears



Dr. Alibert performs a smallpox vaccination on an infant in the year 1800. The doctor has scratched the skin with cowpox, which conferred immunity against smallpox (painting by Constant Desbordes). *Jean-Loup Charmet/Photo Researchers, Inc.*



suddenly on the face, arms, and palms. Within a few days, the lesions fill with fluid and pus* and spread to other parts of the body, including the inside of the nose and mouth. The sores can expand and break open, causing pain. Eventually, scabs form and later fall off. During its early stages, smallpox can be confused with chicken pox, which is caused by a different virus (varicella zoster, var-uh-SEH-luh ZOS-ter). Chicken pox produces a much milder rash that usually develops on the body and is less prominent on the face, arms, and hands.

How Do Doctors Make the Diagnosis?

Because smallpox was wiped out in the last quarter of the twentieth century, very few doctors practicing in the 21st century have ever seen a case. With the heightened awareness of the possibility that smallpox could be used as a weapon in biological warfare*, doctors are trained to recognize the disease. To make a diagnosis of smallpox, tests would be done on blood and fluid from a patient's lesions to identify the virus. To prevent a widespread outbreak, the patient would be isolated, and those in close contact with the person would be vaccinated. In the early 2000s, one diagnosed case of smallpox could cause a public health emergency.

What Is the Treatment for Smallpox?

There is no known cure for smallpox. Receiving the smallpox vaccine within four days of being exposed to someone who has the disease may prevent infection or lessen symptoms. Scientists are looking for new medicines as possible treatments for the disease. Public health agencies

* **pus** is a thick, creamy fluid, usually yellow or ivory in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

* **biological warfare** is a method of waging war by using harmful microorganisms to purposely spread disease to many people.

* **immunology** (ih-myoo-NOL-uh-jee) is the science of the system of the body composed of specialized cells and the substances they produce that help protect the body against disease-causing germs.

* **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

* **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.

BIRTH OF A VACCINE

Edward Jenner (1749–1823) often is called the father of modern immunology* because of his major contribution to ending smallpox. As an English country doctor, Jenner was fascinated that milkmaids exposed to cowpox (a disease that affects cows and is caused by a virus similar to variola) did not contract smallpox. He developed a vaccine containing live cowpox virus and injected it into an eight-year old boy. The boy did not contract smallpox, and vaccinations for the disease quickly became standard. Following Jenner's discovery, fatalities from smallpox dropped significantly. Jenner believed that his vaccine provided lifelong immunity to the disease. It is now thought, however, that the vaccine may not protect people for more than 10 years.

recommend that patients who have symptoms of smallpox be isolated immediately—either in a special unit of a hospital or at home—so that the infection does not spread to others. Healthcare workers are advised to take careful precautions when treating these patients. In the absence of a cure, treatment focuses on easing symptoms and preventing further infections. Patients may receive intravenous fluids (fluids injected directly into a vein), pain relievers, and antibiotics (to combat bacterial infections that can develop in the open sores) while the disease runs its course.

What Should an Infected Person Expect?

Smallpox infection can last from three to four weeks or until the last scabs fall off. The lesions often leave behind deep, pitted scars. When smallpox is fatal, patients usually die during the second week of illness. Smallpox can lead to serious complications, including the following:

- Hemorrhagic (heh-muh-RAH-jik) smallpox, which is associated with bleeding in the skin and body membranes
- Malignant* smallpox, in which the sores are flat and close together
- Blindness
- Bacterial infections
- Pneumonia*
- Encephalitis*

How Can Smallpox Be Prevented?

Widespread vaccination* in the United States for smallpox ended in 1972. In 1980 the WHO declared the disease eradicated. It is unknown how long vaccine-generated immunity* lasts. Many experts believe that it prevents infection for at least 10 years, but scientists think that few people in the world as of 2009 were still immune to smallpox.

DID YOU KNOW?

Before Jenner developed the cowpox vaccine, a technique called variolation achieved similar results. Medical practitioners in Asia would deliberately infect patients with a mild form of smallpox by blowing dried smallpox scabs into their noses. When they recovered, patients were immune to the disease. Thirty percent of the people who naturally contracted smallpox died, but only about 1 or 2 percent of people who had been variolated died.

By the 18th century, this dried-scab form of variolation was practiced in Africa, India, and much of the Ottoman Empire. Europeans practiced a form that involved puncturing the skin. Variolation was introduced into North America by African slaves. In Massachusetts, the Puritan clergyman Cotton Mather (1663–1728) learned about it from his slave Onesimus. Because of Mather's support of the technique, variolation was first tried during a smallpox epidemic in Boston in 1721.

Variolation was dangerous, however. Patients died from the procedure, and the mild form of the disease they contracted was still contagious and could spread to others, causing an epidemic. One son of King George III died after being variolated.

Two official facilities store samples of the virus: the CDC in Atlanta, Georgia, and the Russian State Research Center of Virology and Biotechnology in Koltsovo. In the unlikely event that bioterrorists were to get access to any of these stored samples, it is possible that they might try to use the virus to launch a biological attack. If this were to happen, vaccines would be in high demand. To prepare for such a potential emergency, mass production of the vaccine was under way in the United States in the early 2000s.

Owing to possible side effects of the smallpox vaccine, the CDC suggests that it be given only to those at greatest risk of being exposed to the virus, including military personnel and first responders, for example, medical care providers, law enforcement personnel, and laboratory workers. About one in a million people who are vaccinated die from the effects of the vaccine, and a small percentage experience scarring or serious infections.

▶ See also **Bioterrorism • Encephalitis • Varicella (Chicken Pox) and Herpes Zoster (Shingles)**

Resources

Books and Articles

Finer, Kim R. *Smallpox*. Philadelphia, PA: Chelsea House, 2004.

Peters, Stephanie True. *Epidemic! Smallpox in the New World*. New York: Benchmark Books, 2005.

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Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://emergency.cdc.gov/agent/smallpox/index.asp>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/csr/disease/smallpox/en>.

Smoking *See Addiction; Lung Cancer; Pregnancy; Sudden Infant Death Syndrome; Tobacco-Related Diseases.*

Snail Fever *See Schistosomiasis.*

Snake Bites *See Animal Bites and Stings.*

Social Phobia (Social Anxiety Disorder)

Social phobia (FO-bee-a), also known as social anxiety (ang-ZY-e-tee) disorder, is an intense, long-lasting fear of social situations in which embarrassment may occur.

Angie's Story

Kim was shy. He did not like to raise his hand in class, but when the English teacher asked him a question, he answered in a soft voice. Angie, by contrast, was so afraid of being called on that she began skipping English class. Her problem went beyond ordinary shyness. She suffered from social phobia.

What Is Social Phobia?

Social phobia is an intense, long-lasting fear of embarrassment in social situations. It is different from shyness or stage fright, however. Social phobia involves extreme anxiety, an intense feeling of fear, worry, or nervousness. It may cause people to avoid social situations or to feel intensely

self-conscious or uncomfortable and may lead to problems at home, work, or school.

Some people with social phobia are afraid of one particular type of social activity, such as giving a speech, talking in class, eating in a restaurant, or going to a party. Others have a broad form of the disorder, in which they fear and avoid almost any interaction with other people. In its most extreme form, the disorder can greatly limit people's lives. It makes it hard for them to go to school or work. It also makes it almost impossible for them to form relationships with others. Some children who have a particular and intense form of social phobia that causes them to be too anxious to speak in certain situations may have another type of disorder, known as selective mutism.

What Causes Social Phobia?

There are probably several causes for social phobia. People may learn their fear in part from watching how other people behave and what results from their behavior. Research also suggests that some people may inherit a tendency for anxiety. Research points to the possible role of the amygdala (a-MIG-da-la), a small structure inside the brain that is believed to be the seat of fear responses, whether learned or inherited. In addition, some studies have looked at the role of various hormones*, which have an effect on how the body responds to stress. Scientists have explored the theory that certain hormones may influence some people to overreact to criticism expressed by others.

What Are the Symptoms of Social Phobia?

Children with social phobia may cry, throw tantrums, freeze, shy away from others, or avoid or refuse to participate or perform in certain situations without really understanding what the problem is. Teenagers and adults, by contrast, realize the source of their fears. While they know their fears can be extreme, unreasonable, or out of proportion, they feel they cannot control them. Instead, they avoid the feared situation, or they face it with great distress. People with social phobia commonly fear situations that include the following:

- giving a speech
- performing on stage
- eating in a restaurant
- using a public restroom
- talking in class
- talking to a teacher
- going on dates
- going to parties
- meeting someone new
- talking on the phone

About 7 percent of adults in the United States show symptoms of social anxiety disorder in any given year. The problem typically starts in

Speaking Up

A common form of social phobia is fear of public speaking. Many people have a less extreme form of this fear. Toastmasters International is an organization with more than 11,700 clubs in 92 countries and more than 235,000 members worldwide. The aim of this group is to help people become more comfortable with and skilled at speaking in public. Some of the organization's tips for successful public speaking are:

- Know the material that you will present. Practice your speech, and change it if necessary.
- Imagine yourself giving the speech successfully. Imagine your voice as loud, clear, and confident.
- Realize that people do not want you to fail. They want you to be interesting and fun to listen to.
- Do not apologize for nervousness or problems. Doing so just calls attention to any problems you have.
- Think about what you are saying, not how you are saying it. Focus on getting your message across.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **serotonin** (ser-o-TO-nin) is a neurotransmitter, a substance that helps transmit information from one nerve cell to another.

* **neurotransmitters** (nur-o-trans-MIH-terz) are chemical substances that transmit nerve impulses, or messages, throughout the brain and nervous system and are involved in the control of thought, movement, and other body functions.

the mid-teens although the person may have shown social inhibition or shyness since childhood. It can also begin in childhood. The problem occurs more often in women than men, but a higher percentage of men who have social phobia seek treatment for it.

How Are Teenagers Affected?

Most teenagers feel self-conscious at times, but those who are gripped by social phobia may be so overcome by self-doubt and worry that they find it hard to join in social activities. Instead, they may withdraw to the point where they have trouble making and keeping friends or participating in class. Their constant fear of being criticized or judged harshly may lead them to fret too much about their health and appearance. Some teenagers may try to escape the anxiety by drinking alcohol or using other drugs. Others may try to mask fear by acting like class clowns. Still others may stop going to school or taking part in after-school activities and may avoid opportunities to socialize with friends. As a result, their grades may fall, and their self-esteem may decline.

How Is Social Anxiety Disorder Treated?

Medications Four out of five people with social anxiety disorder feel better when treated with medications, psychotherapy, or both. Several kinds of medications have been shown to help people with the disorder. Although they cannot cure social anxiety, certain medications, called selective serotonin* reuptake inhibitors, can decrease the intensity of anxiety, allowing people to learn and practice new ways to feel comfortable in social situations. These medications work to correct imbalances in neurotransmitters* (such as serotonin), which play a part in mood conditions such as anxiety and depression. Other medications that are sometimes used are benzodiazepines (BEN-zo-dy-AZ-a-peenz), fast-acting agents that help people relax and decrease physical symptoms of anxiety such as sweating, trembling, and a pounding heart.

Psychotherapy In psychotherapy (sy-ko-THER-a-pee), people talk about their feelings with a mental health professional, who can help them change the thoughts, behaviors, or relationships that play a part in their problems. With social phobia, certain approaches to therapy can be especially helpful. Exposure (ex-PO-zhur) therapy is a technique in which people are gradually introduced, in a relaxed and supportive environment, to situations that frighten them, until they begin to feel more and more comfortable. Anxiety management training includes various techniques, such as deep breathing, that people can be taught to use to help control their distress. Cognitive techniques help people learn to identify beliefs they have that might not be reasonable (for example, “I will die if I have to give this talk”) and replace them with more realistic ideas about the likelihood of danger in social situations (for example, “It might be uncomfortable, but I know the material, and I will be okay”).

▶ See also **Anxiety and Anxiety Disorders** • **Selective Mutism**

Resources

Books and Articles

Hollander, Eric, and Nicholas Bakalar. *Coping with Social Anxiety: The Definitive Guide to Effective Treatment Options*. New York: Holt, 2005.

Organizations

Anxiety Disorders Association of America. 8730 Georgia Avenue, Suite 600, Silver Spring, MD, 20910. Telephone: 240-485-1001. Web site: <http://www.adaa.org>.

National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov/health/topics/social-phobia/index.shtml>.

Social Phobia/Social Anxiety Association. 2058 E. Topeka Drive, Phoenix, AZ, 85024, Web site: <http://www.socialphobia.org>.

Soft Tissue Infections See *Skin and Soft Tissue Infections*.



Soiling results when solid body waste becomes hard and compacted in the large intestine, blocking it and causing it to stretch out of shape. If softer waste (liquid stool) seeps around the blockage, it can leak out of the anus, causing soiling. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Soiling (Encopresis)

Soiling, also called encopresis (en-ko-PREE-sis), is having uncontrolled bowel movements in one's underwear.

What Is Soiling?

Young children routinely have bowel movements in their diapers or underwear, but by about three years of age most children are able to maintain good bowel control and can be toilet-trained. When people who have established bowel control begin to have a bowel movement in their pants, the condition is called soiling, or encopresis. This soiling is often a leaking and not a full bowel movement. Most people who have a problem with soiling do not even realize that it is happening, because they do not feel as if they are having a bowel movement. In the majority of cases, encopresis is a medical problem. This medical problem can have serious psychological effects, ranging from embarrassment to family stress to teasing.

Why Does Soiling Happen?

Soiling is related to constipation (kon-sti-PAY-shun). Constipation is infrequent, hard, and painful bowel movements. When food goes through the digestive system, it is broken down into a thick, sludge-like liquid. The nutrients that the body needs, such as sugars, are absorbed from this liquid in the small intestine. The rest of the material passes into the large intestine, where water is reabsorbed. The remaining solids, called feces (FEE-seez), are then passed out of the body as a bowel movement.

When the bowels move infrequently, the large intestine reabsorbs so much water that the feces become hard and compacted. As a result, bowel movements are painful, causing many people to try to avoid having them. Doing so only makes the problem worse. Eventually, the mass of hard solids in the large intestine causes it to stretch out of shape. As it stretches, small amounts of liquid sludge from the small intestine seep around the hard mass of feces in the large intestine and then leak out of the body. This is the material that causes soiling.

Some adults think that children soil on purpose or that soiling is evidence of a psychological problem. In reality, soiling accidents are not intentional. Sometimes children who are teased or embarrassed about soiling can have emotional or behavior problems. Generally, once the soiling is treated and stops, these problems disappear.

How Is Soiling Treated?

There are three steps to treating soiling:

- Empty the large intestine
- Establish regular bowel movements
- Maintain regular bowel movements

An enema or a laxative medication often is used to empty the large intestine. With an enema, liquid is pushed into the large intestine to soften the hard mass of feces and create the urge to expel it. Sometimes strong laxatives are used instead to encourage the intestine to contract and push out the feces.

Once the large intestine is unblocked, it is important to establish regular bowel movements to keep it clear. A doctor may recommend laxatives taken by mouth, such as milk of magnesia, products that contain senna, or mineral oil. These laxatives keep waste material moving quickly through the large intestine so that it remains soft. Setting aside time each day to try to have a bowel movement (usually after breakfast or dinner) also helps establish a regular schedule.

Once a person is having regular daily bowel movements, laxatives are reduced and then gradually eliminated so that a regular schedule can be maintained without artificial assistance. Eating a high-fiber diet and drinking plenty of liquids also help maintain bowel regularity. Once feces move through the large intestine in a regular, painless way, the problem of soiling disappears. Unfortunately, it often takes time for soiling to be diagnosed correctly and properly treated. Sometimes consultation with

a mental health professional, who works with a person's doctor, helps in developing a good behavioral treatment program that also minimizes emotional difficulties.

▶ See also **Bedwetting (Enuresis)**

Resources

Books and Articles

Galvin, Matthew. *Clouds and Clocks: A Story for Children Who Soil*, 2nd ed. Washington, DC: Magination Press, 2007.

Organizations

American Academy of Pediatrics. 141 Northwest Point Boulevard, Elk Grove Village, IL 60007-1098. Telephone: 847-434-4000. Web site: http://www.aap.org/publiced/BK5_Soiling.htm.

* **hypochondria** (hy-po-KON-dree-ə) is a mental disorder in which people believe that they are sick, but their symptoms are not related to any physical illness.

Somatoform Disorders

Somatoform (so-MAT-a-form) disorders are a group of conditions in which physical symptoms suggest a disease or medical condition, but no physical cause can be found. The term “somatoform” is derived from the Greek “soma,” meaning “body.” A “somatoform disorder” is one in which emotional problems are transformed into body symptoms. These disorders include hypochondria, conversion disorder, and somatization (so-ma-ti-ZA-shun) disorder. Somatoform disorders do not include malingering or Munchausen syndrome, both of which involve pretending to be physically ill or intentionally producing the symptoms of an illness.*

How Can Somatoform Disorders Be Told Apart?

Somatoform disorders are alike in that they involve physical symptoms without evidence of physical disease. The symptoms stem from an emotional cause. To understand how the disorders differ from each other, it may be helpful to consider the cases of three young people in a doctor's waiting room who were all having trouble with their voices. Tommy, a teenager, was only hoarse, but he feared this meant that he was getting throat cancer. Nine-year-old Mary had suddenly lost her voice completely and could not speak. Lillian, who was 25, was also hoarse and coughing, but she had many other symptoms, including dizziness and a stomachache.

As it turned out, Tommy was suffering not from cancer but from hypochondria. He had been much too worried about his hoarseness,

which had come from cheering for his high school football team. The doctor could find nothing wrong with Mary's larynx, or voice box. Her mother said that Mary had been punished severely for "talking back," and the doctor suspected that she had lost her voice because of conversion disorder. None of Lillian's many symptoms, which had come and gone for years, could be traced to any physical disorder. The doctor thought that she must have somatization disorder. Tommy, Mary, and Lillian were referred to mental health professionals for treatment.

More Symptoms of Somatoform Disorders

Hypochondria People with hypochondria have the fear or belief that they have a serious illness, such as heart disease or cancer, even though medical tests show no sign of disease. People with this condition may be excessively concerned with a wide range of common, usually minor, symptoms, such as coughing, nausea, dizzy spells, and various aches and pains. When their physician reassures them that these symptoms do not mean that they are seriously ill, they are not always convinced and may remain anxious, worried, and preoccupied with their symptoms. They may then go to various other doctors, seeking a "true" diagnosis of the same symptoms.

Conversion disorder Conversion disorder, a much rarer somatoform disorder, might cause people to lose their voice, sight, or hearing or to become paralyzed in one or more of their limbs. They also may have trembling or lose feeling in various parts of their bodies. The condition is psychological, because medical examination can find no physical explanation for the symptoms. It typically begins suddenly after an extremely stressful event in a person's life. The symptom or affected body part is usually related in some way to the trauma or stress that triggered the conversion reaction. For example, a soldier who is extremely distressed after killing people during combat might develop "paralysis" in his weapon arm. Conversion disorder resulting from war experience has also been called shell shock or battle fatigue. Someone who has witnessed the murder of a loved one may develop "blindness" as a conversion symptom.

Somatization disorder In somatization disorder, there are many different recurring symptoms in various parts of the body. These may include headache, backache, and pains in the abdomen, chest, and joints. There also may be digestive symptoms, such as nausea and abdominal bloating, or symptoms that involve the reproductive and nervous systems. As in other somatoform disorders, medical examinations and testing generally detect no clear physical cause for the symptoms.

Pain disorder and body dysmorphic disorder Two other kinds of somatoform disorders are pain disorder and body dysmorphic (dis-MOR-fik) disorder. Pain disorder is similar to somatization disorder, except that pain is the main symptom. The pain may be in one or several

areas of the body, but it does not fit a pattern of any particular medical illness or injury, and diagnostic tests fail to show the presence of any disease. In body dysmorphic disorder, a person becomes extremely concerned about some imagined or very slight body defect. Sometimes called “imagined ugliness,” body dysmorphic disorder can cause great distress and cause a person to avoid being seen in public. In some cases, a person may seek unnecessary plastic surgery.

What Causes Somatoform Disorders?

The causes of somatoform disorders are not clearly understood. In hypochondria, a person may be overly sensitive to body sensations, or they may exaggerate the meaning of normal body sensations. A distressing memory of childhood illness may also play a part. It is believed that conversion disorder, somatization disorder, and pain disorder are all caused by the conversion, or shifting, of stressful emotional events or feelings of conflict into body symptoms to relieve anxiety*. Body dysmorphic disorder involves a distorted body image and may be influenced by cultures that emphasize the importance of physical appearance and early experiences which may have interfered with developing self-esteem.

How Are Somatoform Disorders Diagnosed and Treated?

Somatoform disorders are diagnosed by performing a medical evaluation and testing to determine whether there is a physical reason for a patient’s symptoms and complaints. If there is not, a somatoform disorder may be diagnosed by looking closely at the particular signs and symptoms. A correct diagnosis is important, in order to avoid unnecessary surgery and other medical procedures and to begin proper treatment for the particular disorder.

Psychotherapy Psychotherapy* is the appropriate treatment for somatoform disorders. With the help of a mental health professional, a person tries to understand and resolve anxiety, trauma, or conflicts that are behind these conditions. Treatment may take varying lengths of time, depending on the severity of a disorder in a particular person.

▶ See also **Anxiety and Anxiety Disorders • Body Image • Conversion Disorder • Hypochondria • Malingering • Munchausen Syndrome • Stress and Stress-Related Illness**

Resources

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://familydoctor.org/online/famdocen/home/common/pain/disorders/162.html>.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person’s physical or mental well-being.

* **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.



▲
A red and inflamed throat from pharyngitis, an infection caused by *Streptococcus* bacteria. Dr. P. Marazziti
Photo Researchers, Inc.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **influenza** (in-floo-EN-zuh), also known as the flu, is a contagious viral infection that attacks the respiratory tract, including the nose, throat, and lungs.

* **adenovirus** (ah-deh-no-VY-rus) is a type of virus that can produce a variety of symptoms, including upper respiratory disease, when it infects humans.

* **mononucleosis** (mah-no-nu-kee-O-sis) is an infectious illness caused by a virus with symptoms that typically include fever, sore throat, swollen glands, and tiredness.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

Children's Hospital Boston. 300 Longwood Avenue, Boston, MA 02115. Telephone: 617-355-6000. Web site: http://www.childrenshospital.org/views/august06/somatoform_disorders.html.

Sore Throat/Strep Throat

The pain and discomfort of a sore throat, also called pharyngitis (fair-un-JY-tis), are usually the result of inflammation due to infection or irritation.

Strep throat is caused by bacteria in the *Streptococcus* (strep-to-KOK-us) family. Its main symptoms are sore throat and fever. The medical term for strep throat is streptococcal pharyngitis.*

What Is a Sore Throat?

A sore throat can be a symptom of many infectious diseases. Viral infections such as the common cold, influenza*, adenovirus* infection, and infectious mononucleosis* cause most sore throats. Bacterial infections are less common, but the sore throats they produce usually are more severe. Group A beta hemolytic streptococci (he-muh-LIH-tik strep-tuh-KAH-kye) are the most common bacterial culprits, and they cause strep throat. Rarely, fungal infections can cause a sore throat, usually in people with a weakened immune system*. Non-infectious causes of sore throat include allergies, postnasal drip (the dripping of mucus from the back of the nose into the throat), and too much yelling or straining the voice. Smoking and other irritants can also cause a sore throat.

Are Sore Throats Common?

Sore throats are very common, especially in children. It is not unusual for children between the 5 and 10 years of age to develop several sore throat infections over the course of a year. Most of these illnesses are common viral respiratory infections. About 15 percent of all sore throats are caused by group A streptococci.

All of the infections that cause sore throats are contagious. They can spread through contact with drops of fluid from an infected person that can be coughed or sneezed into the air. The drops can be inhaled or transferred by the hand to the mouth or nose. The infections that cause sore throats also can spread through direct contact with an infected person, such as through kissing.

What Are the Signs and Symptoms of a Viral Sore Throat?

Sore throats are painful, sometimes swollen, and red. Many viral infections that cause sore throats are associated with other symptoms, including hoarseness, runny nose, cough, and diarrhea*.

Sore throat is a common symptom of infectious mononucleosis, a viral infection caused by the Epstein-Barr (EP-steen BAR) virus. The tonsils* become very swollen and may have white patches or an extensive coating. Swallowing is difficult, and in a few cases, the tonsils enlarge enough to cause difficulty breathing. Other signs and symptoms of mononucleosis include swollen lymph nodes* in the neck, fever, extreme tiredness, muscle aches, and an enlarged spleen.

What Are the Symptoms of Strep Throat?

People with strep throat feel generally weak and tired. The tonsils often are enlarged, there may be white specks and pus* on them, or they may be covered with a gray or white coating. Other symptoms of strep throat include high fever; headache; enlarged and tender lymph nodes in the neck; and abdominal* pain.

How Do Doctors Diagnose the Cause of a Sore Throat?

If a patient's sore throat and other symptoms match those of a common viral cold or respiratory infection, the doctor may base the diagnosis on the physical symptoms alone. Nasal and throat swabs can be tested to detect other causes of a sore throat, if necessary.

If the doctor suspects that a patient might have a strep throat infection, the doctor uses a cotton swab to take a sample from the throat and tonsils for a culture*. Often, the doctor will do a rapid strep test of the bacteria from the throat swab in the office. This quick test can give the doctor results in 10 to 15 minutes. A positive result indicates that strep bacteria are present; a negative result means that the strep bacteria may or may not be present and the more extensive culture should be done.

Infectious mononucleosis is diagnosed by examining blood samples for antibodies* to the virus.

How Is a Sore Throat Treated?

Treatment of a sore throat depends on the diagnosis. If it stems from a common cold caused by a virus, treatment is aimed at relieving symptoms until the illness disappears. Drinking plenty of fluids can help prevent dehydration* and clear out mucus* in the back of the throat. Water, ginger ale, warm tea with honey, and clear soups are good choices, but not acidic juices (such as lemonade or orange juice), because they can irritate the throat. Gargling with warm salt water can help soothe a sore throat, and over-the-counter pain relievers and throat drops can help ease symptoms as well. Antibiotics are not effective for treating viral infections such as colds. Most viral sore throats go away on their own without complications, and they generally clear up within a few days to a week.

The best treatment for infectious mononucleosis is rest. In addition, over-the-counter medications such as acetaminophen* can help relieve pain and fever. Studies have shown that one type of antiviral medication

* **tonsils** are paired clusters of lymphatic tissue in the throat that help protect the body from bacteria and viruses that enter through a person's nose or mouth.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **pus** is a thick, creamy fluid, usually yellow or ivory in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

* **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

- * **corticosteroids** (kor-tih-ko-STIR-oyds) are chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.
- * **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.
- * **scarlet fever** is an infection that causes a sore throat and a rash.
- * **rheumatic fever** (roo-MAH-tik) is a condition associated with fever, joint pain, and inflammation affecting many parts of the body, including the heart. It occurs following infection with certain types of strep bacteria.
- * **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.
- * **abscesses** (AB-seh-sez) are localized or walled off accumulations of pus caused by infection that can occur anywhere within the body.

(valacyclovir) may be useful in reducing the severity of symptoms. Severe cases of infectious mononucleosis may benefit from the administration of corticosteroids* to reduce swelling and inflammation. Infectious mononucleosis can take from one to two months to subside, and other symptoms from the illness, such as tiredness, can remain for months after.

How Is Strep Throat Treated?

When strep throat has been diagnosed, a course of antibiotic* is usually prescribed. A doctor may recommend a 10-day course of treatment or alternatively a one-time antibiotic shot, which can be an advantage if a patient experiences difficulty swallowing, nausea or vomiting. Regardless of type, any antibiotic should be taken as directed to prevent complications. Symptoms of strep throat usually improve within one to two days of starting the antibiotic.

What Are the Complications of a Strep Throat?

Strep throat can lead to scarlet fever*, rheumatic fever*, kidney* problems, including post-streptococcal glomerulonephritis, or throat abscesses*. Prompt treatment with antibiotics can prevent most of these complications.

Can Sore Throats Be Prevented?

Many respiratory infections both viral and bacterial are spread through contact with respiratory fluids from infected people. People who have respiratory infections and sneeze or cough in a classroom, on a playground, or in another crowded environment, can spread the infection to other people. Moisture droplets from their coughing or sneezing are passed into the air. Others inhale these germs, and then they too become infected.

Another way respiratory infections can be passed along is by hand-to-hand contact or by touching objects that an infected person has recently handled. That is why doctors tell people to wash their hands regularly. If someone has an infection or has been in close contact with someone who does, it is wise not to share utensils, food, and drinking glasses with that person.

▶ See also **Common Cold • Glomerulonephritis • Influenza • Laryngitis • Mononucleosis, Infectious • Rheumatic Fever • Scarlet Fever • Streptococcal Infections**

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Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web sites: <http://familydoctor.org/online/famdocen/home/common/infections/cold-flu/163.html>; <http://familydoctor.org/online/famdocen/home/common/infections/common/bacterial/670.html>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/strepThroat/default.htm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web sites: <http://www.nlm.nih.gov/medlineplus/streptococcalinfections.html>; <http://www.nlm.nih.gov/medlineplus/ency/article/003053.htm>.

Spastic Colon *See Irritable Bowel Syndrome.*

Speech Disorders

A speech disorder is a condition that interferes with a person's ability to speak clearly and be understood. It may be caused by congenital problems, developmental delays, hearing problems, accidents, strokes, or defects in any of the organs or muscles involved in producing speech or in any of the areas of the brain that control speech.

How Does Speech Develop?

Speech and language develop most intensively during the first three years of life. When babies are born, they can make sounds by pushing air out of the lungs and through the vocal cords in the throat. The air vibrates these vocal cords, located in the larynx (LAR-inks) or voice box, creating sound.

Newborns learn that a cry will bring food, comfort, and companionship, and they begin to recognize certain sounds. As the jaw, lips, tongue, throat and brain develop over the first nine months of life, infants learn how to use the voice to mimic simple controlled sounds, such as “ba ba” or “da da.” During this time, they learn to regulate the action of muscles in the face, mouth, neck, chest, and abdomen to produce speech-like sounds. At first, these sounds do not convey meaning as words do. Eventually, however, children begin to use words that others can understand. The responses they get encourage them to speak more and more. With practice, words become more understandable.

SIGN LANGUAGES

Spoken language is not the only way that people can communicate. Many people who are deaf and/or unable to speak learn to communicate through manual communication or signed language. In the early 2000s, three signed languages were used in the United States: American Sign Language (ASL), Signed Exact English, and Cued Speech.

In the mid-1700s, a French educator working with poor deaf children developed a system for spelling out French words with a manual alphabet, expressing whole concepts with one or two hand signs, and adding emphasis with standardized facial expressions. In 1816, Thomas Gallaudet (1787–1851) brought French Sign Language to the United States. French Sign Language was modified to incorporate English terms, while maintaining French sentence structure, to form what later was called American Sign Language (ASL). Gallaudet University in Washington, D.C., is named for Thomas Gallaudet.

Signed Exact English was developed by educators in California who worked with children with hearing loss and deafness. This language takes the same alphabet and hand signs as American Sign Language, but places them into English sentence structure.

Cued Speech, developed in 1966 by the American scientist R. Orin Cornett, uses hand signs to represent sounds, rather than letters or concepts. It is used in conjunction with mouthing of word cues, such as the most prominent vowel in each word.

During the preschool years, children increase their mastery of speech sounds, word and sentence formation, word and sentence understanding, the tone and rhythm of speech, and effective use of language.

What Can Go Wrong?

Speech disorders arise from many different conditions and have a wide range of causes. Two main parts of the brain are involved in producing and understanding speech: Broca's area and Wernicke's area. Broca's area coordinates the muscles of the lips, tongue, jaw, and vocal cords to produce understandable speech. Wernicke's area controls the comprehension, or understanding, of others' speech. Damage to these or other portions of the brain or to the nerve connections to the organs that make speech (tongue, mouth, chest, and so forth) can result in disordered speech.

Stroke, trauma, or infection may be the root cause of these disruptions. Severe mental retardation often has a negative impact on speech development. In some cases, anatomy plays a role in speech disorders, for example cleft palate, cleft lip, hearing problems, and damage to the larynx all can interfere with speech.

Speech disorders are fairly common in children. Many children show delays in developing speech, a condition that is frequently outgrown. Often the cause of a child's speech disorder is never known.

When adults develop a speech disorder after years of speaking normally, it usually is easier to locate the cause. For instance, a stroke, head injury, brain tumor, or dementia* may involve damage to the areas of the brain that affect speech or speech understanding. In other cases, an accident, a surgical procedure, or a viral infection can cause damage to the nerves that control the functions of the larynx.

Phonological (Articulatory) Disorders

Phonological (articulatory) (ar-TIK-yoo-la-tor-ee) disorders interfere with the process whereby the muscles of the mouth, tongue, jaw, throat, and diaphragm work together to produce clear, understandable sounds. These problems typically begin in childhood and can persist into adulthood. They also may be called fluency disorders.

It is normal for children to have problems with articulation as they are learning to speak. For instance, many children between the ages of two and three are unable to pronounce the sound “th.” Other children in this age group stutter, which means that they repeat sounds occasionally or hesitate between words. Most children outgrow such problems rather quickly. If problems persist, however, they are considered speech disorders.

Lisp A lisp is a relatively common speech disorder in which a person has trouble pronouncing the sounds of the letters *s* and *z*. One of the most well-known lispers is the cat, Sylvester, featured in the Tweety Bird cartoons, whose favorite exclamation is “thuffering thuccotash!” (suffering succotash)

Lisping can happen for a variety of reasons: an abnormal number or position of teeth; unconscious imitation of other lispers; defects in the structure of the mouth, such as a cleft palate; or hearing loss. Usually lisps can be corrected by working with a speech-language therapist who coaches the person with the lisp on how to make the sound correctly.

Stuttering Stuttering often begins in early childhood and may persist into adulthood. People who stutter repeat certain speech sounds, or prolong certain sounds, or hesitate before and during speaking. Stuttering often is referred to as a fluency disorder because it disrupts the smooth flow of speech. More than million Americans stutter, and most began stuttering between the ages of two and seven.

Stuttering can have social and emotional consequences. People who stutter may be self-conscious about their speech. Some show signs of tension, such as twitching, unusual facial expressions, or eye blinks, when trying to get words out. Experts are not sure what causes stuttering, although some studies show that stuttering has a tendency to run in families, suggesting that it may have a genetic component.

Other cases of stuttering may be neurogenic (noor-o-JEN-ik), meaning that they are caused by signal problems between the brain and the nerves or muscles that control speech. Stuttering also may result from emotional trauma, stress, or other psychological causes.

* **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

SUCCESSFUL SPEAKERS

What do singers Carly Simon and Mel Tillis, television journalist John Stossel, and actors James Earl Jones, Marilyn Monroe, and Bruce Willis have in common? All had the problem of stuttering. Their public successes point to one of the unique features of stuttering: although it is a problem in everyday conversation, it often disappears when someone is singing or delivering memorized lines. Further, people who stutter often can learn strategies for overcoming the problem as they grow older.

James Earl Jones

In his autobiography, actor James Earl Jones describes how he overcame his stuttering problem by reading Shakespeare aloud to himself and then reading to audiences, debating, and acting. Jones provided the voices for Darth Vader in *Star Wars* and King Mufasa in the animated *Lion King*; he has also acted on stage and in numerous films.

John Stossel

As a reporter for the television news magazine *20/20*, John Stossel depends on his voice to make a living. He stuttered as a child and worked hard to hide the condition. Stossel started his career in news as a researcher, but eventually he was asked to go on the air. He considered quitting when he found himself stumbling over certain words, but he got help overcoming his stuttering through speech therapy at the Hollins College speech clinic in Roanoke, Virginia. Stossel later became a spokesman for the National Stuttering Association.

Researchers have found that stuttering affects males about three times more often than females. Certain situations, such as speaking before a group of people or talking on the telephone, may make stuttering more severe for some, whereas singing or speaking alone often improve fluency.

Most young children outgrow their stuttering, and it is estimated that less than 1 percent of American adults stutter. However, children who do not outgrow stuttering by the time they enter elementary school may need speech therapy. Many people have overcome stuttering and gone on to achieve success in careers that require public speaking, acting, and singing.

Brain Disorders

Speech disorders in adults usually are the result of damage to the portions of the brain that control language. Damage may be caused by head injury, brain tumor, or stroke. Adults who have aphasia (a-FAY-zha) have trouble speaking and difficulty understanding what others are saying. Dysphasia (dis-FAY-zha) is a condition that causes similar, but less severe, challenges in speaking and understanding. The symptoms of aphasia and dysphasia depend on which area of the brain is affected: Broca's area or Wernicke's area.

Broca's aphasia Broca's aphasia results from damage to the area that coordinates the muscles of the lips, tongue, jaw, and vocal cords that produce understandable speech. People with damage to Broca's area frequently speak in short, meaningful phrases that are produced with great effort, omitting small words such as "is," "and," and "the." People with Broca's aphasia often are aware of their speech difficulties and may become frustrated by their speech problems.

Wernicke's aphasia Wernicke's aphasia results from damage to the area of the brain responsible for understanding speech. People afflicted with this form of aphasia have trouble understanding others and often are unaware of their own problems. They may speak in long rambling sentences that have no meaning, often adding unnecessary words. They may even create nonsense words.

Global aphasia Global aphasia results from damage to large portions of the language areas of the brain. Individuals with global aphasia have severe communication difficulties and may be extremely limited in their ability to speak or to comprehend language.

How Are Speech Disorders Diagnosed and Treated?

Diagnosis Many adults recognize when they develop a speech difficulty and seek help from doctors and trained speech-language therapists. Parents of children with speech disorders often are the first to call the condition to the attention of healthcare providers.

Speech-language therapists often make an initial evaluation to help determine what problems exist and the best way to treat them. Because talking and hearing are closely related, children with speech disorders often undergo a hearing evaluation done by an audiologist (aw-dee-OL-o-jist), who is educated in the study of the hearing process and hearing loss. The audiologist can determine if a person has a hearing loss, identify the type of loss, and recommend how the person can make the best use of any remaining hearing. When the speech disorder is caused by damage to the nerves or brain, a neurologist* may also be involved in the evaluation process.

Treatment People with aphasia often benefit from speech-language therapy, which focuses on helping people make the most of their remaining abilities and learning other methods of communicating. Supplemental methods of communication that assist an individual in speaking are called Augmentative Communication Devices (ACDs). Available ACDs include portable communication computers, personalized language boards, and picture exchange programs. As technology continues to improve and become more portable, communication possibilities for aphasic and dysphasic adults continue to expand.

▶ See also **Alzheimer's Disease • Brain Tumor • Cleft Palate • Deafness and Hearing Loss • Infection • Intellectual Disability • Laryngitis • Stroke • Trauma • Viral Infections**

* **neurologist** (new-RHAL-eh-jist)
a physician who specializes in diagnosing and treating diseases of the nervous system.

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Organizations

- American Speech-Language-Hearing Association.** 2200 Research Boulevard, Rockville, MD, 20850-3289. Toll free: 800-638-8255. Web site: <http://www.asha.org/public/speech/disorders>.
- National Aphasia Association.** 350 Seventh Avenue, Suite 902, New York, NY, 10001. Toll free: 800-922-4622. Web site: <http://www.aphasia.org>.
- National Institute on Deafness and Other Communication Disorders, National Institutes of Health.** 31 Center Drive, MSC 2320, Bethesda, MD, 20892-2320. Toll free: 800-241-1044. Web site: <http://www.nidcd.nih.gov>.
- National Stuttering Association.** 119 W. Fortieth Street, 14th Floor, New York, NY, 10018. Toll free: 800-937-8888. Web site: <http://www.nsastutter.org>.
- Stuttering Foundation of America.** P.O. Box 11749, 3100 Walnut Grove Road, Suite 603, Memphis, TN, 38111-0749. Toll free: 800-992-9392. Web site: <http://www.stutteringhelp.org>.

Spina Bifida

Spina bifida (SPY-na BI-fi-da) is a birth defect in which the spinal column does not form properly, leaving a gap or opening in the spine.

Brian Teaches Class

As part of a sixth-grade science project, Brian chose to report on a condition called spina bifida. He showed a picture of the ring-shaped bones, or vertebrae, of the spine and demonstrated how the vertebrae protect the spinal cord and anchor muscles. He explained that in people with spina bifida, some of the bony plates that should cover the spine do not close, leaving an unprotected opening at the back of the spine.

No one in Brian's class had ever heard of spina bifida, and they all were surprised to learn that Brian had been born with it. He had a mild form of the condition, but he underwent a surgical procedure that corrected it when he was an infant. He ended his presentation by showing the small scar on his lower back.

What Is Spina Bifida?

Spina bifida is a Latin term meaning “split spine” or “open spine.” It is the most common of several birth defects called neural tube defects. The neural tube contains the cells that ultimately make the spinal cord, spine, and brain, and it develops during the first three to four weeks of pregnancy (often before a woman even knows that she is pregnant).

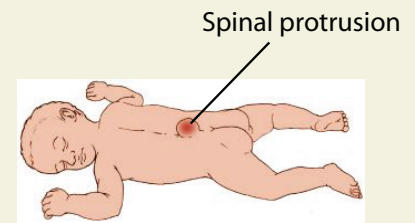
Spina bifida results when the sides of the neural tube fail to join together properly, leaving an open area. Often the gap occurs in the lower back at the base of the spine. The spinal cord is part of the central nervous system, which allows individuals to move and sense the world around them. Because spina bifida involves the central nervous system, it can cause a range of physical and mental problems.

Prenatal Testing for Spina Bifida

Sometimes parents can find out whether their baby has spina bifida before birth. Several commonly used tests can help to provide this information.

Maternal-Serum Alfa-Fetoprotein (AFP) Test This test is performed between the sixteenth and eighteenth weeks of pregnancy. Alfa-fetoprotein is a substance made by the developing fetus. Because the mother and fetus are connected via their circulatory systems, AFP from the fetus gets into the mother's bloodstream. By measuring the amount of AFP in the mother's blood, doctors get an indication of the likelihood that the fetus has certain birth defects. This test does not give a definite answer, and high levels of AFP only suggest that the fetus *might* have spina bifida. If AFP levels are high, doctors repeat the test. If the results are again high, doctors order other tests to confirm that the fetus has spina bifida. Many times, high AFP readings are false alarms and the baby is just fine.

Ultrasound Medical professionals can use ultrasound to confirm or rule out spina bifida. An ultrasound works by bouncing sound waves off of internal structures. A computer converts the returning sound waves into an image of the fetus inside the uterus. Sometimes the defect in the developing spine is visible on the ultrasound image.



▲ Babies born with spina bifida often have an unprotected opening at the back of the spine. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Amniocentesis is a procedure medical professionals can perform between the sixteenth and eighteenth week of pregnancy. In this procedure, a needle passes through the mother's belly into her uterus to collect some of the fluid that surrounds the fetus. This fluid, called amniotic fluid, contains cells and chemicals from the fetus. In this fluid, medical professionals can measure the levels of AFP to help them determine whether the fetus may have spina bifida. Like the AFP test of the maternal blood, though, the test of the amniotic fluid does not give a definite answer.

Is Spina Bifida Always Serious?

Spina bifida is a common birth defect, but it does not always cause serious problems. At birth, the gap may be so slight that it is invisible and harmless. However, sometimes the spinal cord bulges out through the malformed vertebrae and serious neurological (nerve) problems result.

Spina bifida occulta Brian was born with spina bifida occulta, the mildest form of spina bifida. "Occulta" means hidden, and in many cases, the gap in the spine is never detected. Often an opening in one or two of the vertebrae occurs, but the spinal cord is not affected. A dimple, a birthmark, or a patch of hair may be visible on the skin overlying the site of the gap.

Scientists estimate that up to 40 percent of all Americans have this form of spina bifida, but few ever know they have it. Most people with spina bifida occulta never need treatment. Brian was an exception. He needed surgery because as he grew, the lower end of his spinal cord got caught against his vertebrae, causing him to have problems controlling his bladder. The doctors "unhooked" the spinal cord and closed the gap surgically.

Spina bifida manifesta Spina bifida manifesta includes two forms of spina bifida that together represent one of the most common disabling birth defects. On average, 1 out of 1,000 babies in the United States is born with one of these forms, either meningocele (me-NING-go-seel) or myelomeningocele (MY-e-lo-me-NING-go-seel).

Meningocele Of babies born with spina bifida manifesta, about 4 percent have the meningocele form. The meninges (me-NIN-jez) consist of three layers of tough membranes that cover and protect the brain and spinal cord. The brain and spinal cord are also bathed in a fluid called cerebrospinal fluid (CSF). A meningocele is a CSF-filled sac formed when the meninges balloon through the gap in the vertebrae. It looks like a large blister covered by a thin layer of skin. The sac can range in size from as small as a grape to as large as a grapefruit.

A meningocele is harmless if the sac contains only CSF. However, if nerves are caught in the sac, the affected baby can have problems controlling muscles and the bladder. Babies with this form of spina bifida usually have surgery during infancy to put the meninges back inside the vertebrae and to close the gap in the vertebrae.

Myelomeningocele When many people think of spina bifida, they think of the myelomeningocele form. Approximately 96 percent of babies born with spina bifida manifesta have myelomeningocele, and it is the most serious type of spina bifida. As in meningocele, the meninges bulge through the gap in the spine, but in myelomeningocele, part of the spinal cord bulges out as well. The sac may be covered with skin or the nerves may actually be exposed.

People with myelomeningocele have a variety of physical and mental problems, the severity of which depends on the location of the defect in the spine. A gap high on the spinal column creates more problems than a gap at the lower back. People often experience loss of movement and feeling (paralysis) below the abnormal vertebrae. The most severely impaired children cannot walk or control their bowel or bladder. Most babies born with myelomeningocele also have hydrocephalus, which means that they have too much fluid inside and surrounding their brain. If hydrocephalus is left untreated, the excess pressure in the skull can cause blindness and permanent brain damage.

Myelomeningocele requires surgery within 24 to 48 hours of birth. Surgeons must close the gap in the vertebrae to protect the spinal cord and prevent infection. They also must treat hydrocephalus, if it is present. They do this by placing a device called a shunt into the brain to drain excess fluid and relieve pressure on the brain.

What Causes Spina Bifida?

Spina bifida sometimes runs in families, which suggests that genes may play a role in some cases. In 90 to 95 percent of cases, however, babies are born to families that have never before had a child with the condition. Mothers who have diabetes, a high fever during pregnancy, or who have taken a drug called valproic acid to treat epilepsy* seem to have a greater chance of having a baby with spina bifida than other mothers. In addition, scientists have linked a deficiency of folic acid (a B vitamin) in the mother's diet to a higher risk of having a baby with spina bifida. Adding folic acid to the diet significantly reduces the chance that a woman will give birth to a baby with spina bifida.

Living with Spina Bifida

Most children with spina bifida occulta, and many with meningocele, live normal lives without any impairment. Children born with myelomeningocele, however, often have multiple problems resulting from damage to their spinal cord. Surgery to repair the gap in the vertebrae and to place a shunt in the brain can prevent further damage to the nervous system. It cannot, however, reverse the nerve problems that are already present at birth.

The severity of symptoms caused by myelomeningocele varies from child to child. A common problem is the inability to control the bowel and bladder. Catheters*, diapers, and attentive caregivers can all play a role in helping to control this problem and/or in alleviating associated embarrassment.

Preventing Spina Bifida: The Role of Folic Acid

Scientists have linked spina bifida to a deficiency of folic acid during the first weeks of pregnancy. One of the B vitamins, folic acid is essential for proper functioning of the human body. During pregnancy and during fetal development, the mother's body and the fetus's body need more folic acid than usual.

Scientists estimate that the incidence of spina bifida can be decreased by about 70 percent if all women of child-bearing age consume 0.4 mg of folic acid each day.

Good sources of folic acid include dark-green, leafy vegetables (such as spinach and broccoli); eggs; and orange juice. In addition, the U.S. Food and Drug Administration mandates that breads, enriched grains, and cereals have folic acid added to them. Even with folic acid supplements added to common foods, the average American diet does not contain 0.4 mg of folic acid per day. Most multivitamins, however, contain the recommended dose of folic acid.

* **epilepsy** (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.

* **catheters** (KAH-thuh-ters) are small plastic tubes placed through a body opening into an organ (such as the bladder) or through the skin directly into a blood vessel. They are used to give fluids to or drain fluids from a person.

* **catheter** (KAH-thuh-ter) is a small plastic tube placed through a body opening into an organ (such as the bladder) or through the skin directly into a blood vessel. It is used to give fluids to or drain fluids from a person.

Many affected children cannot walk without crutches or leg braces, and many need a wheelchair. In addition, some children have learning difficulties, particularly with reading and math. Special education classes can help them in their academic work.

Children with spina bifida often develop sensitivity or an allergy to latex (natural rubber), which is used in such healthcare products as gloves and catheter* tubes. The allergy probably develops because they come into contact with latex so often and at such a young age as a result of their medical care.

Even with the disabilities caused by spina bifida, children who have the condition often live well into adulthood. With the help of early and continuing medical, psychological, and educational treatment, children with spina bifida can lead full and productive lives.

▶ See also **Birth Defects and Brain Development • Hydrocephalus • Incontinence • Paralysis**

Resources

Books and Articles

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Sandler, Adrian. *Living with Spina Bifida: A Guide for Families and Professionals*. Chapel Hill: University of North Carolina Press, 2003.

Organizations

March of Dimes. 1275 Mamaroneck Avenue, White Plains, NY, 10605. Telephone: 914-997-4488. Web site: http://www.marchofdimes.com/pnhec/4439_1224.asp.

Spina Bifida Association. 4590 MacArthur Boulevard, NW, Washington, DC, 20007. Toll free: 800-621-3141. Web site: <http://www.sbaa.org>.

Spinocerebellar Ataxia

A spinocerebellar ataxia (SCA) is one of a group of inherited disorders in which individuals experience degeneration of the cerebellum leading to uncoordinated and clumsy movements that get worse over time. The word "ataxia" literally means "without order" and refers to the symptom of uncoordinated (or unordered) movement.

What Is Spinocerebellar Ataxia?

When it comes to movement, a vital part of the body is the cerebellum (sare-uh-BELL-um), a portion of the brain located at the back of the head. It helps the body make smooth and coordinated movements. A group

of 28 different types of disorders, together called spinocerebellar ataxias or spinal cerebellar ataxias (SCA), interfere with that control and lead to uncoordinated movement, which is known as “ataxia.” The 28 types of SCA are distinguished by the age of onset, the genes* involved, the symptoms in addition to ataxia, the degree of severity of symptoms, the progression of the disease, and the prognosis. The types of SCA are classified either by the chronological order of gene discovery or by the names of families in which they were first discovered (such as Machado-Joseph disease), or by the chronological order of gene discovery (such as SCA 3).

How Common Is Spinocerebellar Ataxia?

The SCAs are rare diseases and accurate estimates of their incidence were unavailable as of 2009. Type 3 is the most common (23% of all SCAs). Other more common SCAs are Type 1 (16%), 2 (18%), 6 (17%), and 7 (2–5%). Some types occur more often in certain ethnic groups, such as SCA 3 in Portuguese and German persons, SCA 10 in Mexicans, SCA 13 in French individuals, and SCA 14 in Japanese people.

People who experience ataxias usually begin having symptoms when they are between 30 and 50 years of age, and the symptoms worsen over 10 to 20 years. The onset exceptions are SCA 2 and SCA 7, which start in childhood.

Is Spinocerebellar Ataxia Inherited?

Spinocerebellar ataxias are inherited disorders. They arise because of a mutation* that disrupts the construction of DNA*, which in turn affects the production of proteins that are essential to properly running bodily functions. The problem in SCAs begins in the building blocks of DNA.

How Does DNA Make Proteins? DNA has the shape of a twisted ladder, but unlike an actual ladder, DNA can peel apart like a zipper into two halves, which are called strands. When DNA unzips, its “rungs” are split in two with half a rung going to each strand. Each “half-rung” of the DNA is a chemical compound called a base. DNA has only four different bases. The four bases are cytosine (C), guanine (G), adenine (A), and thymine (T). These bases line up in a particular order on the strand. Part of a DNA strand, for instance, may have the following order: CAGGTCAATCGCCAAA. Each of the four bases has a certain shape that fits nicely with one—and only one—other base: C and G fit together, and A and T fit together. As a result, the strand on the other side of the DNA “zipper” has the exact opposite order. Scientists call this opposite order “complementary.” In this example, the order would be GTCCAGTTAGCGGTTT.

To make a protein, the DNA unzips, leaving its bases exposed, and an enzyme (called RNA polymerase) starts making a new complementary strand. The new complementary strand is called messenger RNA, or mRNA. From there, another structure, called a ribosome, latches onto and runs along the newly formed mRNA. The ribosome is a matchmaker

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person’s body structure and physical characteristics. Inherited from a person’s parents, genes are contained in the chromosomes found in the body’s cells.

* **mutation** (myoo-TAY-shun) is a change in an organism’s gene or genes.

* **DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-klay-ik AH-sid), is the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.

* **nervous system** is a network of specialized tissue made of nerve cells, or neurons, that processes messages to and from different parts of the human body.

* **brain stem** is the part of the brain that connects to the spinal cord. The brain stem controls the basic functions of life, such as breathing and blood pressure.

* **autonomic nervous system** is a branch of the peripheral nervous system that controls various involuntary body activities, such as body temperature, metabolism, heart rate, blood pressure, breathing, and digestion. The autonomic nervous system has two parts—the sympathetic and parasympathetic branches.

of sorts. It reads the bases on the mRNA three at a time and then matches that three-base set, which is called a codon (COE-don), with a particular amino acid, which is another type of chemical compound that serves as a building block of proteins. All of the proteins in the human body are made of 20 amino acids, and these different amino acids correspond to specific codons. By reading one codon after another on the mRNA, the ribosome can link together an exact chain of amino acids, which becomes a particular type of protein that has an explicit job to do in the body.

A person with an inherited spinocerebellar ataxia has a mutation that can throw off the entire DNA-RNA-amino acid-protein pathway. The mutation causes numerous repeated three-base sequences. These repeats, called trinucleotide repeats, result in the production of an abnormal protein (such as ataxin in SCA 1) that may lead to dysfunction or degeneration of parts of the nervous system* and other organs. Even healthy people have a certain number of trinucleotide repeats, and this normal condition does not cause SCA. When too many repeats exist, however, an individual can develop SCA. With a moderate number of repeats, a person has the disease but may or may not manifest the symptoms.

Individuals with a moderate or large number of repeats will transmit SCA by autosomal dominant inheritance, which means that a child need only inherit an abnormal gene from one parent to get the disease. In other words, every child born to an affected parent has a 50 percent chance of inheriting SCA. The number of repeats increases with each generation (which is called “anticipation”), and symptoms start earlier with an increasing number of repeats. Thus, a child may develop symptoms at an earlier age than his or her parents or even the grandparents. In some individuals, SCA is not inherited. Instead, a mutation occurs for the first time in the egg or sperm and causes SCA. Such a first-time mutation is called a “de novo” mutation.

What Are the Symptoms and Signs of Spinocerebellar Ataxia?

All SCAs have some common symptoms even though different genetic mutations cause them. Symptoms include a drunken or wide-based gait with falls and dysarthric (slurred) or staccato (clipped) speech. Swallowing becomes difficult, and patients may inadvertently inhale some food and choke. Eye movements become slowed and nystagmus (jerky). When reaching for an object, patients’ hands may start to shake, and they may overshoot the item they are attempting to grasp. Individuals with SCA1 may have jerky or otherwise abnormal muscle movements that result from dysfunction (improper function) of the motor pathways (the muscle-controlling nerve pathways) in the brain stem* and spinal cord. Dysfunction of the nerves leads to muscle wasting, cramps and twitching, decreased muscle stretch reflexes (a muscle contraction that follows a stretch), and loss of feeling in the feet or legs in SCA 1, 2, 3 and 4. Dysfunction of the autonomic nervous system*, which are the nerves

that control automatic functions such as heart rate and digestion, causes dizziness on standing in SCA 3. Other eye abnormalities include slowed eye movements in SCA 2 and 3, an inability to close the eyes and a “staring” look in SCA 3, and vision loss due to retinal* degeneration in SCA 7. Types of SCA that start in infancy (e.g., SCA 2 and SCA 7) lead to poor muscle tone and developmental delay. Abnormal writhing or jerky limb movements can occur in SCA 3. Problems with memory and spatial difficulty (problems judging distances, causing the patient to bump into barriers or knock over items) occur in SCA 3, 12, and 13. A unique feature of SCA 6 is positional vertigo*, which causes a disconcerting spinning sensation. Convulsions* occur in SCA 7 and 10. Heart involvement occurs in SCA 7.

How Is Spinocerebellar Ataxia Diagnosed?

A neurologist* or a movement disorders specialist usually makes the diagnosis after taking a thorough medical and family history and conducting a physical exam. Frequently, the medical professional will also order blood tests to rule out other conditions, such as vitamin or thyroid gland* deficiency, and may order magnetic resonance imaging* (MRI) of the brain. The MRI will show whether the patient has a shrunken cerebellum and will also exclude other causes of ataxia such as multiple sclerosis*, ischemic strokes* or tumors*.

Genetic testing The only way to differentiate the specific type of SCA a patient has is to look for genetic mutations in DNA, which is usually obtained from blood. As of 2009, such tests were commercially available for SCA 1, 2, 3, 5, 6, 7, 8, 10, 13, 14, and 17. Medical professionals can also run tests on adults (not children) who do not have SCA but have a strong family history of SCA. Doing so determines the likelihood that these individuals will develop symptoms later in life. Such tests are only conducted after individuals have undergone genetic and psychological counseling so they can understand the personal, professional, and health implications of a positive test. Testing cannot, however, pinpoint when symptoms will start if they have no symptoms.

Prenatal (prior to birth) tests, such as chorionic villus sampling* and amniocentesis*, can determine if the fetus has inherited SCA. Based on the results, a couple can decide if they want to continue with the pregnancy or proceed to abortion on medical grounds. Such genetic testing can also look for SCA in artificially implanted embryos.

How Is Spinocerebellar Ataxia Treated?

As of 2009, no treatment was available for SCA. Over time, patients may need walkers or wheelchairs. Some patients may also require speech therapy. Therapists can help with impaired swallowing, and nutritionists can instruct patients about what types of foods they can eat. Physical and occupational therapists* can help patients learn how to modify their home and work environment to make life as easy as possible.

* **retina** (RET-i-na) is the tissue that forms the inner surface of the back of the eyeballs; it receives the light that enters the eye and transmits it through the optic nerves to the brain to produce visual images.

* **vertigo** (VER-ti-go) is the feeling that either the environment or one's own body is revolving or spinning, even though they are not.

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

* **neurologist** (new-RHAL-eh-jist) a physician who specializes in diagnosing and treating diseases of the nervous system.

* **thyroid gland** (THY-roid GLAND) is located in the lower part of the front of the neck. The thyroid produces hormones that regulate the body's metabolism (me-TAB-o-LIZ-um), the processes the body uses to produce energy, to grow, and to maintain body tissues.

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.

* **multiple sclerosis** (skluh-RO-sis), or MS, is an inflammatory disease of the nervous system that disrupts communication between the brain and other parts of the body. MS can result in paralysis, loss of vision, and other symptoms.

* **ischemic strokes** are events that occur when a blood vessel bringing oxygen and nutrients to the brain becomes clogged by a blood clot or other particle. As a result, nerve cells in the affected area of the brain cannot function properly.

- * **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.
- * **chorionic villus sampling** (KOR-ee-on-ik VIL-lus sampling) is a test in which a small tube is inserted through the cervix and a small piece of the placenta supporting the fetus is removed for genetic testing.
- * **amniocentesis** (am-nee-o-sen-TEE-sis) is a test in which a long, thin needle is inserted in the mother's uterus to obtain a sample of the amniotic fluid from the sac that surrounds the fetus. The fetal cells in the fluid are then examined for genetic defects.
- * **physical and occupational therapists** are professionals who are trained to treat injured people by means of activities designed to help them recover or relearn specific functions or movements and restore their abilities to perform the tasks of daily living.
- * **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

What Is the Prognosis for Spinocerebellar Ataxia?

Patients with milder forms can anticipate a normal life expectancy, whereas SCAs that start in infancy lead to severe disability and death in adulthood. Most people die from respiratory failure or lung complications such as pneumonia*.

▶ See also **Genetic Diseases**

Resources

Books and Articles

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- Rangamani, G. N. *Managing Speech and Swallowing Problems: A Guidebook for People with Ataxia*, 2nd ed. Minneapolis, MN: National Ataxia Foundation, 2006.

Organizations

- National Ataxia Foundation.** 2600 Fernbrook Lane, Suite 119, Minneapolis, MN, 55447. Toll free: 762-553-0167. Web site: <http://ataxia.org>.
- WE MOVE.** 204 West Eighty-fourth Street, New York, NY, 10024. Toll free: 800-437-MOV2. Web site: <http://www.wemove.org>.

Sports Injuries

Sports injuries include the physical, musculoskeletal injuries that result from taking part in a sport.

The Chris Benoit Story

Odell and his friend Jason were huge fans of pro wrestling. They never missed a weekly broadcast, and the highlight of their year was when Odell's dad took the boys to a live match. But one day in 2007, Jason called with bad news. "Did you hear? The Rabid Wolverine! He's dead!"

Odell turned on the news. It was true: One of his favorite wrestlers, Chris Benoit, a.k.a. "The Rabid Wolverine," had been found dead at his home. But the news got worse: Benoit's son and wife were dead, too. Police believed that Benoit killed them and then himself.

As he watched the report, Odell thought, "How could this have happened? He was in great shape."

Just because an athlete looks great doesn't mean he or she is not suffering from a sports-related injury.

What Are Sports Injuries?

The general term “sports injuries” includes the physical, musculoskeletal injuries that result from taking part in a sport. The most common musculoskeletal sports injuries are ankle sprains; muscle strains such as of the hamstring and groin; knee injuries, including rupture or tear of the anterior cruciate ligament (ACL); and injuries to the elbow. Generally speaking, these injuries get better with home care, which includes icing and elevating the affected area, rest, and the use of analgesics, particularly nonsteroidal anti-inflammatory drugs (NSAIDs). Approximately 4 million emergency-room visits in the United States each year involve injuries sustained while people engage in sports.

However, possible sports injuries go beyond sprains and strains, particularly among professional or hyper-fit athletes of both sexes.

What Pressures do Athletes Face?

Professional sports is a multi-billion dollar industry. In the National Football League, the value of the 31 teams averaged \$531 million as of 2002; in Major League Baseball team values averaged \$295 million. Clearly, a great deal of money is riding on the performance on professional sports teams, and that does not take into consideration the value of endorsements, products, and other income sources, or other professional sports and sports entertainment, such as bicycling and pro wrestling, or amateur athletics, including college and high-school sports.

When so much money is at stake, ethics* and personal welfare can easily take a back seat to winning.

What are Performance Enhancing Drugs?

The human body has natural limits. Training and practice hone the athlete's skills to push the edge of those limits and produce astonishing performances. But there is always the desire to be better, stronger, or faster, whether it comes from wanting personal glory or the cash rewards that follow winning. Once the natural limits are reached, some athletes turn to performance-enhancing drugs.

Anabolic steroids Anabolic steroids can be synthetic or naturally produced by the body. The male hormone testosterone is an anabolic steroid; it promotes the development of muscle and influences male traits, such as a deep voice and body hair. Men and women who take anabolic steroids develop more muscle in a relatively short amount of time. However, anabolic steroids have side effects. Men may develop shrunken testicles, prominent breasts, baldness, and a higher voice. Women may find themselves with more body hair, a deeper voice, an enlarged clitoris, and an increased appetite. Both sexes can experience baldness, increased levels of cholesterol, elevated blood pressure, and acne.

* **ethics** is a guiding set of principles for conduct, a system of moral values.

Detroit Lions linebacker Reggie Brown works with weights during a rehabilitation session at a rehabilitation institute in Houston, TX, January 12, 1998. Brown was recovering from a severe neck injury sustained in a game against the New York Jets where he collided with another player dislocated his top two neck vertebrae, bruising his spinal cord and leaving him unable to breathe and with no feeling below the neck. *AP Images.*



More worrisome, however, is the psychological condition commonly called “roid rage.” High levels of steroids have been linked to increased aggression, which can range from a mild person simply becoming more assertive to someone overreacting violently. The drugs may also uncover an underlying psychological disorder.

It is estimated that between 500,000 and 1 million young athletes have tried anabolic steroids.

Human growth hormone The ready availability of human growth hormone (HGH) and the fact that it is undetectable in standard drug tests have led some athletes to inject themselves with it. However, a 1993 study conducted by the University of Vienna with serious athletes and a study on non-athletes that appeared in the *American Journal of Physiology* found that a course of HGH injections had no effect on body weight, body fat, or the strength of the biceps or quadriceps. The researchers concluded that while HGH may help people who lack the hormone, it apparently does not change the strength or body composition of those who do not lack the hormone.

Stimulants Athletes may also turn to stimulants or diuretics to enhance their performance. Stimulants are drugs that act on the nervous system to increase heart rate and metabolism and reduce fatigue. They also sharpen focus and aggressiveness.

This group of drugs includes caffeine, amphetamines, ephedrine, cocaine, and methamphetamine. It is easy to become addicted to

stimulants, which can also cause heart problems, hypertension, weight loss, convulsions*, and brain hemorrhages.

Diuretics Diuretics remove water from the body, and athletes use them to lose weight quickly. However, as a diuretic removes fluids, it also washes out the electrolytes they carry. Electrolyte imbalances can cause muscle cramps and heart arrhythmia, and overuse of diuretics can also lead to dehydration*.

What Other Injuries Can Athletes Face?

Head and Brain Injuries Head injuries can occur in any field in sports. More than 64,000 cyclists went to emergency rooms for head injuries in 2007, far exceeding the number of football players (36,412), baseball/softball players (25,079), and basketball players (24,701).

Between 15 and 40 percent of former boxers show symptoms of chronic brain injuries, ranging from speech problems to needing institutional care. One study showed that most professional boxers have some brain damage, a result of being hit with the equivalent of a 13-pound bowling ball traveling at 20 miles an hour every time a punch is landed.

Former professional football players also have been found to suffer brain injuries. In 2007, doctors studied the brain of Justin Strzelczyk, a former Pittsburgh Steelers lineman who had died, in a car accident. They found that Strzelczyk, who was 36 when he died, had a condition more often found in people in their 80s: chronic traumatic encephalopathy. Between 1995 and 2004, 44 football players died from head injuries; during the same time period, high school and college players suffered 48 head injuries. The NFL estimates that 160 concussions occur among pro players each year. Regarding the double murder-suicide of Chris Benoit, the conclusion suggested by an autopsy* on Benoit's brain was that Benoit suffered brain damage from years of blows to the head and that this damage caused dementia*, which seemed to explain his erratic behavior and may have contributed to his violent acts.

Amenorrhea Male and female athletes, especially runners and gymnasts, have very little body fat. Female athletes can experience a decrease in or a halt to their menstrual cycle*, a condition called amenorrhea. Because female athletes may experience considerable stress during competition, have low body weight, and expend a great deal of energy, their bodies may cease to menstruate.

This condition is not permanent, and it can be corrected. A physician may prescribe birth control pills to an amenorrheic female athlete in order to restore a normal cycle.

MRSA Infections An unexpected side effect of the collegial atmosphere surrounding team sports is the spread of bacteria, including MRSA. MRSA, or methicillin-resistant *Staphylococcus aureus*, is a

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **autopsy** (AW-top-see) is an examination of a body after death to look for the cause of death or the effects of a disease.

* **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.

* **menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.

A BRIEF HISTORY OF PERFORMANCE-ENHANCING DRUGS

The use of drugs to enhance athletic performance was first suspected in 1886, when the 24-year-old Welshman Arthur Linton died during a race in France; he likely took the stimulant trimethyl.

1935: German scientists develop anabolic steroids.

1954: The doctor of the Soviet Olympic powerlifting team admits to injecting the Soviet lifters with testosterone.

1958: Ciba Pharmaceuticals releases the anabolic steroid methandrostenolone.

1960: A major article in *Sports Illustrated* discloses the use of tranquilizers, amphetamines, and other drugs among athletes.

1973: East German women win 10 of 14 gold medals at the world swimming championships.

1975: The Olympics bans anabolic steroids.

1983: Four weightlifters are stripped of their medals for using steroids at the Pan Am Games; a total of 23 medals, including 11 gold medals, are forfeited.

1988: Canadian sprinter Ben Johnson loses both his gold medal and his world record after testing positive for anabolic steroids.

1990: Federal law makes illegal the possession of steroids without a prescription.

1992: Former NFL player Lyle Alzado dies of brain cancer, that he attributed to more than

20 years of using steroids and human growth hormone. He was 43.

1998: A team is ejected from the Tour de France bicycling competition after the director admits to giving his team performance enhancing drugs, including erythropoietin.

2001: Retired baseball player Ken Caminiti admits to using steroids and estimates that half of the players in major league baseball also use them. Two years later, he suffers a heart attack and dies at age 41.

2004: A *New York Times* article estimates that between 500 and 2,000 of East German athletes who were involved in using performance-enhancing drugs face serious health problems ranging from infertility to liver tumors to heart disease.

2007: Pro wrestler Chris Benoit is found dead in his home, along with his wife and son. Police rule it a murder-suicide. Autopsy results suggest Benoit had brain damage from repeated concussions, which caused his erratic and violent behavior.

2007: Olympic runner Marion Jones is stripped of her five medals from the Sydney Olympics after admitting to using steroids.

2008: The Committee on Oversight and Government Reform in the U.S. House of Representatives begins investigations of steroid and HGH use in professional baseball and wrestling.

form of bacterial infection that can be spread by sharing equipment, uniforms, and even towels, or by the cuts and scrapes associated with team play.

The antibiotics used to treat regular staph infections cannot kill this type of bacterial infection, and so it is important for the athlete to have an infected wound tested before antibiotics are used.

To guard against MRSA infections, athletes should not share equipment, towels, or razors with teammates and should be sure to shower with soap and water after practice or a game.

What to Do If You Are Injured

The choice of treatment depends on the severity of the injury. When an injury occurs athletes should stop playing or exercising and not try to “play through the pain.”

When to call the doctor The doctor should be called when the following situations occur:

- The injury causes severe pain, swelling, or numbness
- The athlete cannot put weight on the area
- An old injury aches, hurts, or swells
- A joint does not feel normal or feels unstable
- If the pain or other symptoms increase after home treatment

When and how to treat the injury yourself If the injury does not have the above criteria, the athlete can treat the injury at home using the R-I-C-E method for 48 hours after the injury occurs to reduce pain and swelling and promote healing.

- **Rest.** Reduce regular activities and take the weight off an injured foot, ankle, or knee.
- **Ice.** Place ice on the injured area using a cold pack or ice bag for 20 minutes four to eight times a day. To avoid cold injury do not leave the ice on the injury longer than 20 minutes.
- **Compression.** Put even pressure such as an elastic wrap bandage, boot, air cast, or splint on the injured area to help reduce swelling.
- **Elevation.** Keep the injured area above the heart by elevating it on a pillow.

How Can Sports Injuries Be Prevented?

There are a number of actions a person can take to prevent injury while exercising or engaging in athletic activity. These include the following:

- Always do a proper warm up routine of exercises and stretches.
- Always do a proper cool down after exercising.
- Wear the proper shoes and equipment for the activity.
- Make sure one's body is mature enough and properly trained to do the activity (i.e., it is suggested youth leagues limit the number of times participants pitch per week to avoid injuries).
- Don't play if injured.

▶ See also **Brain Injuries • Broken Bones (Fractures) • Concussion • Substance Abuse**

Resources

Books and Articles

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▲
The staph infection impetigo most often involves the face. Impetigo is more common among young children. In young adults, it may be a complication of other skin problems. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

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Organizations

American Association of Neurological Surgeons. 5550 Meadowbrook Drive, Rolling Meadows, IL, 60008, Web site: <http://www.neurosurgerytoday.org>.

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-226-4267. Web site: http://www.niams.nih.gov/Health_Info/Sports_Injuries/sports_injuries_ff.asp.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Toll free: 888-346-3656. Web site: <http://www.nlm.nih.gov/medlineplus/sportsinjuries.html>.

Sprains See *Strains and Sprains*.

Staphylococcal Infections

Staphylococcal (stah-fih-lo-KAH-kul) infections are infections caused by the organism Staphylococcus aureus (stah-fih-lo-KAH-kus ARE-ree-us) and related species of bacteria, over thirty species in all.

What Are Staphylococcal Infections?

They cannot be seen with the naked eye, but bacteria* cover the skin's surface. *Staphylococcus aureus* (*S. aureus*) bacteria, also called staph (pronounced "staff") bacteria, often live on people's skin, particularly around openings

such as the nose, mouth, genitals*, and anus*, and sometimes inside the nose and mouth, without causing disease. But when a person's skin is broken or cut, the bacteria can enter the wound and cause an infection. Staph infections range from minor skin infections to joint, bone, or lung infections to widespread or systemic infections that can be life threatening. Some strains* of staph produce a toxin (or poison) that causes illness.

Newborns, elderly people, and people with immune systems* weakened by diseases such as cancer and AIDS* are at greater risk of serious staph infections. Some serious infections, often resistant to many antibiotics, can be acquired in a hospital when a patient is being treated for another condition. In fact, in the United States, staph infections are considered the leading cause of primary infections that result from being medically treated within hospitals and healthcare centers; or, what are called nosocomial (nas-eh-KO-meh-el) infections.

How Common Are Staphylococcal Infections?

Some species of staph bacteria are present on people's skin all the time. The more dangerous *Staphylococcus aureus* may come and go regularly from people's noses and skin. Skin infections caused by staph, such as boils, are quite common. Many staph infections are minor and do not require treatment; serious staph infections are less common. Overall, studies have shown that staph bacteria exist on the skin or inside the nose of about 20 to 30 percent of all healthy people in the United States. They can remain there indefinitely without any medical problems. They exist less frequently in the mouth; mammary glands; and intestinal, upper respiratory, and urinary tracts. However, if a break in the skin occurs or the bacteria is able to invade the body by other means, then serious health problems can result when the body's immune system cannot effectively counter them. The immune system is especially vulnerable to such outbreaks in newborn infants, breastfeeding women, and people with compromised immune systems, surgical incisions, and serious diseases or illnesses.

Overall, the incidence of staph infections steadily increased during the late 1990s and early 2000s in the United States and other developed countries. Globally, if left untreated such infections, as a group, potentially kill the majority of people afflicted. People more prone to staph infections and serious symptoms are more apt to die from such infections.

Are Staphylococcal Infections Contagious?

Sometimes staph infections of the skin are contagious. In such circumstances, they are called communicable (contagious) diseases because bacteria can be transmitted between humans. Infrequently, staph bacteria are spread through the air. However, they are usually transmitted from human-to-human contact. If a person touches another person who has a staph infection of the skin, with either open sores or bodily fluids, and then touches his or her own mouth, nose, or an area of broken skin, the staph infection can spread. A person also can spread the bacteria from one

* **genitals** (JEH-nih-tuls) are the external sexual organs.

* **anus** (A-nus) is the opening at the end of the digestive system, through which waste leaves the body.

* **strains** are various subtypes of organisms, such as viruses or bacteria.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

part of the body to another through touch. Staph can also be transmitted via contaminated surfaces and food.

What Are Some Types of Staphylococcal Infections?

Impetigo (im-pih-TEE-go) is a skin infection that usually occurs around the nose and mouth. In impetigo, fluid-filled blisters appear and often burst and form yellowish crusts of skin. Impetigo is a contagious infection that can spread if a person scratches the blisters and then scratches or touches another area of the body.

THE EVOLUTION OF ANTIBIOTIC-RESISTANT STAPH

Antibiotics are used widely to treat infections such as those caused by staph. Over time, staph bacteria may become stronger so that the antibiotics may not be as effective against the germ; this change is known as antibiotic resistance. When Scottish biologist Alexander Fleming (1881–1955) discovered penicillin in 1928, staph bacteria were highly sensitive to it. By the early 2000s, few staph bacteria were killed by penicillin. These bacteria often are resistant to many antibiotics.

The more important strains of antibiotic-resistant staph are known as methicillin-resistant staphylococcus aureus (MRSA). MRSA is resistant to commonplace antibiotics, but it is still susceptible to the last-resort, more powerful medications. A more serious strain of staph infection, vancomycin intermediate *S. aureus* (VISA), can resist vancomycin, one of the most powerful (and last-resort) antibiotics available. Although all strains of the bacteria found so far have been treatable with some type of antibiotic, VISA potentially could defy all medication available in the early 2000s to treat it. Fortunately, VRSA was quite rare.

In the past, MRSA and VISA infections usually developed only in a hospital or healthcare facility where prolonged treatment of patients with several antibiotics is common. As of 2008, however, community-acquired MRSA (those infections within a local community but outside a health facility) was widespread, even in previously healthy individuals without a history of recent antibiotic treatments. In fact, the Centers for Disease Control and Prevention (CDC) states that approximately 12 percent of MRSA infections (throughout the United States) were as of 2008 community-associated, although the percentages varied widely depending on region. The spread of community-acquired MRSA alters its treatment especially concerning the initial choices of antibiotics. As of 2009, the progression of MRSA was a great health concern, emerging as a serious public health problem. Of utmost importance for anyone who may have MRSA is the need to get prompt medical attention for any and all skin and soft tissue infections.

Overall, the prudent use of antibiotics remained especially important as more bacterial strains become more resistant to antibiotics.

Carbuncles (KAR-bung-kulz) and furuncles (FYOOR-ung-kulz), also known as boils, are staph infections that produce a red, swollen bump filled with pus* in the skin surrounding a hair follicle*. With boils pus forms in a single hair follicle, whereas carbuncles form from grouped furuncles and have several small chambers, like a series of connected boils.

Cellulitis (sel-yoo-LYE-tis) is an infection of the deeper layers of the skin and the connective tissues below the skin's surface. People with cellulitis usually have an area of red, swollen, tender, warm skin. They also may have fever, swollen lymph nodes*, and a general feeling of being ill. Cellulitis is most common on the face and lower legs.

In women who are breastfeeding their infants an inflammation of the breast can develop. Called mastitis, the infection can cause bacteria to be released in the mother's milk, which can harm the child.

Scalded skin syndrome (formally called staphylococcal scalded skin syndrome, and also known as Ritter disease) is a staph infection that typically occurs in infants and children less than five years of age (but can occur in people of all ages) and causes large portions of skin to be shed from the body. In this condition, the staph bacteria produce a toxin that damages skin. Fluid collects beneath the skin and loosens it so that large portions slip off when rubbed. Where the skin slips off, raw areas remain that eventually crust over. When the area under the skin is exposed, the child is at risk of excessive fluid loss and additional bacterial infections. Other symptoms include fever and skin redness and tenderness. Babies with this condition may become extremely ill.

Toxic shock syndrome (TSS) is a severe infection that, like scalded skin syndrome, is caused by a toxin produced by staph bacteria. With initial symptoms of severe headache, high fever reaching 105° Fahrenheit (40.5° Celsius), sore throat, and sunburn-looking rash, it can develop into a life-threatening condition when such symptoms as dehydration* and diarrhea* occur, followed by peeling skin over much of the body. Muscle, kidney, and liver damage can lead quickly to loss of life. TSS was first recognized in the late 1970s and early 1980s, mostly among women who were using certain types of very absorbent tampons, but it can occur in people of both sexes and in both children and adults. After this type of absorbent tampon was no longer available, TSS usually developed after surgery or in wounds that, in most cases, did not look infected but contained the toxin-producing staph. Skin abscesses* or other staphylococcal infections may also lead to TSS. Symptoms of TSS include sudden fever, low blood pressure, very red rash, vomiting, diarrhea, and muscle pain.

Staph bacteria can produce other types of toxins that cause food poisoning if a person eats contaminated food (usually meats, poultry, eggs, and dairy products) that has not been heated or refrigerated at the proper temperature. Symptoms include belly pain, nausea (NAW-zee-uh), and vomiting. If the food poisoning is severe, a person may experience headaches, muscle aches, and blood pressure changes.

Some staph infections affect internal organs. Staph is a common cause of the bone infection osteomyelitis (ah-stee-o-my-uh-LYE-tis). Staph infections

* **pus** is a thick, creamy fluid, usually yellow or ivory in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

* **hair follicle** (FAH-lih-kul) is the skin structure from which hair develops and grows.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

* **abscesses** (AB-seh-sez) are localized or walled off accumulations of pus caused by infection that can occur anywhere within the body.

- * **catheter** (KAH-thuh-ter) is a small plastic tube placed through a body opening into an organ (such as the bladder) or through the skin directly into a blood vessel. It is used to give fluids to or drain fluids from a person.
- * **colonized** means that a group of organisms, particularly bacteria, are living on or inside the body without causing symptoms of infection.
- * **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.
- * **susceptibility** (su-sep-ti-BIL-i-tee) means having less resistance to and higher risk for infection or disease.
- * **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

also may cause pneumonia (nu-MO-nyah), an inflammation of the lungs; blood infection (sepsis); and, more rarely, meningitis (meh-nin-JY-tis), an inflammation of the membranes that surround the brain and the spinal cord (the meninges, meh-NIN-jeez). The bacteria may spread from an infection elsewhere in the body, or they can come from a medical device, such as a catheter*, that has been colonized* by staph bacteria. *Staphylococcus aureus* also may infect the heart valves, where it causes inflammation and gives rise to a condition called endocarditis (endo-kar-DYE-tis).

How Is a Staphylococcal Infection Diagnosed?

A doctor may diagnose and treat a staph infection based on its appearance, but a definite diagnosis is made by identifying the organism under a microscope or by culture* with the use of a laboratory. Samples are taken from the site of the infection, which may be the skin, the blood, or an abscess. Imaging scans such as x-rays can help with diagnoses in identifying locations of the infection. Staph food poisoning generally is diagnosed based on symptoms, dietary history, and sometimes illness in other people who have eaten the same food or eaten at the same place. Minor superficial infections are usually diagnosed without the need of blood samples and cultures. However, serious infections rely on the laboratory, especially when the infection lies within the bloodstream, heart, or lungs. In such cases, samples and cultures of blood and affected fluids are taken and analyzed by skilled laboratory personnel to verify the proper course of medical treatment.

What Is the Treatment for Staphylococcal Infections?

Minor skin infections caused by staph bacteria often can be treated with an over-the-counter antibiotic ointment, or they can heal on their own. The choice of the antibiotic often depends on the severity of the infection, its location, and the susceptibility* of the particular staph strain. If a person has an abscess that stems from a staph infection, surgery to drain the pus may be necessary in addition to antibiotics, to allow the infection to heal.

More serious staph infections, such as endocarditis, osteomyelitis, TSS, and scalded skin syndrome, usually require hospitalization and supportive care, such as antibiotics, intravenous* fluids to prevent dehydration, and other medications. Endocarditis caused by staph may require surgery in which the infected, damaged heart valve is removed and an artificial valve is inserted. Scalded skin syndrome is treated with intravenous antibiotics so that the skin can be protected from becoming dehydrated and, consequently, from peeling off.

Because antibiotics are used widely to treat both minor and serious infections caused by staph and other bacteria, some strains of bacteria have become resistant to common antibiotics. Discovery of new medications

and forms of treatment are important, and scientists continue to work in the early 2000s on developing a *Staphylococcus aureus* vaccine that might help people with weakened immune systems resist staph infections.

How Long Does a Staphylococcal Infection Last?

Minor skin infections caused by staph bacteria usually clear up within a week, whereas more serious widespread illnesses may take several weeks to more than a month to resolve.

What Are the Complications of Staphylococcal Infections?

Minor staph skin infections rarely result in complications, but some can produce more widespread infection, such as sepsis, a serious systemic infection caused by bacteria invading the bloodstream. TSS can lead to shock*, organ failure, and death. Scalded skin syndrome can give rise to other infections, dehydration, and sepsis. Osteomyelitis can cause permanent bone damage and may require surgical treatment. Under normal circumstances, healthy patients fully recover from staph infections within a short period. However, even healthy people can develop repeat infections, which can eventually become more serious.

Can Staphylococcal Infections Be Prevented?

There are several ways to help prevent the spread of staph infections:

- Washing hands with warm water and antibacterial soap before eating and after using the toilet or touching the nose
- Washing any cuts, scrapes, or open sores
- Showering, rather than bathing, in order to reduce the risk of spreading the infection to other parts of the body
- Using separate towels, washcloths, bed linens, and other related materials from other members of a household, and laundering them daily in hot water and bleach
- Not sharing brushes, combs, clothing, and other personal items
- Keeping wounds covered with a clean bandage after applying an antiseptic

Food poisoning can be prevented by washing hands before food preparation, storing food properly before cooking, cooking food to the appropriate temperatures, using clean utensils and dishes, and refrigerating or freezing food as soon as possible after cooking. To lessen the risk of TSS, women are advised to use less-absorbent tampons, to change them frequently, and not to use only tampons during a menstrual period, or to avoid tampons altogether.

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

▶ See also **Antibiotic Resistance**

Resources

Books and Articles

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Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC, 6612, Bethesda, MD, 20892. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov>.

STDs *See Sexually Transmitted Diseases (STDs).*

Stealing *See Conduct Disorder.*

Stings *See Animal Bites and Stings.*

Stomach Cancer

Stomach cancer, also called gastric cancer, is a disease in which the cells in the stomach divide without control or order and take on an abnormal appearance. These cancerous cells often spread to nearby organs and to other parts of the body.

How Does Stomach Cancer Develop?

The stomach is the sac-like organ located in the upper abdomen, under the ribs, which plays a role in the digestion of food. It connects the esophagus (e-SOF-a-gus), the tube that carries swallowed food, with the small intestine, which absorbs the nutrients needed by the body. When food enters the stomach, the muscles in its wall create a rippling motion that mixes and mashes it. The glands in the lining of the stomach release juices

that help to digest the mixture. After a few hours, the food becomes a liquid and moves into the small intestine, which makes it easier for the intestine to continue the process of digestion and absorb the substances that the body needs for energy.

Stomach cancer begins when some of its cells take on an abnormal appearance and begin to divide without control or order. If left untreated, these cancer cells can grow through the stomach wall, and they can spread to nearby organs or to nearby lymph nodes*. Through the lymphatic system, the cancer cells can spread to distant areas of the body, including the lungs and the ovaries.

About 95 percent of all stomach cancers are adenocarcinomas, which start in the glandular cells of the stomach. Other types of stomach cancer include malignant* transformation of the immune* tissue of the stomach wall, which causes lymphoma of the stomach wall; cancer affecting the hormone-producing cells in the stomach that causes a condition called carcinoid tumor; and gastrointestinal stromal tumors, a rare form of stomach cancer that affects nervous system tissue within the stomach.

Who Gets Stomach Cancer and Why?

Each year, about 24,000 people in the United States learn that they have cancer of the stomach. Like most other forms of cancer, stomach cancer occurs most frequently in older people, usually 55 years of age or older. Fortunately, for reasons that scientists cannot fully explain, the number of people who get this disease dropped steadily between the 1940s and the early 2000s.

Stomach cancer is much more common in other countries, especially Japan, Chile, and Iceland. Researchers think the reason may be that people in these countries eat many foods that are preserved by drying, smoking, salting, or pickling. Eating foods preserved in this way may raise someone's risk for developing stomach cancer. People who smoke cigarettes may also be at higher risk of developing stomach cancer.

What Happens When People Have Stomach Cancer?

Symptoms At first, stomach cancer does not cause any symptoms. And when it eventually causes symptoms, they often are mistaken for less serious stomach problems, such as indigestion, heartburn, or a virus. Therefore, it is hard to find stomach cancer early, which makes it more difficult to treat. Possible symptoms include:

- Discomfort or pain in the abdomen
- Nausea and vomiting after meals
- Bloating of the stomach after meals
- Anemia
- Weakness, fatigue, or weight loss
- Vomiting blood or passing black, tar-like stools

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.

* **immune** (ih-MYOON) means resistant to or not susceptible to a disease.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

Diagnosis When people report these symptoms to their family doctor, they may be referred to a gastroenterologist (gas-tro-en-ter-OL-o-jist), a doctor who specializes in diagnosing and treating digestive problems. The gastroenterologist may order additional diagnostic tests to figure out what is wrong.

One of the most common procedures is called endoscopy (en-DOS-ko-pee), which involves passing a very thin, lighted tube down the esophagus and into the stomach. This tube allows doctors to look directly at the inside of the stomach. If an abnormal area is seen, doctors can remove some tissue from it through the tube and have the tissue examined under a microscope. This process, called a biopsy (BY-op-see), determines whether cancer cells are present.

A person might also have an upper GI series, which is a series of x-rays of the upper gastrointestinal (gas-tro-in-TES-ti-nal) tract, including the esophagus and stomach. These pictures are taken after the person drinks a thick chalky liquid called barium (BA-ree-um). The barium outlines the stomach on the x-rays, helping doctors locate tumors or other abnormal areas.

Doctor might also want to test for blood in the feces*, the solid waste that people produce when they go to the bathroom. This test involves placing a small amount of feces (stool) on a slide and having it tested in the laboratory. Sometimes, blood in the stool is a sign of stomach cancer or other cancers of the digestive tract.

If cancer is diagnosed, then doctors need to find out whether it has spread to other parts of the body. They often use imaging tests such as CT scans* or ultrasound* to check for this possibility.

How Is Stomach Cancer Treated?

Because the symptoms associated with stomach cancer seem so minor at first, people rarely report them right away. Therefore, the cancer usually has spread into the stomach wall or even beyond the stomach when it is found, which makes it difficult to cure.

The most common treatment is an operation called gastrectomy (gas-TREK-to-mee), during which surgeons remove part or all of the stomach and some of the surrounding tissue. If all of the stomach needs to be removed, then surgeons connect the esophagus directly to the small intestine. The nearby lymph nodes usually are removed, too.

People with stomach cancer may also be treated with radiation therapy or chemotherapy*, either in an attempt to destroy some of the cancer cells or to ease some of their symptoms, such as pain. Radiation therapy focuses high-energy rays on the body to destroy cancer cells and to stop or slow their growth. During chemotherapy, anti-cancer drugs are given by mouth or by injection into a muscle or blood vessel.

Because stomach cancer is so difficult to cure, researchers have looked at other ways to treat this disease. Studies called clinical trials have been conducted to evaluate some new treatments in cancer patients. One

example is biological therapy, which triggers the body's own immune system to attack and destroy cancer cells.

Living with Stomach Cancer

Because people with stomach cancer often have part or all of the stomach removed, they need time to readjust to eating after the surgery. At first, patients are fed intravenously (in-tra-VEE-nus-lee), through a vein in the hand or arm. Within several days, they usually can start taking in liquids, then soft foods, and then more solid foods. Often they need to follow a special diet until they can adjust to having a smaller stomach or none at all. People with stomach cancer need to work with dietitians and nutritionists to make sure that they are getting the nutrients their body needs.

▶ See also **Cancer: Overview • Tumor**

Resources

Books and Articles

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Organizations

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-ACS-2345. Web site: <http://www3.cancer.org/cancerinfo>.

Cedars-Sinai Medical Center. 8700 Beverly Boulevard, Los Angeles, CA, 90048. Telephone: 310-4-CEDARS. Web site: <http://www.csmc.edu/5548.html>.

Memorial Sloan-Kettering Cancer Center. 1275 York Avenue, New York, NY, 10065. Telephone: 212-639-2000. Web site: <http://www.mskcc.org/mskcc/html/1467.cfm>.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: http://cancernet.nci.nih.gov/wyntk_pubs/stomach.htm.

United Ostomy Associations of America. P.O. Box 66, Fairview, TN, 37062-0066. Toll free: 800-826-0826. Web site: <http://www.uoaa.org>.

Stomach Ulcer See *Helicobacter Pylori Infection*.



▲
An uncorrected case of strabismus can create the appearance of crossed eyes.
Biophoto Associates/Photo Researchers, Inc.

- * **Down syndrome** is a genetic disorder that can cause mental retardation, shortness, and distinctive facial characteristics, as well as many other features.
- * **cerebral palsy** (se-RE-bral PAL-zee) is a group of conditions, all of which affect a person's ability to move. They are usually caused by injury to the brain before or soon after birth.
- * **hydrocephalus** (HY-droe-SEF-uh-lus) is a condition, sometimes present at birth, in which there is an abnormal buildup of fluid within the skull, leading to enlargement of the skull and pressure on the brain.
- * **tumor** (TOO-mor) usually refers to an abnormal growth of body tissue that has no known cause or physiologic purpose and is not an inflammation.
- * **cataracts** (KAH-tuh-rakts) are areas of cloudiness of the lens of the eye that can interfere with vision.
- * **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

Strabismus

Strabismus is a condition in which the eyes cross or do not work together normally, which may lead to permanent loss of vision in one eye.

What Is Strabismus?

When people cross their eyes, the world suddenly doubles. Images, like the words on this page, become blurred, and it appears as if there are two of each. When the eyes function correctly, they work together to focus images and to allow the brain to develop a three-dimensional view of the world. But when the eyes cannot work together, as when people cross their eyes, the brain sees double. The result is double vision.

Fortunately, both eyes work together for most people. But some people have an eye disorder that causes the eyes to fail to line up properly, resulting in blurred or double vision. This condition is called strabismus (stra-BIZ-mus), which comes from a Greek word that means squinting. Often in strabismus, one eye may remain straight and the other eye may turn in, which may look to others as if the person is crossing one eye.

Why Do People Have Strabismus?

Strabismus usually develops during infancy or early childhood. In most cases, there is no known cause, although sometimes several members of the same family have the disorder, which may mean that in some cases strabismus is inherited, like eye color is. Other possible causes include the following:

- Farsightedness, causing focus difficulties
- Damage to one eye or to the part of the brain that controls the muscles involved in eye movement
- Other disorders that affect the brain, including Down syndrome*, cerebral palsy*, and hydrocephalus*
- Less commonly, vision is blocked by a tumor* or cataracts* that causes cloudiness in the normally clear lens of the eye. Strabismus affects about 3 to 5 percent of children in the United States. It occurs in boys and girls equally. Fortunately, if it is diagnosed and treated early, there is a good chance of saving or improving vision in the affected eye.

Some adults have strabismus, perhaps because they were not treated for it as a child or because the treatment was not effective. Other adults may develop strabismus when a disorder such as stroke* causes the eyes to cross or not work together normally.

How Do Six Muscles in Each Eye Work as One?

The eyes and the nerves that connect them to the brain work like the two lenses of binoculars. They merge the image seen by each eye into one image. Six muscles are attached to each eye, and they control how the

eyeball moves left and right or up and down. To make it possible for the brain to develop a single three-dimensional image, the muscles must work together to focus, just as the two lenses of binoculars must be aligned to focus together.

People with strabismus have trouble with one or more of the muscles in an eye. Instead of working together, one eye is out of alignment. Sometimes strabismus seems to come and go, depending on how tired the eyes are, and sometimes the eyes remain out of correct position. There are different forms of strabismus:

- When one eye points inward toward the nose, which makes the person look cross-eyed, the condition is esotropia (es-o-TRO-pe-a).
- When one eye points away from the nose, as if looking to the outside, the condition is exotropia (ek-so-TRO-pe-a) or walleye.
- When the brain turns off the vision in the turned eye in favor of the vision in the straight eye, the condition is called strabismic amblyopia (stra-BIZ-mik am-blee-O-pee-a) or lazy eye. Amblyopia does not mean that the eye is lazy. Instead, the brain turns off the image coming from the optic nerve in that eye so the person sees only one clear image of the world instead of having blurred or double vision.

A Little Pirate

Mrs. Apple noticed that the eyes of her baby Chloe often did not work together. She had read in a book how babies sometimes appear cross-eyed or how it seems one eye is looking off in another direction from the other, which can be normal for a very young baby. But when Chloe was about four months old, Mrs. Apple became worried. Chloe's left eye seemed to be looking at her nose when Mrs. Apple moved her face close, and the right eye seemed to be looking straight ahead. Mrs. Apple took the baby to an ophthalmologist* for an eye exam and was told that Chloe likely had strabismus.

It is usually a parent who first notices the signs of strabismus when children are infants or preschoolers. The children are too young to complain about double or poor vision. If Mrs. Apple had not taken action because of her worries, the strabismus might have developed into amblyopia, leaving Chloe without vision in the crossed eye. Without treatment, amblyopia may become permanent.

The ophthalmologist recommended that Chloe wear an eye patch over her normal eye. The doctor explained that this could force the weaker eye to develop vision more properly.

How Do Doctors Diagnose Strabismus and Amblyopia?

Diagnosis Doctors use a variety of methods to diagnose strabismus and amblyopia. Most involve observation of how the child looks at objects, because most children are too young to recognize the letters on a standard eye chart. The doctor will cover one eye and then the other, holding and moving

Will Crossed Eyes Become Stuck?

Many people have received the following warning: "If you keep crossing your eyes like that, they could stay that way forever!"

Although the warning may be intended to stop a silly behavior, it is not medically true. Voluntarily crossing the eyes will not harm them or put them at risk of strabismus.

* **ophthalmologist** (off-thal-MOLL-o-jist) is a medical doctor who specializes in treating diseases of the eye.

objects and watching to see if the child squints or tries to cover or close one eye in favor of the other. The doctor also will check the alignment of the eyes by shining a light in both eyes to see if the reflection falls in the same place in the pupils (the black spot in the center of the eye) of both eyes.

Many children do not like to have their eyes covered during these exams. Some are frightened of the equipment that may be held close to their faces. Some techniques under development in the early 2000s used computers to track eye movements from a distance, sometimes while the child is watching a cartoon.

Treatment The most common treatment of strabismus involves wearing a patch like Chloe's over the stronger eye. The brain now starts to try to send and receive signals from the weaker eye, and the muscles that control it try to bring the eye back to a normal focus. The same result often is achieved with eye drops that blur the vision in the normal eye to make the other eye work harder. Doctors may also prescribe special eyeglasses for some children with strabismus. Some of these eyeglasses use prisms that change how the image is sent into the eye.

Some techniques involve disabling or weakening one or more of the muscles in the eye. This strategy is designed to force the other muscles to work harder to bring the affected eye into focus with the normal eye. Surgery can reposition the eye muscles of one or both eyes. The operation can leave the eyes straight and vision normal, although sometimes the eyes appear straight but people still need eyeglasses to achieve good vision. Sometimes, injections are used to disable one or more eye muscles for a period of time, which may achieve similar results to surgery.

Treatment is most effective when children are young, which is why vision testing and early diagnosis are important. Strabismus and amblyopia do not simply go away, as some people believe. With treatment, children like Chloe can have almost normal vision and no restrictions on activities as they grow up.

▶ See also **Cataracts • Farsightedness • Marfan Syndrome**

Resources

Books and Articles

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Organizations

American Association for Pediatric Ophthalmology and Strabismus.

P.O. Box 193832, San Francisco, CA, 94119-3832. Telephone: 415-561-8505. Web site: <http://www.aapos.org/index.cfm>.

American Optometric Association. 243 N. Lindbergh Boulevard, St.

Louis, MO, 63141, Web site: <http://www.aoa.org/strabismus.xml>.

Optometrists Network. 93 Bedford Street, Suite 5D, New York, NY, 10014, Web sites: http://www.strabismus.org/all_about_strabismus.html; <http://www.strabismus.org/references.html>.

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

Strains and Sprains

Strains and sprains are injuries to the body's soft tissues. Strains are injuries to muscles and/or tendons, which are the cords that connect muscles and bones. Sprains are injuries to ligaments, which are bands of strong connective tissue that support the joints (areas in the body where two bones meet) and connect the bones to each other. Strains and sprains may result from sudden injury or from long-term overuse.

What Are Strains and Sprains?

Strains and sprains are injuries to the body's soft tissues—its muscles, tendons, and ligaments. They are everyday occurrences for athletes but can happen to anyone as the result of a fall, a twist, or any other sudden blow to the body.

Strains are injuries to muscles or to tendons, which support the bones and connect them to the muscles. Sprains are injuries to ligaments, which are bands of connective tissue that support the joints and connect the bones to each other.

Strains occur most often in the muscles and tendons of the legs and back: Hamstring pulls, groin pulls, and sore back muscles are common forms of strain. Sprains most often affect the joints, such as the ankles, knees, and wrists. Both strains and sprains cause pain, swelling, and inflammation*. The injured area may also be discolored if it has been bruised and blood pools underneath the skin.

Most people recover from strains and sprains if they see their doctor promptly and follow the doctor's instructions, which often involve what is known as a R.I.C.E. protocol: rest, ice, compression, and elevation.

What Are the Different Types of Strains and Sprains?

Doctors usually classify strains and sprains by the degree of damage done to the muscles or ligaments.

First degree A first-degree strain or sprain is the least serious of the three degrees and causes the least amount of damage or stretching of ligaments or muscle fibers. No tears occur in the tissue fibers, pain and swelling are minimal, and range of motion (movement up and down, or sideways) usually is not affected to any significant degree. People who have a first-degree strain or sprain may experience some slight disability

Strains and sprains are injuries to the muscles, tendons, and ligaments.

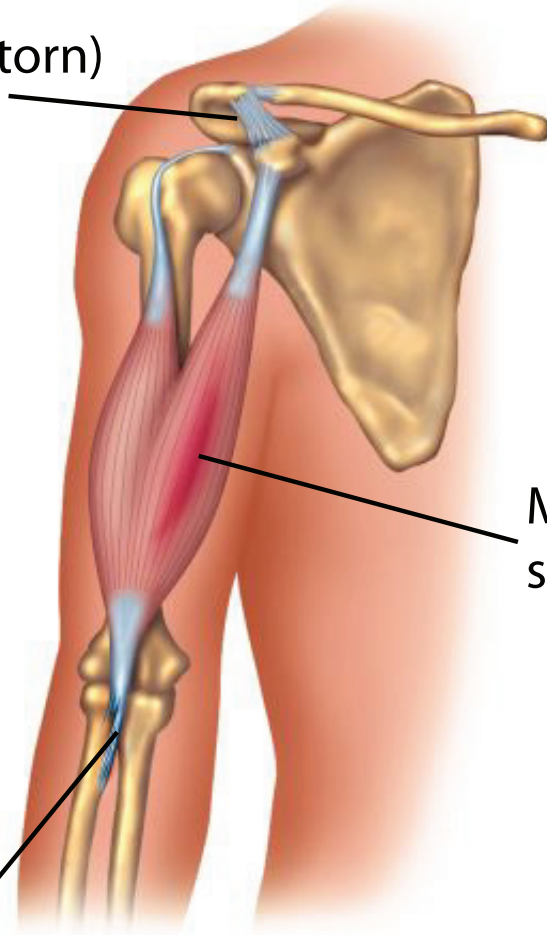
Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.



Sprained
(partially torn)
ligament

Torn
tendon

Muscle
strain



* **edema** (e-DEE-ma) means swelling in the body's tissues caused by excess fluids.

in using the affected joint, but on the whole, they can resume normal activities after a short recovery period.

Second degree In a second-degree strain or sprain, up to 80 percent of the tissue fibers are ruptured. The individual experiences more pain, edema*, and reduced range of motion. Unlike first-degree injuries, two to three weeks may pass before the pain and swelling begin to show real improvement. Athletes who resume their sports activity too soon risk the real possibility that the second-degree injury will turn into a third-degree injury, which requires a longer recovery time.

Third degree In third-degree injury, a 100 percent rupture occurs in all the tissues that surround the joint capsule: muscles, tendons, and ligaments. A person with a third-degree sprain or strain can no longer use the injured part of the body and will experience pain and visible bruising. X-rays may show that even though bones have not been broken, they may have been chipped. Doctors call such bone chips avulsion (a-VUL-shun)

fractures. Medical professionals usually tell patients to protect the injured area for 8 to 10 weeks and may order surgery to repair damaged joints.

What Is the Treatment for Strains and Sprains?

Doctors who treat strains and sprains use the expression “RICE DIETS” to describe the steps required for healing. The “RICE” part of the term refers more to first-aid practices, whereas “DIETS” refers to more definitive therapies performed by or under doctor’s supervision.

- **R: Rest.** The amount of rest depends on the degree of injury.
- **I: Ice.** Ice causes blood vessels to constrict (get small) which helps reduce inflammation.
- **C: Compression.** Bandages and wraps play a role in reducing pain and swelling, and in helping ruptured small blood vessels to heal more quickly.
- **E: Elevation.** Lifting the injured area above level of the heart helps keep swelling down and blood from pooling in the area of damage.
- **D: Drugs.** Doctors may recommend the use of aspirin, ibuprofen*, or other anti-inflammatory medications during the first few days after the injury.
- **I: Incision, drainage, and injection.** Third-degree sprains sometimes require these procedures.
- **E: Exercise.** Patients may be taught how to do certain leg exercises that will help them after their injuries.
- **T: Therapy.** Patients may benefit greatly from physical therapy to get the injured part of the body back in use without hurting it again.
- **S: Surgery.** A bad strain or sprain may need surgery to repair damaged tissue or fractured (broken) bones.

Can Strains or Sprains Be Prevented?

Many strains and sprains can be avoided. Precautions at home include the following:

- Clearing ice away from porches, steps, and sidewalks
- Wearing shoes and boots with nonskid soles
- Holding hand rails on stairways
- Using rubber mats in tubs and shower stalls
- Choosing rugs with nonskid backing
- Making sure night-time entrances have adequate lighting
- Keeping a night light or wall light on between the bedroom and the bathroom
- Keeping tools, toys, and other items away from places where people can trip over them
- Ensuring that ladders are steady when they are used

Sports Medicine

Athletes and those who exercise for physical fitness are at risk for strains and sprains. The branch of medicine that specializes in treating these injuries is called sports medicine.

Doctors who specialize in sports medicine can help athletes improve performance without injuring the body. They can also test athletes for drug use, treat injuries that result from exercise or sports, advise about proper clothing and protective gear, and supervise diet and fluid intake during training and travel, especially abroad.

* **ibuprofen** (eye-bew-PRO-fin) is a nonsteroidal anti-inflammatory drug (NISAD) used to reduce fever and relieve pain or inflammation.

* **strains** are various subtypes of organisms, such as viruses or bacteria.

Rules for athletes include starting slowly, stretching frequently, and always remembering to warm up and cool down before and after strenuous exercise.

▶ *See also* **Carpal Tunnel Syndrome • Repetitive Stress Syndrome • Trauma**

Resources

Books and Articles

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Organizations

American Academy of Orthopaedic Surgeons. 6300 North River Road, Rosemont, IL, 60018-4262. Telephone: 847-823-7186. Web site: <http://orthoinfo.aaos.org/topic.cfm?topic=A00111>. Web site: <http://orthoinfo.aaos.org/topic.cfm?topic=A00410>. Web site: <http://orthoinfo.aaos.org/topic.cfm?topic=A00065>.

American Physical Therapy Association. 1111 North Fairfax Street, Alexandria, VA, 22314-1488. Telephone: 703-684-2782. Web site: <http://www.apta.org/consumer>.

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Telephone: 301-495-4484. Web site: http://www.niams.nih.gov/Health_Info/Sprains_Strains/default.asp.

Strep Throat *See Sore Throat/Strep Throat.*

Streptococcal Infections

Streptococcal (strep-tuh-KAH-kul) infections are caused by various strains of Streptococcus (strep-tuh-KAH-kus) bacteria.*

What Are Streptococcal Infections?

Streptococci (strep-tuh-KAH-kye) are common bacteria that live in the human body, including the nose, skin, and genital tract. These bacteria can destroy red blood cells, damage them, or cause no damage at all. The

amount of damage they do is used to classify streptococcus strains. The ones that destroy red blood cells are known as beta-hemolytic (he-muh-LIH-tik), and these strains are categorized as groups A through T.

Groups A and B streptococci are most often associated with disease. Group A strep (GAS) infections range from superficial skin infections and strep throat to serious and life-threatening illnesses such as toxic shock syndrome and necrotizing fasciitis (NEH-kro-tie-zing fash-e-EYE-tis). Group B strep (GBS) is the leading cause of life-threatening infections in newborns. In pregnant women, GBS can lead to bladder infections, infections of the womb, and death of the fetus*.

Alpha-hemolytic streptococci are strains that damage red blood cells but do not destroy them. Two important strains are *S. viridans* (VEER-ih-dans), which is found in the mouth and is involved in tooth decay and endocarditis* and *S. pneumoniae* (nu-MO-nye), which can cause pneumonia*, middle ear infection, and meningitis*.

Group A Streptococcus (GAS) Infections

How common are they? According to the National Institute of Allergy and Infectious Diseases (NIAID), more than 10 million cases of mild GAS infections, such as skin and throat infections, are diagnosed each year. Between 9,000 and 10,000 cases of more serious infections, including toxic shock syndrome and necrotizing fasciitis, occur annually. People with immune systems weakened by diseases such as diabetes or cancer, are at a greater risk for developing serious GAS infections.

Are they contagious? GAS bacteria are contagious and spread through contact with fluid from the mouth or nose of an infected person or contact with infected skin lesions*.

Examples of GAS infections

- Strep throat, or streptococcal pharyngitis (fair-un-JY-tis), is a painful inflammation of the throat. Symptoms include a sore throat with white patches on the tonsils*, swollen lymph nodes* in the neck, fever, and headache.
- Scarlet fever, which often occurs along with strep throat or other strep infections, is caused by strains of group A strep that produce a toxin (or poison) that results in a very red rash and a bright red tongue, along with a high fever.
- Impetigo (im-pih-TEE-go) is a superficial skin infection common in young children. Symptoms include fluid-filled blisters (one or more) surrounded by red skin. The blisters eventually break and form a honey-colored crust.
- Cellulitis (sel-yoo-LYE-tis) is an inflammation of the skin and/or its underlying soft tissues. Symptoms include skin that is red, tender, and painful to the touch; fever; and chills.

* **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

* **endocarditis** (en-do-kar-DYE-tis) is an inflammation of the valves and internal lining of the heart, known as the endocardium (en-doh-KAR-dee-um), usually caused by an infection.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

* **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.

* **tonsils** are paired clusters of lymphatic tissue in the throat that help protect the body from bacteria and viruses that enter through a person's nose or mouth.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.



▲ After Hungarian physician Ignaz Semmelweis (1818–1865) had the physicians at a Vienna, Austria, hospital wash their hands regularly with an antiseptic, the hospital's mortality rate fell dramatically. *The Library of Congress.*

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

* **arthritis** (ar-THRY-tis) refers to any of several disorders characterized by inflammation of the joints.

* **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

- Bacteremia (bak-tuh-REE-me-uh) is the presence of bacteria in the bloodstream, which can spread infection to other organs. Bacteremia that causes symptoms, which is known as sepsis, is associated with fever, rapid heart rate, and low blood pressure that may lead to shock*.
- Toxin-producing strains of GAS can cause a rare but serious illness called streptococcal toxic shock syndrome. The infection may occur anywhere in the body, and the toxin is released into the bloodstream, causing low blood pressure and shock.
- Necrotizing fasciitis (or flesh-eating disease) is a rare, rapidly progressing infection of the deeper layers of skin, muscle, and other tissues. Symptoms usually start at the site of an injury, where the skin becomes painful, swollen, discolored (e.g., red, purple, or bronze), and hot to the touch. The skin gradually becomes darker and blisters can form while the tissues beneath the skin are being damaged. Fever, shock, and multiple organ damage may accompany this serious infection.
- Rheumatic (roo-MAH-tik) fever, a syndrome involving arthritis* and inflammation of the heart, is actually a complication of untreated strep throat. Rashes and neurological problems may also occur, and people with rheumatic fever may have permanent damage to one or more heart valves.

Making the diagnosis With skin infections, a doctor may take a sample from the affected area to culture*. For other types of suspected infections, blood samples are drawn and swabs of fluid from the patient's nose and throat are cultured for bacteria. A rapid strep test on a sample taken with a throat swab can also be done in a doctor's office.

Treatment Superficial skin infections often are treated with topical (on the skin) antibiotic ointments. Other GAS infections are treated with oral (by mouth), intramuscular (IM), or intravenous* (IV) antibiotics. Serious GAS infections require hospitalization, during which patients receive IV fluids and antibiotics. In some cases, such as with necrotizing fasciitis, surgical removal of damaged tissue is necessary. Treatment of rheumatic fever depends on the severity of the disease but includes using antibiotics to treat strep infections, anti-inflammatory medicines such as high-dose aspirin, and medications to treat heart complications.

What to expect Symptoms of strep throat usually improve within one to two days after starting antibiotics. Skin infections often clear up within a week, but more serious infections can take weeks or even months to heal. Complications from serious bacterial infections include sepsis, shock, organ damage and failure, and death.

Prevention Maintaining good health and hygiene can help reduce the risk of bacterial infection. Not sharing food or eating utensils, washing

hands frequently, and cleaning and bandaging cuts and scrapes can help prevent the spread of bacteria.

Group B Streptococcus (GBS) Infections

How common are they? According to the Centers for Disease Control and Prevention, GBS is the most frequent cause of life-threatening infections in newborns. Early screening of pregnant women for GBS and treatment have reduced infection rates by approximately 70 percent. In the early 2000s, 17,000 cases of GBS infection occurred annually in the United States.

Are they contagious? GBS infections are contagious and can pass from mother to child before or during birth. At least 25 percent of women are carriers of GBS at some point in their lives but do not become ill from it. The bacteria can be found in the bowel, vagina*, bladder, and throat.

Examples of GBS Infections

- Newborns can develop sepsis, pneumonia, and meningitis due to infection with GBS. Symptoms of GBS infection in newborns include fever, irritability, extreme sleepiness, breathing difficulties, and poor feeding.
- GBS bacteria in pregnant women can cause urinary tract infections* as well as chorioamnionitis (kor-e-o-am-nee-on-EYE-tis, infection of the womb and membranes surrounding the fetus) and stillbirth (a fetus that is dead at birth). Symptoms of urinary tract infection include fever, pain, and a burning sensation during urination. Women with chorioamnionitis often do not show symptoms of infection until after childbirth. Symptoms include fever, belly pain, and rapid pulse.
- The most common GBS infections in other people are urinary tract infections, sepsis, tissue infections, and pneumonia. GBS infections, including pneumonia and sepsis, are more likely to be found in people with weakened immune systems or chronic diseases, such as diabetes.

Making the diagnosis GBS infections are diagnosed by performing cultures of blood, urine, or cerebrospinal fluid* to identify the bacteria.

Treatment GBS infections are treated with antibiotics, often intravenously, and they usually require a hospital stay, particularly for newborns. Pregnant women with urinary tract infections usually are treated with antibiotics as well.

What to expect Recovery can take several weeks. Complications in infants, particularly those with meningitis, include hearing and vision loss and brain damage. Approximately 5 percent of cases of GBS disease in newborns are fatal.

Shaking Hands with Semmelweis

Ignaz Philipp Semmelweis (1818–1865) was a Hungarian physician working at the Vienna (Austria) General Hospital in 1847, who suspected that doctors could spread disease by not washing their hands thoroughly after working with cadavers before delivering babies. At the time, up to 30 percent of women who gave birth in hospitals died of puerperal (pyoo-ER-puh-rul) fever, a group A streptococcal bacterial infection that occurred after childbirth. Semmelweis noticed that women who delivered their babies with midwives were less likely to become ill. He had his student doctors wash their hands with an antiseptic, which is a solution that prevents the growth of bacteria. Because the idea that germs could cause disease had not yet been introduced, Semmelweis' ideas about hand washing were not well received until many years later.

* **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.

* **urinary (YOOR-ih-nair-e) tract infection** or UTI, is an infection that occurs in any part of the urinary tract. The urinary tract is made up of the urethra, bladder, ureters, and kidneys.

* **cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) is the fluid that surrounds the brain and spinal cord.

* **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.

* **vaccines** (vak-SEENS) are preparations of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

* **sinuses** (SY-nuh-ses) are hollow, air-filled cavities in the facial bones.

* **sputum** (SPYOO-tum) is a substance that contains mucus and other matter coughed out from the lungs, bronchi, and trachea.

Prevention Most newborn cases can be prevented by testing women in the 35th to 37th week of pregnancy for the bacteria. A culture swabbed from the vagina and rectum* can determine whether a woman has GBS. If she does, giving IV antibiotics during labor reduces the risk of passing GBS to the baby. Vaccines* to prevent GBS infections during pregnancy were being developed in the early 2000s.

Alpha-Hemolytic Streptococcus Infections

How common are they? Infections with alpha-hemolytic strep bacteria are common; many strains live naturally in humans.

Examples of alpha-hemolytic strep infections

S. PNEUMONIAE (NU-MON-YI) INFECTIONS

- Bacterial pneumonia is an inflammation of the lungs that often occurs after or along with an upper respiratory infection. Symptoms may develop quickly and can include fever, chills, cough, rapid breathing, chest pain, belly pain, and vomiting. Before antibiotics were developed, bacterial pneumonia was the most common cause of death in adults.
- Otitis (o-TIE-tis) media is an inflammation of the middle ear. The infection usually is associated with ear pain and sometimes with fever.
- Sinusitis (sy-nyoo-SY-tis) is an inflammation of the sinuses*, usually due to infection. Symptoms include a stuffy nose, colored discharge (green, yellow, or tinged with blood) from the nose, tenderness around the eyes, and headache or a feeling of pressure in the head.
- Meningitis is an inflammation of the membranes covering the brain and the spinal cord. Symptoms include fever, weakness, vomiting, irritability, and stiff neck.

S. VIRIDANS (VEER-IH-DANZ) INFECTION

- Endocarditis is an infection of the inner surface of the heart or heart valves that can be caused by *S. viridans* and other bacteria. Bacteria can enter the bloodstream (during a dental procedure, for example) and attach to already damaged heart tissue or an abnormal heart valve, causing more damage. Symptoms include extreme tiredness, weakness, fever, chills, night sweats, and weight loss. The infection can progress, resulting in problems with heart function in some cases.

Making the diagnosis Depending on the type of infection, a diagnosis is made by testing blood, sputum*, or cerebrospinal fluid samples for signs of the bacteria.

Treatment Oral or IV antibiotics are used, depending on the severity of the infection. A hospital stay may be needed, particularly in cases

of pneumonia or meningitis. Long courses of antibiotics, lasting several weeks or more, may be required to treat endocarditis.

Prevention Vaccines against *S. pneumoniae* are given routinely to infants and the elderly, as well as to children and adults with weakened immune systems or certain medical conditions. People with abnormal or damaged heart valves are given courses of antibiotics when they have some types of surgical procedures, including dental work, to help prevent endocarditis from developing from the shedding of bacteria into the bloodstream that occurs with these procedures.

▶ See also **Impetigo • Meningitis • Otitis (Ear Infections) • Scarlet Fever • Sepsis • Sore Throat/Strep Throat • Toxic Shock Syndrome**

Resources

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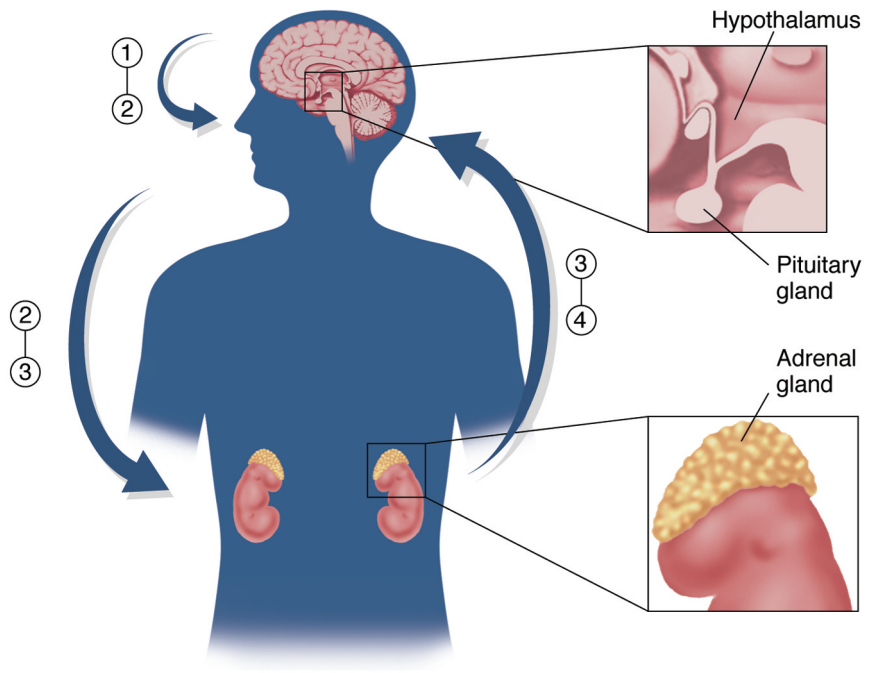
Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/dbmd/diseaseinfo/groupastreptococcal_g.htm. Web site: <http://www.cdc.gov/groupBstrep>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/streptococcalinfections.html>.

Stress and Stress-Related Illness

Stress is a physical and/or emotional response to a difficult, painful, or challenging experience and may affect children, teenagers, and adults. The body's stress response system can cause a rapid heartbeat, a rise in blood pressure, and other physical changes. Stress-related illnesses are physical or mental maladies that may be brought on or made worse by stress. They can include headaches, stomachaches, sleeplessness, depression, anxiety, and other conditions. Relaxation and stress management techniques often help people deal with stress.

The body's stress hormone response. When the brain perceives stress, the hypothalamus releases corticotropin-releasing factor (1), which triggers the release of adrenocorticotropic (ACTH) (2) from the pituitary gland. ACTH (2) travels through the bloodstream and (along with signals from the brain sent through the autonomic nervous system) stimulates the adrenal glands to release cortisol and epinephrine into the bloodstream (3). Cortisol and epinephrine (3) help provide energy, oxygen, and stimulation to the heart, the brain, and other muscles and organs (4) to support the body's response to stress. When the brain perceives that the stress has ended, it allows hormone levels to return to their baseline values. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



Good Stress and Bad Stress

Everyone experiences stress, which is the body's general response to any event, real or imagined, that requires an adaptation or extra effort. In most cases, an event or situation is not stressful by itself. Rather, it is how people view the event and what they believe about their own ability to respond to it that create stress. About 10 percent of modern stress can be linked to actual physical threats to life or safety, such as being threatened with a weapon or needing to slam on the brakes to avoid an accident. The other 90 percent of stress seems to result from people's perceptions of life events, such as arguments with friends or family, concerns about school or work, or problems individuals do not know how to solve. The causes for a majority of doctor visits are believed to be stress-related.

Stressors Stressors are the triggers for the body's stress response. These triggers are unique to each person. An event that one person finds relaxing may create tension in another. Stressors fall into several different categories:

- Physical stressors affect a person's body. These biological stressors may include exercise, illness, or disabilities.
- Environmental stressors include noise, overcrowding, poverty, natural disasters, or even technology that causes too much change in too short a period of time.
- Life situations create both good and bad stressors. These may include moving to a new home, changing schools or jobs, or experiencing changes in the family structure, such as marriage, divorce, the birth or adoption of a new child, or the death of a friend or family member.

- Behaviors can also be stressors. These may include smoking cigarettes, taking drugs, not sleeping enough, eating too little or too much, or exercising too little or too much.
- Certain patterns of thinking (cognitive actions) can be stressors, too. These may include fearing change, interpreting minor losses as catastrophes, or recalling difficult life events.

Stress, anxiety, and excitement Stress is often associated with negative thoughts or events that people find unpleasant, frightening, or anxiety-producing. It may come about as a result of being bullied or teased by peers, being anxious about a test, feeling disappointed about not achieving a goal, or from efforts to bundle too many activities into too little time. Sometimes life events that cause stress initially result in anxiety that turns instead into positive excitement. An audition, a game point, or a date to the prom are positive stressors. Stress is the body's natural response to the difficult demands or exciting new challenges it encounters everyday.

Trauma and stress Some events are so stressful that they overwhelm people, and no amount of deep breathing or positive thinking may seem to help. Accidents, injuries, abuse, violence, war, serious threats to physical safety, or the sudden death of a loved one are examples of traumas that cause a stress response within the body.

Which Illnesses Are Stress-Related?

It is difficult for researchers to establish a definite cause-and-effect relationship between stress and specific physical symptoms or illnesses. Not only do people's minds and bodies react differently to stress, but there are other factors at work when someone gets sick. The following conditions are known or believed to be stress-related (as opposed to stress-caused):

- Pain caused by muscular problems, such as tension headaches, back pain, jaw pain, and repetitive stress syndrome. Pain of many kinds seems to be caused or made worse by stress.
- Gastrointestinal (gas-tro-in-TES-ti-nal) problems, such as heartburn, stomach pain, and diarrhea.
- Insomnia, or difficulty sleeping.
- Substance abuse, including smoking, drug addiction, and heavy drinking of alcohol. Substance abuse, in turn, can lead to other illnesses, including heart disease and cancer.
- Asthma attacks in people who already have the condition or who are susceptible to it.
- Post-traumatic stress disorder, a mental disorder in which people relive a terrifying experience in dreams and memories long after the event has passed, and acute stress disorder, in which they have similar symptoms immediately after the event.

Coping with Stress

Tips for coping with stress include the following:

- Be realistic.
- Don't try to be perfect.
- Don't expect others to be perfect.
- Take one thing at a time.
- Be flexible.
- Share feelings.
- Maintain a healthy lifestyle.
- Meditate.
- Ask for help when necessary.
- Have fun.

Tips for helping others cope with stress include the following:

- Pay attention.
- Take them seriously.
- Be patient.
- Offer help when necessary.

* **eating disorders** are conditions in which a person's eating behaviors and food habits are so unbalanced that they cause physical and emotional problems.

* **schizophrenia** (skit-so-FREE-nee-ah) is a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors, which distort their view of reality.

- Other mental disorders, including eating disorders*, anxiety, depression, and possibly schizophrenia*.
- Cardiovascular (car-dee-o-VAS-kyu-lar) problems, such as irregular heartbeat, hardening of the arteries, and heart attack. Stress makes the heart beat more quickly and increases blood pressure temporarily. Although long-term effects have not been proven, many scientists suspect that they exist.

What Is the Stress Response?

Stressors both good and bad set off a series of events within the body's neuroendocrine system. Often called the "fight or flight" response, these events are triggered by the brain, which alerts the body's autonomic nervous system* to prepare all systems to react to an emergency. The autonomic nervous system sends a message in a split second through nerve fibers, which signal all the other body systems.

During this alarm period, various hormones are activated with many dramatic effects on other body systems. The heart beats faster, blood pressure is raised, and blood vessels dilate (open wider) to increase blood flow to the muscles. The pupils dilate to aid vision. The digestive system slows down so that the body's resources and energy can be used wherever else they are needed, and the production of saliva decreases. The bronchi dilate to aid breathing. The skin sweats to cool the body, and the liver releases its stores of glucose, the major fuel of the body, to increase the person's energy level. The body stays in this state until the brain tells it that the emergency has ended.

What Happens with Too Much Stress?

Researchers have found that chronic stress and post-trauma stress can suppress the immune system*, interfering with the body's natural ability to defend itself against infection. Chronic stress may also contribute to many other problems of mind and body, including:

- Headaches or stomachaches
- Allergic responses, such as skin rashes or asthma
- Irritability, aggression, or conduct disorders
- Bruxism (grinding the teeth)
- Sleep disorders
- Eating disorders
- Alcoholism or substance abuse
- Anxiety
- Phobias
- Depression

Long-term stress (chronic stress), frequently recurring stress, or extreme stress from a life-threatening event can keep the body's stress response system activated for a long time. Long-term stress may lead to

HANS SELYE AND STRESS RESEARCH

Hans Selye (1907–1982) is considered the founder of modern stress research. He authored 39 books, wrote more than 1,700 scholarly papers, and was cited as a source in more than 362,000 scientific papers and countless articles in magazines and newspapers around the world. He also established the International Institute on Stress at the University of Montreal. The body’s “general adaptation syndrome” is often called “Selye syndrome.”

Selye defined stress as “the nonspecific response of the body to any demand,” which means the body’s reaction to any change in its environment. Selye linked physical illnesses not just to bacterial and viral infections but also to hormones within the body that become activated whenever the body responds to external stressors, such as temperature extremes, pain, and threats to safety. Selye determined that many of the body’s hormonal responses to stress were helpful and adaptive (positive change in response to environment), but others were maladaptive (unhelpful change) and placed physical demands on the body that could result in disease.

Still, Selye described stress as the spice of life; it might make one person sick while invigorating another. In one of his bestselling books, *The Stress of Life*, Selye offered this rhymed advice: “Fight for your highest attainable aim/But never put up resistance in vain.” When people choose wisely about when to invest effort and emotional energy, they reduce the damaging side effects of stress, keep distress to a minimum, and increase our enjoyment of life.

emotional or behavioral problems, post-traumatic stress disorder, or the development of stress-related illnesses. Chronic* stress is believed to be a factor in many cases of abuse, violence, and suicide. Over the long term, chronic stress may contribute to the development of cardiovascular problems, such as high blood pressure, heart disease, and stroke. People who experience chronic stress can benefit from working with a doctor or therapist to learn stress management techniques.

What Is the Antidote for Too Much Stress?

The antidote for stress is relaxation, creating a state of ease, rest, and repose within the body. Taking a deep breath almost always is the first step toward relaxation, allowing individuals to determine that the emergency that triggered the body’s stress response has ended.

Relaxation response At the end of a stress response cycle, the body begins a relaxation response: Breathing slows down, hearts stop racing, muscles stretch out, minds become peaceful, and levels of stress hormones return to their baseline values. There are various techniques for achieving a relaxation response. Some people listen to music or sing, go for a long walk

- * **autonomic nervous system** is a branch of the peripheral nervous system that controls various involuntary body activities, such as body temperature, metabolism, heart rate, blood pressure, breathing, and digestion. The autonomic nervous system has two parts—the sympathetic and parasympathetic branches.
- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.
- * **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

or a run in the park, or practice meditation. Other techniques that promote a relaxation response include yoga, abdominal breathing, progressive muscle relaxation, biofeedback, guided imagery or visualization, hypnosis, prayer, belonging to support groups, or spending time with pets or loved ones. Because stress is an inevitable part of living, the long-term antidote for stress is learning coping strategies that allow people to live with it successfully.

Resilience Resilient people who experience high levels of stress but recover quickly and show low levels of illness are stress-resistant personalities. According to researchers, such resilient people seem to have several characteristics in common:

- They view change as a challenging and normal part of life, rather than as a threat.
- They have a sense of control over their lives, they believe that setbacks are temporary, and they believe that they will succeed if they work toward their goals.
- They have commitments to work, family, friends, support networks, and regular activities that promote relaxation, including hobbies, vacations, sports, yoga, and meditation.

Some people seem to be born with resilient personalities and good stress management skills. They know instinctively how to manage and how to find the help they need from others. However, at times when a little help is not enough and only extra-strength help will do, or when a person needs some coaching to improve coping skills, it may be useful to turn to a doctor, counselor, or therapist.

Resources

Books and Articles

Donovan, Sandy. *Keep Your Cool! What You Should Know about Stress*. Minneapolis, MN: Lerner, 2009.

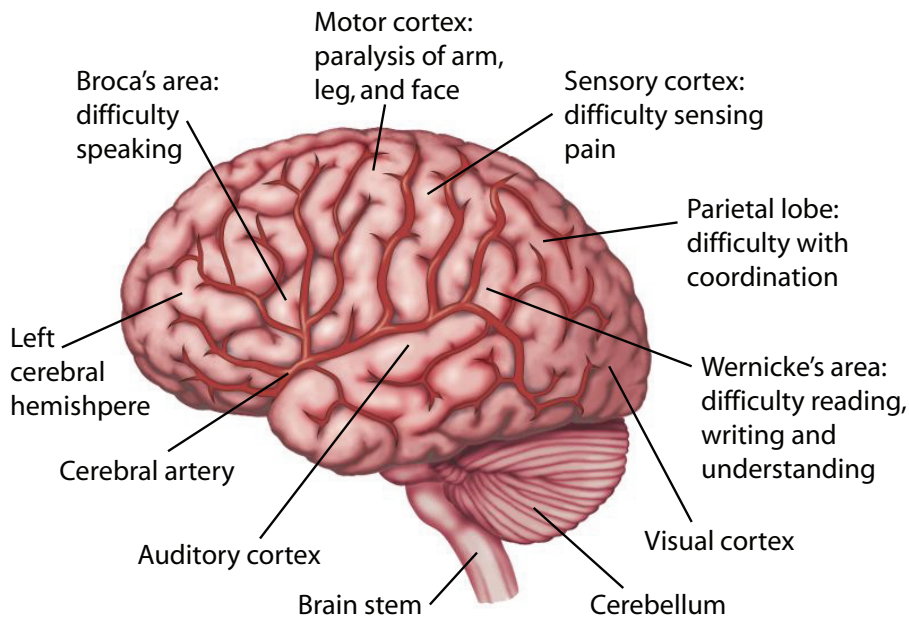
Greenberg, Jerrold S. *Comprehensive Stress Management*. New York: McGraw-Hill, 2008.

Organization

American Institute of Stress. 124 Park Avenue, Yonkers, NY, 10703. Telephone: 914-963-1200. Web site: <http://www.stress.org>.

Stroke

A stroke is the sudden destruction of brain cells when blood flow to the brain is disrupted, usually by a blockage in a blood vessel. It can cause weakness, speech problems, paralysis, and death, although most people survive.*



Strokes can affect many different parts of the brain. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Carmen's Story

While eating lunch with her grandfather on a sunny afternoon, 14 year-old Carmen was in the midst of describing her summer camp plans when suddenly one side of her grandfather's face went slack. He tried to speak, but he was slurring his words. Without warning, he clutched the picnic table, and the drinking glass he held smashed to the ground.

"Grandma," Carmen called. As her grandmother rushed to dial for emergency aid, Carmen held her grandfather's trembling hand.

In a few minutes, the ambulance arrived to carry him to the hospital, where a brain scan showed that Carmen's grandfather had undergone an ischemic (is-KEE-mik) stroke. Because Carmen and her grandmother acted quickly, the diagnosis was made in the Emergency Department less than three hours after his symptoms started, and the doctors were able to give him t-PA, a powerful drug that dissolved a blood clot that was blocking the flow of blood to his brain. Special guidelines specify that t-PA may be given only within *three hours* from the onset of stroke symptoms, so it was especially important that Carmen took prompt action. In a few days, her grandfather was ready to return home. Over several months, with the help of physical, occupational, and speech therapies, Carmen's grandfather was able to make a full recovery.

What Is a Stroke?

A stroke occurs when the blood supply to part of the brain is suddenly interrupted, or when a blood vessel in the brain bursts, spilling blood into the spaces surrounding neurons (nerve cells). Like other cells, brain cells die when they no longer receive oxygen and nutrients from the bloodstream or when they are damaged by sudden bleeding into or around the brain.

There are two major types of strokes. Ischemic strokes involve a reduced blood flow to the brain. Hemorrhagic (hem-o-RAJ-ik) strokes involve bleeding in the brain. “Ischemia” (is-KEY-me-a) is the term used to describe the loss of oxygen and nutrients when there is inadequate blood flow. If ischemia is left untreated, it can lead to infarction (in-FARK-shun), or cell death and tissue death in the surrounding area.

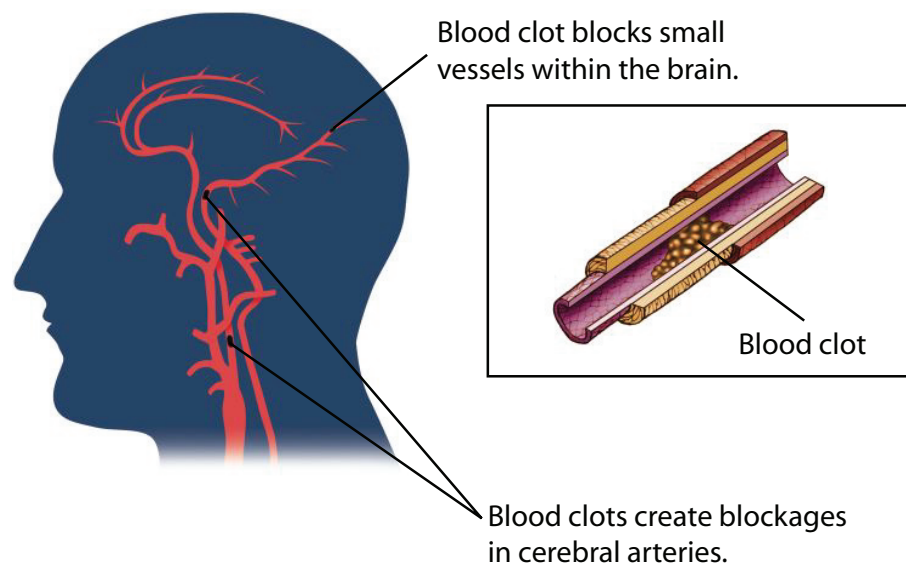
Ischemic Strokes

Ischemic strokes occur when a blood vessel to the brain becomes blocked, suddenly decreasing or stopping blood flow and ultimately causing an infarction. Ischemic strokes account for approximately 80 percent of all strokes. A blood clot (also called a thrombus) is the most common cause of vessel blockage and brain infarction.

Blood clots Blood clotting is necessary in the body to stop bleeding and to allow repair of damaged areas, but when blood clots develop in the wrong place within an artery, they can cause injury by stopping the normal flow of blood. Problems with clots develop more frequently as people age.

An embolus is a clot that has formed in a blood vessel somewhere in the body, often in the heart. It can break away from the wall of the vessel where it was formed, travel through the circulatory system, and become wedged in the brain, causing an embolic stroke. Ischemic strokes also can be caused by the formation of a blood clot in one of the cerebral arteries (arteries supplying blood to the brain). If the clot grows large enough, it will block blood flow.

Stenosis Stenosis, or a narrowing of the arteries, also can cause ischemia. Occurring in large arteries or small arteries, stenosis is called blood vessel disease or small vessel disease. The most common blood vessel



A blockage in an artery that supplies blood to the brain can cause an ischemic stroke. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

disease that causes stenosis is atherosclerosis. Deposits of plaque (a mixture of cholesterol and other fatty substances) build up along the inner walls of larger and medium sized arteries causing thickening, hardening, and loss of elasticity of the artery walls.

Transient ischemic attacks Some people get a warning that they may be headed for a future stroke. A transient ischemic attack (TIA) is a very small stroke caused by a temporarily blocked blood vessel. Unlike a full stroke, a TIA leaves no permanent damage. Symptoms are similar to those of a full stroke, but they usually last 24 hours or less. It is impossible to know whether the symptoms are caused by a stroke or by a TIA, so any symptoms should receive immediate medical attention. Having a TIA increases the risk of having a full stroke in the future, and medical attention can sometimes prevent or lessen the severity of the stroke.

Hemorrhagic Strokes

Hemorrhagic strokes are caused by burst blood vessels. In a healthy brain, the neurons do not come into direct contact with blood. Oxygen and nutrients move across a membrane from the blood vessel to the brain cells. Neuroglial (noo-ro-GLEE-al) cells help control which fluids and nutrients reach the neurons of the brain. When an artery in the brain bursts, blood spills out into the surrounding tissue, overriding the control of neuroglial cells and disrupting the delicate chemical balance of the brain.

Hemorrhagic strokes may occur in several ways. Aneurysms, or weak spots on artery walls, can stretch or “balloon” until eventually they break and spill blood into surrounding brain cells. Hemorrhages can also happen when plaque-encrusted arteries lose their elasticity and become brittle and thin enough to crack. Hypertension (high blood pressure) increases the risk that a brittle artery wall will give way and release blood into surrounding brain tissue.

Individuals who have an arteriovenous (ar-ter-ee-o-VEN-us) malformation (a tangle of defective blood vessels and capillaries within the brain that can rupture) can also be at increased risk for hemorrhagic stroke. Although hemorrhagic strokes are less common than ischemic strokes, they have a much higher fatality rate, because more brain tissue can be damaged more quickly.

How Do People Know They Are Having a Stroke?

Symptoms of stroke, such as those experienced by Carmen’s grandfather, appear suddenly. They may include:

- Numbness or weakness of the face, arm, or leg, particularly on one side
- Confusion, trouble talking, and trouble understanding speech
- Difficulty seeing in one or both eyes
- Dizziness, difficulty walking, loss of balance, or loss of coordination
- Severe headache with no known cause

The United States and the World

- Stroke is the third leading cause of death in the United States, killing more than 160,000 people each year. About 75 percent of all strokes occur in people over the age of 65.
- Stroke is a significant cause of long-term disability.
- Strokes can occur at any age; however, the risk for stroke more than doubles each decade after the age of 55.
- Stroke may strike individuals of any race, but death due to stroke is higher for African Americans than for whites.
- In 2005, costs associated with stroke totaled about \$57 billion.
- The southeastern region of the United States has the highest stroke mortality rates in the country, but it is not yet clear why this is the case.
- Approximately 700,000 strokes occur each year, and of these, about 500,000 are first strokes, whereas 200,000 occur in people who have had at least one previous stroke.
- The World Health Organization (WHO) estimates that strokes killed approximately 5.5 million people worldwide in 1999.

* **electrocardiogram** (e-lek-tro-KAR-dee-o-gram), also known as an EKG, is a test that records and displays the electrical activity of the heart.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

Strokes are medical emergencies and require immediate medical attention.

How Is Stroke Diagnosed?

Doctors have diagnostic techniques and imaging tools to help diagnose strokes quickly and accurately. When a person with signs and symptoms of stroke arrives at the hospital, the first diagnostic step is a physical examination and a medical history. Often, an electrocardiogram* and a CT scans* will be done to check for signs of heart disease, evidence of prior TIAs, and heart rhythm disturbances. The patient may be asked to answer questions and to perform several physical and mental tests to evaluate the possibility or severity of brain damage.

Imaging tests also help healthcare professionals to evaluate stroke. The CT scan may rule out a hemorrhage or may show evidence of early infarction. If the stroke is caused by a hemorrhage, a CT scan can reveal any bleeding into the brain. MRIs* may be taken to detect subtler changes in brain tissue or areas of dead tissue soon after a stroke.

How Is Stroke Treated?

Stroke treatment most often involves medication and rehabilitation. Acute stroke therapy uses medication to stop a stroke while it is happening by quickly dissolving the blood clot that is causing the stroke or by stopping the bleeding of a hemorrhagic stroke. Surgery is almost never used for acute stroke treatment. Very rarely, and only in hemorrhagic stroke, a neurosurgeon may consider placing an intraventricular drain to remove some blood from a ventricle and relieve pressure on the brain. Carotid endarterectomy (surgery to remove plaque buildup in carotid arteries) may be indicated to prevent an ischemic stroke from happening, although it is rarely performed as an emergency procedure.

Medication and surgery Various medications can be used to treat stroke:

- Antithrombotics work to counteract the chemicals in the body that cause blood to clot.
- Antiplatelet drugs prevent clotting by decreasing the activity of cells that contribute to the clotting properties of blood. They can reduce the risk of ischemic stroke.
- Anticoagulants reduce the stroke risk by thinning the blood and reducing its clotting properties.
- Thrombolytic agents can sometimes be used to treat an ongoing stroke. These drugs work by dissolving the blood clot that is blocking the blood vessel supplying the brain.
- Tissue plasminogen activator (t-PA) can be effective if given intravenously within three hours of the onset of stroke symptoms when a CT scan confirms that a person has suffered an ischemic stroke. However, t-PA increases the risk of major bleeding, so it can be

used only when a patient fully meets the established guidelines, including the onset of symptoms less than three hours in duration. As of 2009, the majority of patients with ischemic stroke turned out to be ineligible for the t-PA treatment.

Surgery is not used to treat an ischemic stroke, but it is sometimes used to treat a hemorrhagic stroke. An attempt to surgically remove accumulated blood and intracranial pressure caused by a hemorrhagic stroke is a delicate procedure, as the surgery itself may generate additional bleeding, thus causing more harm. The surgeon may insert a tube called a shunt, to allow drainage and relieve pressure around the brain. In addition, surgery is sometimes used to repair vascular malformations in and around the brain.

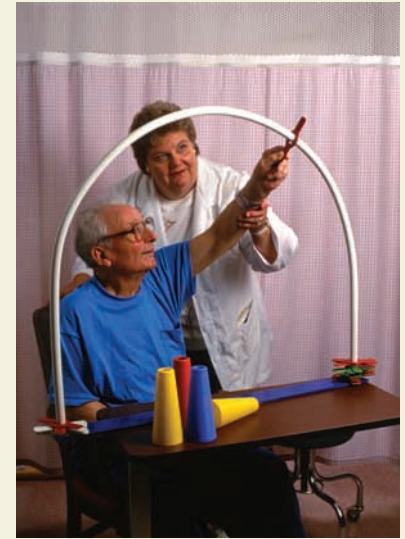
Rehabilitation Post-stroke rehabilitation helps people overcome the disabilities that result from stroke damage. For some people, like Carmen's grandfather, acute stroke treatment and post-stroke therapy lead to a full recovery. For others, recovery is only partial.

Although strokes occur in the brain, they may affect the entire body and all activities of daily living. Some of the disabilities that may result from a stroke include paralysis, or partial paralysis, of different parts of the body, difficulties with memory and concentration, speech problems, and emotional distress as people cope with their changed circumstances. Rehabilitation may involve several different forms of therapy:

- Physical therapy helps people to regain movement, balance, and coordination and to reestablish skills such as sitting, walking, and moving from one activity to another.
- Occupational therapy helps people who have had strokes readapt to everyday life by relearning practical skills needed at home, such as dressing, eating, bathing, reading, and writing.
- Speech therapy addresses the speech and language problems that arise when a stroke causes brain damage in the language parts of the brain. Speech therapy helps people who have no deficits in cognition or thinking but have problems understanding written words, or problems forming speech. One common problem for people who have suffered stroke is aphasia (a-FAY-zha), a condition in which comprehension or expression of words is impaired. Speech therapists help stroke patients by working to improve language skills, develop alternative ways of communicating, and develop coping skills to deal with the frustration of not being able to communicate easily.
- Psychotherapy often is useful following a stroke, because depression, anxiety, frustration, and anger are common post-stroke symptoms.

Preventing Stroke

The most important risk factors* for stroke are hypertension (high blood pressure), heart disease, diabetes, and smoking. Others factors that increase the risk of having a stroke are heavy alcohol consumption, high



▲ Physical therapy helps people who have had strokes regain movement, balance, and muscular coordination. ©Dwight Cendrowski/Alamy.

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **risk factors** are any factors that increase the chance of developing a disease.

Dwight D. Eisenhower

Dwight D. Eisenhower (1890–1969) was a U.S. Army general and the thirty-fourth president of the United States. “Ike,” as he was known, had a meteoric rise as a military commander during World War II. In 1953, he was elected to his first term in the White House. Despite having a heart attack in 1955 and a stroke in 1957, he was elected to a second term. Eisenhower completed his presidency in 1961, when John F. Kennedy was sworn in as thirty-fifth president.

* **atrial fibrillation** (AY-tree-al fib-ri-LAY-shun) is the arrhythmic or irregular beating of the left upper chamber of the heart. This leads to an irregular flow of blood and to the formation of blood clots that can leave the heart and travel to the brain, causing a stroke.

cholesterol levels, and genetic or congenital conditions, such as vascular (blood vessel) abnormalities.

Hypertension People with hypertension (high blood pressure) have a risk for stroke that is four to six times greater than those without hypertension. One-third of adults in the United States have high blood pressure. Antihypertensive drugs and attention to diet can decrease a person’s risk for stroke.

Heart disease After hypertension, the second most powerful risk factor for stroke is heart disease, particularly the condition known as atrial fibrillation*. This condition is more prevalent in older people. Other forms of heart disease that can increase the chances of having stroke include malformations of heart muscle and some heart valve diseases. Cardiac surgery to correct heart malformation or the effects of heart disease can also cause stroke. Strokes occurring during surgery often are the result of dislodged plaques.

Diabetes People with diabetes have three times the risk of stroke as those without diabetes. The relative risk is highest in the fifth and sixth decades of life and decreases after that. People with diabetes who control their blood sugar level well, who avoid smoking, and who avoid or control hypertension, are less likely to have strokes.

Cigarette smoking Smokers have a 40 to 60 percent greater chance of having a stroke than nonsmokers. Smoking increases a person’s chance for ischemic stroke, independent of all other risk factors.

Blood cholesterol levels High cholesterol levels can contribute to the risk of stroke. Too much cholesterol in the blood is associated with plaque developing in the walls of arteries (atherosclerosis), leading to stenosis of blood vessels. By lowering cholesterol through diet and exercise, a person can lower the risk for atherosclerosis and stroke. Doctors may prescribe cholesterol-lowering medication for people with high cholesterol levels.

Lifestyle changes Many strokes can be prevented with changes in lifestyle. These changes include:

- Stopping smoking
- Avoiding binge drinking and overconsumption of alcohol
- Avoiding illicit drugs: cocaine and crack cocaine can cause stroke, and marijuana may produce wide fluctuations in blood pressure and heart rate, which could contribute to stroke development

Medical measures To prevent stroke, doctors may prescribe medications to lower blood pressure and cholesterol levels. In some cases, particularly if a person has atrial fibrillation, doctors may prescribe regular doses of aspirin, coumadin, or other medications that prevent blood clotting. If carotid (ka-ROT-id) arteries (arteries supplying the brain) are partially blocked by plaque, surgery can clear them and prevent strokes in many cases.

Strokes can happen to people of either sex no matter what their age or racial background. Transient ischemic attacks (TIAs) multiply a person's risk of having a full stroke and should receive immediate medical attention.

▶ See also **Aneurysm • Heart Disease • Hypertension**

Resources

Books and Articles

- Butler, Dori Hillestad. *My Grandpa Had a Stroke*. Washington, DC: Magination Press, 2007.
- Hreib, Kinan K. *100 Questions and Answers about Stroke: A Lahey Clinic Guide*. Sudbury, MA: Jones and Bartlett, 2008.
- Lindley, Richard I. *Stroke*. Oxford, UK: Oxford University Press, 2008.

Organizations

- American Heart Association.** 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org>.
- Heart and Stroke Foundation of Canada.** 222 Queen Street, Suite 1402, Ottawa, ON, K1P, 5V9, Canada. Telephone: 613-569-4361. Web site: <http://www.hsf.ca/az/atoz-a.htm>.
- National Institute of Neurological Disorders and Stroke.** P.O. Box 5801, Bethesda, MD, 20824, Web site: <http://www.ninds.nih.gov/disorders/stroke/stroke.htm>.
- National Stroke Association.** 96 Inverness Drive East, Suite I, Englewood, CO, 80112-5112. Toll free: 800-787-6537. Web site: <http://www.stroke.org>.

Stupor and Coma

Stupor and coma describe two different altered states of consciousness. Coma is the deeper of the two.

What Are Stupor and Coma?

Stupor and coma describe two different altered states of consciousness. Stupor is a state of unconsciousness from which an individual can only be roused with a forceful, physical stimulus. Coma is an even deeper level of unconsciousness, during which the individual does not have any voluntary movement or behavior. When in a coma, an individual cannot be aroused with verbal, physical, or even physically painful stimuli, and even basic reflexes may be lost.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

ABOUT CONSCIOUSNESS

Consciousness has two components: awareness and arousal. Awareness is the ability to receive and process all the information communicated by the five senses. People who have intact awareness are able to relate to themselves and to the outside world. Awareness itself is made up of two components: the psychological and the physiological realms. The psychological component involves the individual's mind and mental processes, whereas the physiological component refers to the chemical and physical functioning of the individual's brain and nervous system. The cortical areas of the cerebral hemispheres govern awareness. Awareness, then, suggests a higher level of intellectual functioning.

Arousal, however, is a more basic, physiological level of primitive functioning. Arousal is governed by the functioning of the reticular activating system, which is a network of structures (the brainstem, medulla, the thalamus, and variety of nerve pathways) that function together to produce and maintain arousal. Arousal is exemplified by the involuntary but predictable reflexes that are an individual's automatic response to specific stimuli.

The continuum of consciousness, then, ranges from full intellectual engagement at the highest end of functioning to complete brain death at the lowest end of functioning. States between these two extremes include lethargy, obtundation (reduced level of consciousness), and stupor. When in any of these states, an individual will respond in some capacity to stimuli, even though the stimulus may need to be sufficiently intense to garner even a minimal response (as may occur with stupor). In the case of coma, however, even an intense stimulus will fail to provoke a response.

What Causes Stupor and Coma?

Stupor and coma may stem from the same kinds of disorders. In each case, the disorders affect the functioning of the brain's nerve cells, causing them to respond very slowly or to cease responding. Common causes include liver disease, kidney failure, thyroid disorders, hypothermia (abnormally, dangerously low body temperature), hyperthermia (abnormal, dangerously high body temperature), toxic exposures/poisonings, excess alcohol, drugs such as sedatives or opioids, severe dehydration* and electrolyte imbalances, drug reactions, infection (particularly in the elderly), direct trauma (injury) to the brain, strokes, tumors, aneurysms, seizures, brain abscesses, heart attacks, metabolic problems (high blood glucose, low blood glucose, excess or deficient blood sodium), and oxygen deprivation (asphyxiation).

Who Is Likely to go into a Stupor or Coma?

Given the right circumstances, anybody can suffer from stupor or coma, although the elderly are particularly vulnerable. The same level of illness, trauma, or toxic exposure that a younger person might be able to weather successfully, may well produce stupor or coma in an older individual.

What are the Symptoms of Stupor and Coma?

The most notable symptom of stupor is the individual's inability to respond to normal stimuli. Instead, shouting, shaking, or painful stimuli are necessary to provoke a response. The individual's eyes may be open, but clearly not focusing. In coma, intense stimuli do not provoke a response, and the eyes are closed.

Other features of stupor and coma that may be present include abnormal breathing patterns; unusual contraction or flaccidity of muscles, resulting in odd positioning of limbs and/or head; abnormal dilatation or contraction of the pupils of the eyes; and odd eye movements.

How Are Stupor and Coma Diagnosed?

Impaired consciousness is quite evident upon initial observation, although determining the level and the cause of impairment requires further investigation. Differentiating between stupor and coma requires simple maneuvers to see whether the individual will arouse to intense stimuli (as in stupor) or whether no arousal is possible (as in coma). Physical examination will also be performed to look for other clues that may point to the reason for the impaired consciousness.

If coma is diagnosed, a rating system called the Glasgow Coma Scale (GCS) may be used to assess the depth of the coma, to monitor the individual's progress over time, and to roughly ascertain the individual's overall prognosis. The Glasgow Coma Scale uses a point system to evaluate three categories of functioning: opening of the eyes, using words or voice to respond, and motor response (moving a part of the body to respond). The highest level of functioning is assigned to individuals who spontaneously open their eyes, can give appropriate verbal responses to questions, and can carry out a simple command to move a part of their body. A GCS score of 3-5 may suggest fatal brain damage; a GCS score of eight or more suggests that the chance of recover is good.

Evaluation of the pupils of the eyes and breathing pattern are also important. Blood and urine tests will probably be performed in order to quickly diagnose the presence of toxins (such as high levels of alcohol, drugs, carbon dioxide, or poisons), abnormalities of blood chemistry (such as sodium, potassium, and glucose), liver or kidney failure, low blood oxygen, or infection. CT scans* or MRI* brain scans may be performed to evaluate the possibility of brain injury due to trauma, stroke, aneurysm, or tumor. Quick, thorough evaluation is necessary, so that the cause of the coma is quickly identified and potentially reversible conditions can be treated immediately.

How Are Stupor and Coma Treated?

Impairment of consciousness is considered a medical emergency. Evaluation and treatment of any abnormalities in respiration or circulation should be attended to immediately. Oxygen is often given, and an intravenous (in the vein) line is placed in case fluids or medications need to be given

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **diuretics** (dye-yoor-EH-tiks) are medications that increase the body's output of urine.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

quickly. The ultimate treatment will depend on the underlying cause of the coma, although basic measure may include elevation of the head of the bed, use of diuretics* or steroid drugs to decrease swelling in the brain, and/or administration of sedative drugs to decrease muscle contractions. Infections may require antimicrobial drugs; chemical abnormalities may respond to the administration of sodium or glucose; dehydration may improve with fluids; narcotic overdose may be treated with Narcan; and antiepileptics may stop seizures. In severe situations, surgery may be necessary to relieve excess pressure on the brain or to remove or repair abnormalities (such as a tumor or bleeding aneurysm).

If the coma persists, it may become necessary to place a tube for feeding, either through the nose or through an incision in the abdomen into the stomach. Physical therapy may be employed to move the individual through passive range of motion exercises in order to keep joints and muscles as healthy as possible.

What Is the Prognosis of Stupor and Coma?

Prognosis (the prediction of future healing) depends on the underlying condition responsible for the impaired level of consciousness, the patient's original medical condition, the duration of the stupor or coma, how quickly the individual begins to make a recovery, and the degree of structural damage that the brain has suffered. When the impairment is due to sedative overdose, complete recovery is likely, unless oxygen deprivation has caused brain damage. Prognosis for recovery after impairment due to low blood sugar is very good, if the low blood sugar has been corrected in less than an hour. Head injury may have a good prognosis, although coma lasting more than three months reverses this prognosis. A stroke that prompts a coma lasting less than six hours may have a reasonably good prognosis, although coma lasting more than six hours has a poor prognosis. Heart attack or oxygen deprivation share a poor prognosis.

With treatment, stupor or coma due to toxic exposures (such as drug overdoses) has a higher rate of complete recovery than many other causes of impairment. Only about 15 percent of adults who suffer stupor or coma due to other causes and who remain in a coma for more than just a few hours, return to their previous level of functioning. Children and younger adults may return to their expected level of functioning after as long as two months of impairment of consciousness.

Can Stupor and Coma be Prevented?

Although there is no way to prevent stupor and coma, certain basic measures can decrease the risk, including wearing seatbelts and using appropriate protective head gear (helmets while bike riding); avoiding illicit drugs and excess alcohol; using prescription medications exactly as prescribed; and following standard recommendations for avoiding or treating high blood pressure, diabetes, obesity*, high cholesterol, and other medical conditions.

Resources

Books and Articles

Marx, John A., et al. *Rosen's Emergency Medicine*, 6th ed. St. Louis, MO: Mosby, 2006.

Senelick, Richard C., and Karla Dougherty. *Living with Stroke: A Guide for Families*, 3rd ed. Clifton Park, NY: Delmar Cengage Learning, 2001.

Organizations

Brain Injury Association. 1608 Spring Hill Road, Suite 110, Vienna, VA, 20036. Toll free: 800-444-6443. Web sites: <http://www.biausa.org>; <http://www.biausa.org/Pages/coma.html>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824, Web site: <http://www.ninds.nih.gov/disorders/coma/coma.htm>.

Stuttering

Stuttering is a speech disorder in which the normal flow of words is broken by sounds that are repeated or held longer than normal, or by problems with starting a word.

What Does Stuttering Sound Like?

People who stutter may repeat a speech sound over and over (st-st-stuttering), or they may hold a sound longer than normal (sssssstuttering). In some cases, they may have trouble starting a word, leading to abnormal stops in their speech (no sound). Yet many people who stutter learn to control the problem. The list of famous people in history who overcame stuttering includes scientists Isaac Newton and Charles Darwin; Clara Barton; George VI of England, Winston Churchill, and Joe Biden; and actors Marilyn Monroe, Bruce Willis, and James Earl Jones.

What Is Stuttering?

Stuttering is a speech disorder in which the normal flow of speech is broken. Along with the effort to speak, some people who stutter also make unusual face or body movements, such as rapid eye blinking or trembling of the lips. Certain situations, such as speaking on the phone, tend to make stuttering worse. By contrast, people usually do not stutter when they sing, whisper, or speak as part of a group, or when they do not hear their own voices. No one is sure why this is so.

Being a Good Listener

People who talk to others who stutter should do the following:

- Be patient. Do not finish sentences or fill in words for the person.
- Make normal eye contact. Try not to look embarrassed or concerned.
- Be understanding. Do not make remarks such as “slow down” or “relax.”
- Set a relaxed pace. Try to keep their own speech at a medium speed.
- Be sensible. If they do not understand what the other person says, they should politely ask the person to repeat it.

* **sex-linked** genetic traits involve the chromosomes that determine whether a person is male or female. They usually affect boys, who have only one X chromosome.

* **anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person’s physical or mental well-being.

Most children go through a stage of choppy speech when they are first learning to talk. In addition, teenagers and adults often add extra sounds (for example, “uh” and “um”) to their speech, and they occasionally repeat sounds. These speech interruptions are perfectly normal. Such problems are considered a disorder only when they last past the age when most children outgrow them and get in the way of communicating clearly. Treating stuttering even in young children may help prevent a lifelong problem. Treatment may be considered for children who stutter longer than six months or for those who seem to struggle when they speak. Sometimes, however, no treatment is the best treatment, especially in the case of children whose stuttering worsens when attention is focused on the problem.

What Causes Stuttering?

Stuttering usually begins between two and six years of age. About 1 percent of children stutter, and boys are three times more likely to do so than girls. The most common form of stuttering is thought to arise when children’s developing speech and language abilities are not yet able to keep up with their needs. Stuttering occurs when they search for the right word. This kind of stuttering usually is outgrown.

Another form of stuttering is caused by signal problems between the brain and the nerves or muscles involved in speech. The brain is unable to control all the different parts of the speech system. This kind of stuttering sometimes is seen in people who have had a stroke or brain injury. Yet another, less common form of the disorder is caused by severe stress or some types of mental illness. Some kinds of stuttering seem to run in families, and it is likely that stuttering is sex-linked* (je-NE-tik) in some cases, although no gene for stuttering had been found as of 2009.

How Is Stuttering Linked to Fear?

Contrary to popular belief, there is no evidence that stuttering is caused by anxiety* (ang-ZY-e-tee); an intense, long-lasting feeling of fear; worry; or nervousness. Yet people who stutter may become fearful of meeting new people, speaking in public, or talking on the phone. In such cases, it is the stuttering that causes the fear, not the activity.

How Is Stuttering Diagnosed?

Stuttering usually is diagnosed by a speech-language pathologist (pa-THAH-lo-jist), a professional who is trained to test and treat people with speech, language, and voice disorders. The speech pathologist will ask questions about the problem, such as when it first started and when it is most and least noticeable. The speech pathologist will also test speech and language abilities. In addition, some people may be sent to other professionals for hearing tests and medical tests of the nervous system.

How Is Stuttering Treated?

There are several treatments that may improve stuttering, although none is an instant cure. With young children, the focus often is on teaching parents how to help the child at home. Parents typically are told to have a relaxed attitude and give their children plenty of chances to speak. They may be warned not to criticize their children's speech. They may be urged not to pay attention to the children. Instead, they can be good role models, speaking in a slow, relaxed manner themselves and listening patiently when their children talk.

Speech therapy can help older children, teenagers, and adults relearn how to speak or unlearn faulty ways of speaking. Some people who stutter have fears related to the disorder, such as a fear of speaking in public. Such problems caused by the stuttering can be helped with psychotherapy (sy-ko-THER-a-pea), in which people talk about their feelings, beliefs, and experiences with a mental health professional who can help them work out issues that play a part in their speech problems.

▶ See also **Anxiety and Anxiety Disorders • Social Phobia (Social Anxiety Disorder) • Speech Disorders**

Resources

Books and Articles

De Geus, Eelco. *Sometimes I Just Stutter*. Memphis, TN: Stuttering Foundation of America, 1999.

Stuttering and Your Child: Questions and Answers, 3rd ed. Memphis, TN: Stuttering Foundation of America, 2007.

Williams, Dale F. *Stuttering Recovery: Personal and Empirical Perspectives*. Mahwah, NJ: Erlbaum, 2006.

Organizations

American Speech-Language-Hearing Association. 2200 Research Boulevard, Rockville, MD, 20850-3289. Toll free: 800-638-8255. Web site: <http://www.asha.org/public/speech/disorders/stuttering.htm>.

National Institute on Deafness and Other Communication Disorders, National Institutes of Health. 31 Center Drive, MSC 2320, Bethesda, MD, 20892-2320. Toll free: 800-241-1044. Web site: <http://www.nidcd.nih.gov/health/voice/stutter.htm>.

National Stuttering Association. 119 W. Fortieth Street, 14th Floor, New York, NY, 10018. Toll free: 800-937-8888. Web site: <http://www.nsastutter.org>.

Stuttering Foundation of America. P.O. Box 11749, 3100 Walnut Grove Road, Suite 603, Memphis, TN, 38111-0749. Toll free: 800-992-9392. Web site: <http://www.stutteringhelp.org>.

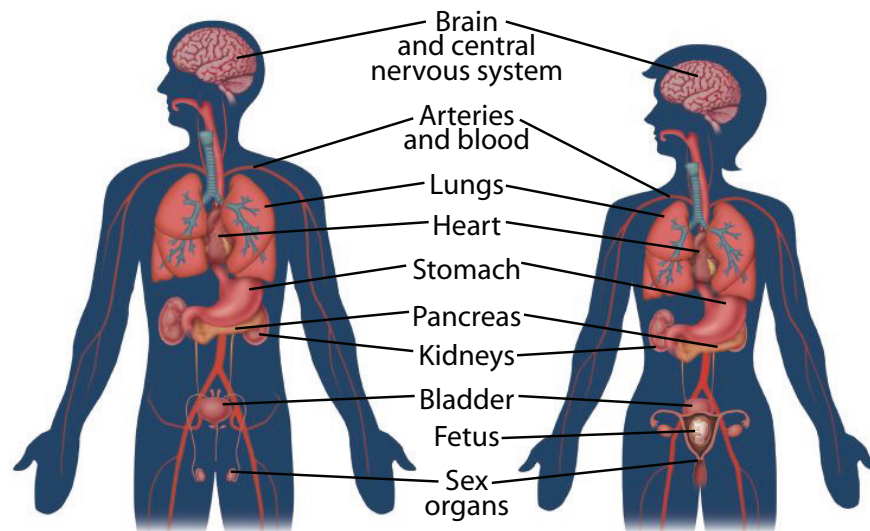
Substance Abuse

Substance abuse is the unhealthy, even dangerous pattern of over consuming alcohol, tobacco, illegal drugs, prescription drugs, and other substances (such as paint thinners or aerosol gasses) that change how the mind and body work. It is possible to abuse some substances without becoming physically, emotionally, or psychologically dependent on them, but continued abuse tends to make people dependent. Dependency on some substances happens very quickly and is difficult to reverse.

What Is Substance Abuse?

Substance abuse is the unhealthy, even dangerous over consumption of various substances such as alcohol and other drugs that usually leads to frequent, serious problems at home, school, or work. People who abuse substances can get sick, ruin their relationships with other people, destroy their lives and the lives of family members, and even die, and while under the influence, they can injure or kill others. In 2007, 19.9 million Americans age 12 and over said they were current users of illegal drugs. In that same year, more than 17 million Americans age 12 or older reported that they drank alcohol heavily. Heavy drinking means that these people binge drank or they drank five or more drinks on five or more days during the previous month. Substance abuse is a serious problem in the United States.

Substance abuse is not the same as occasional alcohol or other drug use. When people are addicted to a substance, they develop a strong physical or psychological need for that drug. One hallmark of addiction is tolerance (TOL-er-uns), which means that over time, people need more and more of the substance to feel a high. Another symptom is withdrawal,



Substance abuse and addiction affect many different parts of the body.
Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

which means that people who are addicted have physical symptoms and feel sick if they stop using the substance.

Alcohol and other drugs cause “intoxication” (in-TOK-sih-KAY-shun), the medical term for a temporary feeling of being high or drunk that occurs just after using a drug. Intoxication leads to changes in the way people think and act. For example, people may become angry, moody, confused, or uncoordinated. These changes increase the risk that people will make poor choices, have accidents that hurt themselves or others, or behave in a way that they will later regret.

Different substances have different effects on the body. Substances that are commonly abused in the United States include the following:

- Alcohol
- Amphetamines
- Anabolic steroids
- Cocaine
- Depressants
- Hallucinogens
- Inhalants
- Marijuana
- Narcotics
- Prescription medications
- Nonprescription (over-the-counter) medications
- Tobacco

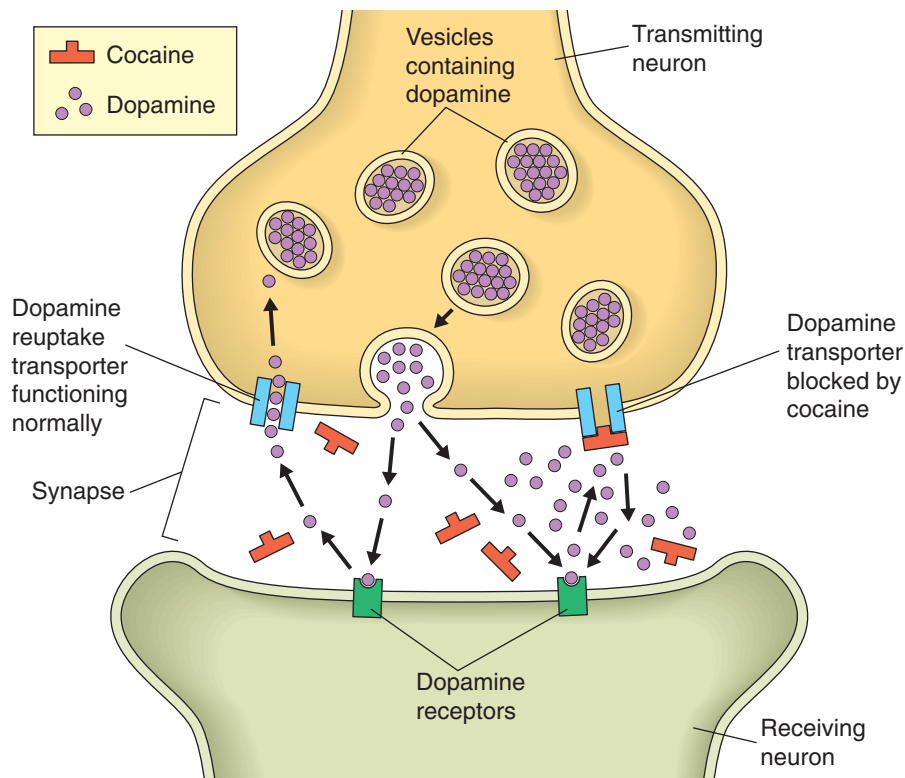
What Causes Substance Abuse?

People give many reasons for starting to drink alcohol or use other drugs. Some people are looking for an easy way to escape problems at home, school, or work. Others hope that alcohol or other drugs will help them fit in or make them appear to be something better than what they are. Some may use substances to “treat” or “self-medicate” depression or boredom. Still others are initially just curious. Whatever the original reason, no one can say for sure which people will go on to have a serious substance abuse problem. However, certain factors raise the risk that abuse will develop. Risk factors for substance abuse problems include the following:

- Family history of substance abuse
- Using alcohol or tobacco at a young age
- Depression
- Low self-esteem*
- Feeling like an outsider
- Poverty
- Child abuse or neglect
- Family problems

* **self-esteem** is the value that people put on the mental image that they have of themselves.

Cocaine is a mood-altering drug that interferes with normal transport of the neurotransmitter dopamine, which carries messages from neuron to neuron. When cocaine molecules block dopamine receptors, too much dopamine remains active in the synaptic gaps between neurons, creating feelings of excitement and euphoria. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



The United States and the World

The World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC) accumulate statistics about health problems resulting from substance abuse. Notable facts include the following:

- In 2004, 19,838 people died as a result of accidental drug overdoses. That number increased from 11,155 in 1999. The abuse of legal drugs among people ages 15 to 24 is likely responsible for the dramatic increase.
- In 2007, twice as many males (12.5%) as females (5.7%) were categorized as substance abusers; however, abuse rates among males and females ages 12 to 17 was equal.
- In 2007, 12.5 percent of people over the age of 12 reported that they had driven a vehicle while under the influence of alcohol or other drugs.

Some of these factors can be changed or controlled by the people themselves, but others cannot. However, that does not mean that those who come from troubled families or low income neighborhoods are destined to be substance abusers. Certain other factors raise the odds that young people will be able to cope with problems without turning to alcohol or other drugs. These factors include the following:

- Learning to do something well
- Being active at school or in the community
- Having a caring adult or friend to talk to

Addiction is a special type of dependence in which people have a compulsive need to use the substance no matter what the consequences are. People who are psychologically addicted need to keep using the substance to feel satisfied. People who are physically addicted feel sick and have physical withdrawal symptoms if they stop using the substance. The risk and type of dependence varies by substance. Substance abuse occurs among people of all ages, cultures, sexes, and races.

What Are Some Commonly Abused Substances?

People abuse a wide variety of drugs, both legal and illegal. Legally available substances include alcohol, tobacco, chemicals in certain household products, over-the-counter drugs, and medicines prescribed by a doctor. Illegally sold substances include numerous street drugs.

Alcohol Although moderate drinking (two to four drinks a day for men and one to two drinks a day for women and older people) is not normally considered harmful, millions of people in the United States abuse alcohol or are alcoholics (people who are physically dependent on alcohol). A 2007 national survey found that 17 million Americans are heavy drinkers and that 57.8 million people engage in binge drinking (more than five drinks on one occasion).

Alcohol affects virtually every organ in the body, and long-term use can lead to a number of medical problems. The immediate effects of drinking too much include slurred speech, poor coordination, unsteady walking, memory problems, poor judgment, and the inability to concentrate. Drinking too much alcohol at one time can cause alcohol poisoning and sudden death. The recklessness that comes from drinking too much is a leading cause of traffic accidents and other injuries. In addition, alcohol drinking by pregnant women is the cause of the most common preventable birth defect fetal alcohol syndrome*. Long-term risks of heavy drinking include liver damage, heart disease*, neurological effects, reduced cognitive functioning, sexual problems for men, and trouble getting pregnant for women.

Tobacco Tobacco contains nicotine (NIK-o-teen), a highly addictive chemical. Nicotine is readily absorbed from tobacco smoke in the lungs, whether the smoke comes from cigarettes, cigars, or pipes. Smoking is the number one cause of preventable death in the United States. The long-term health risks include cancer, lung disease, heart disease, and stroke*. Smoking by pregnant women has been linked to miscarriage*, stillbirth*, premature birth*, low birth weight*, and infant death. Nicotine is readily absorbed from smokeless tobacco as well. Like smoking, dipping or chewing tobacco can have serious long-term effects, including cancer of the mouth, gum problems, loss of teeth, and heart disease.

Marijuana Marijuana (mar-ih-HWAH-nuh; nicknames: pot, herb, weed, blunts, Mary Jane) is the most widely used illegal drug. It is typically the first illegal drug tried by teenagers. It is a mixture of dried, shredded flowers and leaves from the cannabis plant. Marijuana usually is smoked in a cigarette, pipe, or water pipe, but some users also mix it with foods or use it to brew tea. Short-term effects of marijuana use include euphoria*, sleepiness, increased hunger, trouble keeping track of time, memory problems, inability to concentrate, poor coordination, increased heart rate, paranoia*, and anxiety. Long-term risks include lung disease, changes in hormone levels, lower sperm counts in men, and infertility.

Hallucinogens Hallucinogens (huh-LOO-sih-no-jenz) are drugs that distort a person's view of reality. They include LSD (lysergic acid diethylamide; nickname: acid), PCP (phencyclidine; nicknames: angel dust, love-boat), psilocybin (SY-lo-SY-bin; nickname: magic mushrooms), mescaline (MES-kuh-len), and peyote (pay-YO-tee or pay-YO-tay). People who use

Medicinal Marijuana

Marijuana is an illegal drug. In some states, however, it can legally be prescribed for certain medical purposes. Research indicates that marijuana may help in the treatment of glaucoma*, and it may relieve the nausea and wasting away that people with AIDS and cancer sometimes experience as a side effect of medical treatments. But research also shows that marijuana smoke contains more tar than cigarette smoke and may contain high levels of other cancer-causing agents. As of 2009, further research was needed and public policies regarding marijuana remained controversial.

* **glaucoma** is a group of disorders that cause pressure to build in the eye, which may result in vision loss.

* **fetal alcohol syndrome** which occurs if the fetus is exposed to alcohol, is a condition that can be associated with mental, physical, and behavioral differences. Oppositional behavioral problems, learning difficulties, mental retardation, and retarded growth can occur in the children of women who drink alcohol while they are pregnant.

* **heart disease** is a broad term that covers many conditions that prevent the heart from working properly to pump blood throughout the body.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

- * **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.
- * **stillbirth** is the birth of a dead fetus.
- * **premature birth** (pre-ma-CHUR) means born too early. In humans, it means being born after a pregnancy term lasting less than 37 weeks.
- * **low birth weight** means born weighing less than normal. In humans, it refers to a full-term (pregnancy lasting 37 weeks or longer) baby weighing less than 5 pounds.
- * **euphoria** (yoo-FOR-ee-uh) is an abnormally high mood with the tendency to be overactive and overly talkative, and to have racing thoughts and overinflated self-confidence.
- * **paranoia** (pair-a-NOY-a) refers to either an unreasonable fear of harm by others (delusions of persecution) or an unrealistic sense of self-importance (delusions of grandeur).

these drugs may lose all sense of time, distance, and direction. They may behave strangely or violently, which can lead to serious injuries or death. Users react differently to hallucinogens, and some individuals have bad experiences with them.

LSD is one of the most potent of all mind-altering drugs. It may be taken in the form of paper that has been dipped in the drug, powder, liquid, gelatin, or pills. LSD can last for as long as 12 hours in the body. The physical effects of LSD use include dilated (widened) pupils, increased heart rate, higher blood pressure, sweating, loss of appetite, trouble sleeping, dry mouth, and shaking. The psychological effects are much more dramatic, however. Users may feel several different emotions at once, or they may swing from one emotion to another, from euphoria to paranoia. They may have bizarre or terrifying thoughts, or they may see things that are not really there, like walls melting. Some users later have flashbacks, in which they relive part of what they experienced while taking the drug, even though the drug is no longer active in their bodies. Hallucinogens are not physically addictive, but people using them are at risk for accidents,

SAME PROBLEM, DIFFERENT SOLUTION

In the United States, using and selling drugs such as marijuana and heroin is illegal, and people who break drug laws go to jail. In the Netherlands, the government is trying a different approach that stresses treatment rather than punishment.

In the mid-1970s, the Netherlands was hit by a sharp upswing in heroin use. In response, the government launched a policy called harm reduction, which aims to lower the harmful effects of drug use for both users and other members of society. The policy is based on the belief that so-called soft drugs, such as marijuana and the related drug hashish (hah-SHESH), are less dangerous than so-called hard drugs, such as heroin, cocaine, amphetamines, and methamphetamine. To encourage people not to try hard drugs, the government tolerates the sale of small amounts of marijuana and hashish in adults-only coffee shops, much the way alcohol is sold in bars. Marijuana is still considered a controlled substance, but the government generally does not enforce the law regarding it.

Much debate in the early 2000s surrounded this policy and how well it was perceived to work. However, the number of drug addicts in the Netherlands was lower than in many countries. In addition, the average age of addicts was rising, which suggested that fewer young people were getting hooked. But the rate of marijuana and hashish use increased in the late 1990s and early 2000s, although it remained lower than in the United States. Furthermore, the policy failed to address the impact on international laws. Substances were brought into the Netherlands from and through countries where the sale and use of marijuana was strictly prohibited.

violence, panic attacks*, and other consequences of impaired judgment. All of these substances are illegal to use, make, or sell.

PCP can be snorted, smoked, or eaten. It can cause bizarre and sometimes violent behavior. Other possible effects of PCP use include increased or shallow breathing rate, higher blood pressure, flushing, sweating, numbness, poor coordination, and confused or irrational thinking. High doses can lead to seeing or hearing things that are not really there, paranoia, seizures*, coma*, injuries, and suicidal behavior.

Stimulants Stimulants (STIM-yoo-lunnts) are drugs that produce a temporary feeling of euphoria, alertness, power, and energy. As the high wears off, however, depression and edginess set in. Stimulants include cocaine (ko-KANE; nicknames: coke, snow, blow, nose candy), crack cocaine, amphetamine (am-FET-uh-mean), methamphetamine (METH-am-FET-uh-mean; nicknames: speed, meth, crank), and crystallized methamphetamine (nicknames: ice, crystal, glass).

Cocaine is a white powder that is either snorted into the nose or injected into a vein. Crack is a form of cocaine that has been chemically changed so that it can be smoked. Both forms are very addictive. Possible physical effects of cocaine and crack use include increased heart rate, higher blood pressure, increased breathing rate, heart attack, stroke, trouble breathing, seizures, and a reduced ability to fight infection. Possible psychological effects include violent or strange behavior, paranoia, seeing or hearing things that are not really there, feeling as if bugs are crawling over the skin, anxiety, and depression. Eventually, cocaine addicts often wind up losing interest in food, sex, friends, family, everything except getting high.

Amphetamines are human-made stimulants that speed up the central nervous system*, creating a sense of euphoria and increased energy. Amphetamines can be taken orally, injected, smoked, or sniffed. They may be legally prescribed to treat attention deficit hyperactivity disorder (ADHD), to suppress appetite, and to combat fatigue or narcolepsy (a disorder that causes uncontrolled falling asleep). Amphetamines include benzedrine, dexedrine, and methedrine. Street names for amphetamines include black beauties, crystal, hearts, bennies, crank, ice, speed, and meth.

People who abuse amphetamines need more and more of the drug to achieve the same effect or high. When they become dependent, amphetamine users may be jittery, lose weight, feel depressed, anxious, restless, hostile, and lack energy. An overdose may cause tachycardia (very fast heartbeat), high blood pressure, seizures, fever, delirium, paranoia, psychosis*, coma, and cardiovascular collapse.

Narcotics Narcotics (nahr-KOT-iks) are addictive painkillers that produce a relaxed feeling and an immediate high, followed by restlessness and an upset stomach. They can also be deadly. Drugs in this class include heroin (HAIR-oh-in; nicknames: smack, H, skag, junk), morphine (MOR-feen), opium (OH-pee-um), and codeine (KO-deen).

* **panic attacks** are periods of intense fear or discomfort with a feeling of doom and a desire to escape. During a panic attack, a person may shake, sweat, be short of breath, and experience chest pain.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **psychosis** (sy-KO-sis) refers to mental disorders in which the sense of reality is so impaired that a patient cannot function normally. People with psychotic disorders may experience delusions (exaggerated beliefs that are contrary to fact), hallucinations (something that a person perceives as real but that is not actually caused by an outside event), incoherent speech, and agitated behavior, but they usually are not aware of their altered mental state.

The Opium Trade

Ancient Chinese medical texts indicated that opium, imported to the West from China by Arab traders in the 8th century, was used originally for medicinal purposes. When tobacco was introduced to China from the Philippines, the mixing of tobacco with opium became popular. British colonial traders recognized the strong demand for opium. Despite an 18th-century edict by the Chinese government banning the sale of opium and the operation of opium houses, the British continued its sale on the black market. During the late 18th century, opium was at times the largest single commodity in trade.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

* **bone marrow** is the soft tissue inside bones where blood cells are made.

Heroin is made from morphine, a natural substance that comes from the poppy plant. It is a powder that is injected, snorted, or smoked, and it is highly addictive. Immediate effects of heroin use include a heavy feeling in the arms and legs, warm flushing of the skin, dry mouth, clouded thinking, and going back and forth between being wide awake and feeling drowsy. In addition, street heroin varies in strength, and users never know if they are getting a particularly strong dose. If they do, they can overdose (OD) easily, resulting in coma and death. Long-term effects include collapsed veins, infection of the heart lining and valves, liver disease, and HIV*/AIDS from sharing needles.

Sedatives (SED-uh-tivz), sometimes called tranquilizers (TRANK-will-LY-zerz) or sleeping pills, include barbiturates (downers). These drugs produce a calming effect and sleepiness. Physicians prescribe them to relieve anxiety, promote sleep, and treat seizures. When they are abused or taken at high doses, however, many of these drugs can lead to loss of consciousness and death. Combining sedatives with alcohol is particularly dangerous. Possible effects of sedative abuse include poor judgment, slurred speech, staggering, poor coordination, and slow reflexes.

Inhalants

Inhalants are chemical vapors that can be inhaled to produce mind-altering effects. The vapors then enter the lungs. There are three types of inhalants: solvents (such as paint thinners, gasoline, glues, felt-tip marker fluid), gases (such as butane lighters, whipping cream aerosols, spray paints, deodorant sprays, and nitrous oxide or “laughing gas”), and nitrites.

The physical effects of inhalants depend on the chemical being inhaled. Many cause serious, often irreversible health problems, and sometimes cause death. Users can lose consciousness. Other serious, but potentially reversible, effects include liver damage, kidney damage, and depletion of blood oxygen. Irreversible effects of inhalants include hearing loss, loss of muscle control and limb spasms, damage to the central nervous system and brain, damage to the bone marrow*, lung damage, and heart failure.

Club drugs

Club drugs are drugs that are mainly used by young people at parties, clubs, and bars. Although users may think these are harmless, research has shown that they can cause serious health problems and sometimes even death. When combined with alcohol, they can be particularly dangerous. Drugs in this category include MDMA (nicknames: XTC, ecstasy, Adam) GHB (nicknames: liquid ecstasy, Georgia home boy), Rohypnol (nicknames: roofies, roach), and ketamine (nickname: special K).

MDMA combines some of the properties of hallucinogens and stimulants. Possible effects include euphoria, confusion, paranoia, increased heart rate, higher blood pressure, blurred vision, faintness, chills, and sweating. Because this drug is increasingly abused at dances, young people may forget to drink, become dehydrated, and need to be rushed to the

emergency room for immediate treatment. Possible psychological effects include confusion, depression, sleep problems, anxiety, and paranoia. Research has linked MDMA to long-term damage in parts of the brain that are critical for thought, memory, and pleasure.

GHB, Rohypnol, and ketamine are often colorless, tasteless, and odorless, which makes it easy for someone to slip one of these drugs into another person's drink. As a result, these substances are sometimes called "date rape" drugs, because they have been used against women who were drugged unknowingly and then raped. To make matters worse, people may be unable to remember what happened to them while they were under the influence of one of these drugs.

Prescription and Over-the-Counter Drugs

People can abuse legal medicines by taking more than prescribed, using them for nonmedical reasons, or using them to treat unrelated illnesses. The most commonly abused prescription and over-the-counter medicines are stimulants, pain relievers, depressants (such as sleeping pills), cough and cold medicines, and laxatives.

Abusing these substances can cause physical and psychological dependence. Some prescription medications contain alcohol and narcotics—such as codeine—that are physically addicting. Combining alcohol with prescription and over-the-counter drugs, or mixing drugs, can change the effectiveness of the drugs and cause harmful side effects.

Anabolic steroids

Anabolic steroids (AN-uh-BOL-ik STER-oidz) are drugs that are related to testosterone (tes-TOS-tuh-rone), the major male sex hormone. Although these drugs have medical uses, many athletes and bodybuilders abuse them because they can increase muscle build-up with weight lifting or strength training. Although steroids may seem like a shortcut to improved sports performance and a more muscular body, they carry serious health risks. In boys and men, steroids can reduce sperm production, shrink the testicles, enlarge the breasts, and cause problems with sexual performance. In girls and women, they can lead to unwanted body hair, a deep voice, and irregular periods. Steroids can damage the heart, liver, and kidneys. In teenagers, they can stunt bone growth, making users reach a shorter final height than they would have otherwise. High doses of testosterone can also cause outbursts of aggressive or violent behavior (steroid rage).

What Are Some Other Risks of Substance Abuse?

Abusing drugs leads to unclear thinking and unpredictable behavior. Many drugs also cause poor coordination and slow reflexes. It is little wonder, then, that substance abuse is closely tied to accidents and injuries. In 2006, 25 percent of drivers ages 15 to 20 who were killed in automobile accidents were under the influence of alcohol at the time their deaths.

In the United States, substance abuse is a major factor in the spread of infection with HIV (human immunodeficiency virus), the virus that

* **outpatient** a medical procedure that is conducted in a doctor's office or hospital for treatment but does not require an overnight stay in a hospital bed.

* **psychotherapy** (sy-ko-THER-a-pea) is the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.

causes AIDS. It is a direct cause, because many drugs are injected into a vein, and people can spread HIV by using or sharing unclean needles. It is also an indirect cause, because people whose thinking is clouded by alcohol or other drugs are more likely to have unsafe sex, which increases their risk of catching HIV from an infected partner.

How Is Substance Abuse Diagnosed and Treated?

Diagnosis Substance abuse often is difficult to diagnose and treat. Doctors can screen for substance abuse through a medical history, a physical exam, and sometimes blood or urine testing, but doctors and family members often have a hard time convincing substance abusers that they need help. In many cases, substance abusers are more afraid of losing the drug and of withdrawal symptoms than of the health and safety consequences of continued use.

Treatment Treatment for substance abuse consists of helping people stop using the substance, treating withdrawal symptoms, and preventing people from returning to substance abuse afterwards. Outpatient* psychotherapy* and self-help groups can be effective. People with severe problems may require residential treatment programs. Treatment often is provided by doctors and organizations that specialize in substance abuse programs. Steps for helping substance abusers are as follows:

- Evaluate people for psychiatric or medical disorders
- Teach them about the effects of the drug and their addiction
- Offer mutual support and self-help groups
- Provide individual and group psychotherapy
- Offer a replacement for the substance being given up
- Emphasize behavior changes that promote not using the substance
- Offer rehabilitation and life skills training

Even people who are successfully treated must guard against starting to use the abused substance again. People with serious medical or psychiatric symptoms, people who overdose on drugs, and people who have toxic reactions to drugs require immediate medical treatment.

▶ See also **Alcoholism • Eating Disorders: Overview • Pregnancy • Prematurity • Tobacco-Related Diseases**

Resources

Books and Articles

Freimuth, Marilyn. *Addicted? Recognizing Destructive Behavior before It's Too Late*. Lanham, MD: Rowman and Littlefield, 2008.

Klosterman, Lorrie. *The Facts about Drugs and the Body*. New York: Marshall Cavendish Benchmark, 2008.

Rebman, Renee C. *Addictions and Risky Behaviors: Cutting, Bingeing, Snorting, and Other Dangers*. Berkeley Heights, NJ: Enslow, 2006.

Schwartzenger, Tina, ed. *Substance Use and Abuse*. New York: Weigl, 2007.

Organizations

Alcoholics Anonymous. Grand Central Station, P.O. Box 459, New York, NY, 10163. Telephone: 212-870-3400. Web site: <http://www.aa.org>.

National Institute on Alcohol Abuse and Alcoholism. 5635 Fishers Lane, MSC 9304, Bethesda, MD, 20892-9304. Telephone: 301-443-3860. Web site: <http://www.niaaa.nih.gov>.

National Institute on Drug Abuse–National Institutes of Health. 6001 Executive Boulevard, Room 5213, Bethesda, MD, 20892-9561, Web site: <http://www.nida.nih.gov>.

Substance Abuse and Mental Health Services Administration. 1 Choke Cherry Road, Rockville, MD, 20857. Toll free: 877-SAMH-SA-7. Web site: <http://ncadi.samhsa.gov>.

Sudden Infant Death Syndrome

Sudden infant death syndrome (also known as SIDS) refers to the sudden death of an apparently healthy infant under one year of age whose death cannot be explained even after a complete investigation.

Taking Care

Mrs. Wyatt is following all the instructions her doctor gave for the care of her new baby. She puts him to sleep both at night and for daytime naps on his back instead of on his stomach. She makes sure the crib has a mattress that is firm and that no blankets, pillows, or toys are around the baby. She refrains from bundling her baby in thick clothing before putting the baby to bed.

The doctor recommended these precautions because they reduce the risk of sudden infant death syndrome (SIDS), a mysterious disorder that is a leading cause of death for children between the ages of one month and one year.

Since mothers like Mrs. Wyatt started to put their babies to sleep on their backs and began to adopt other preventive strategies, the number of SIDS deaths has dropped substantially. However, SIDS still accounts for about 3,000 deaths per year in the United States, usually while the babies

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

are asleep in their cribs. No one knows for sure why these babies die. Most appear to be healthy until their deaths.

Parents often feel guilt mixed with their grief over the death of their baby. They think perhaps they could have done something more for the baby, but SIDS is no one's fault.

What Is Sudden Infant Death Syndrome?

It is easier to say what SIDS is not than what it is. SIDS does not result from suffocation, choking, vomiting, or a fatal reaction to a vaccination*. A baby does not catch it like a cold.

THE BACK TO SLEEP CAMPAIGN

For decades, parents thought it was best to put babies to sleep on their stomachs. They assumed that if babies were on their backs, they might choke on their vomit if they threw up.

Doctors later explained that there was no reason to fear this potential for choking. In 1992 the American Academy of Pediatrics recommended that babies sleep on their backs, and in 1994 the National Institute of Child Health and Human Development and other organizations reiterated that call by launching a national Back to Sleep Campaign to reduce the risk of SIDS. Between 1992 and 1997, the number of children sleeping on their stomachs decreased dramatically, and the death rate from SIDS dropped by 50 percent.

The National Institute of Child Health and Human Development offers a number of ways to lower the risk of SIDS. These include:

- Providing the baby with a firm mattress or other surface for sleeping
- Having the mother avoid smoking during pregnancy
- Having family members avoid smoking around the baby
- Having the baby sleep near, but not with, a parent, sibling, or other person
- Keeping pillows, loose blankets, and soft toys out of the crib
- Dressing a baby in light clothes while the child is sleeping or napping.

Not all babies should sleep on their backs. A few have problems with their airways or with keeping food down. In these rare cases, parents should consult a doctor, who may recommend that the babies be placed on their stomachs on a firm mattress without soft pillows, blankets, or plush toys.

Some parents have misunderstood the intent of the Back to Sleep Campaign. They never put their children on their stomachs, even when they are awake. Doctors say it is important for children's physical and mental development to spend some time on their stomachs while they are awake, so long as an adult is watching.

Doctors assign a baby's death to SIDS when no other cause of death is found after conducting an autopsy*, an investigation of the place where the baby died, and a review of the baby's medical history.

Researchers explored the possible causes of SIDS for years, and many came to believe that it results from a problem in an area of the brain that controls two important functions while infants are asleep: breathing and waking up. In 2006, a research team conducted autopsies* on 31 infants who had died of SIDS, and they found that about three-fourths of the infants had abnormalities in a certain brain chemical called serotonin. The researchers believed the abnormality prevented the infants from responding normally when they were not getting enough oxygen. These responses include turning the head or taking deeper breaths. It was hoped that this finding would lead to tests that could help determine if an infant actually died of SIDS and possibly to medications that might someday identify and prevent the problem.

Several factors can cause a baby to get insufficient oxygen. For example, babies might not get enough oxygen when they breathe air that is trapped in soft beds or in folds of blankets near their mouths. In such circumstances, they are breathing in their own exhaled carbon dioxide, rather than the oxygen available in the air. A normal baby's brain gets the warning about the insufficient oxygen, but a baby with the serotonin abnormality does not.

A baby can also experience breathing difficulties from respiratory infections such as a cold or other ailment. This fact might explain why SIDS is more likely to occur in the winter, when the risk of infection is higher and, at the same time, babies are more likely to be sleeping with extra bedclothes or blankets.

Researchers have investigated other possible physical problems that could contribute to the risk of SIDS. One possible factor is an immune system* disorder that creates too many white blood cells and proteins, which disrupt the brain's control over breathing and heart rate.

SIDS might be caused by a combination of factors, including some that have yet to be identified.

Who Is at Risk for Sudden Infant Death Syndrome?

SIDS can happen any time within the first year, but it occurs most often between the second and fourth month after birth. It seldom occurs the first two weeks following birth or after six months. The vast majority of babies do not experience SIDS even if they sleep on their stomachs, have infections, or sleep with blankets in their cribs. Others who sleep on their backs in ideal conditions still die of SIDS. No warning signs of SIDS are evident before a baby dies. Doctors only diagnose it after ruling out other possible causes of death.

Although research is beginning to suggest causes for SIDS, no test is yet available to predict who will die of the disorder.

* **autopsy** (AW-top-see) is an examination of a body after death to look for the cause of death or the effects of a disease.

* **autopsies** (AW-top-seez) are examinations of bodies after death to look for causes of death or the effects of diseases.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

What Are the Risk Factors for Sudden Infant Death Syndrome?

A baby is more likely to die of SIDS if the baby has:

- A mother who smoked during pregnancy
- A mother younger than 20 years of age
- A mother who did not receive proper medical care before her baby was born
- A birth before the full nine months of a normal pregnancy
- A lower than normal birth weight
- Family members who smoked around the baby

In addition, babies who are strictly bottle-fed have a higher risk of SIDS. One possible reason is that breast-feeding helps reduce the risk of the types of infections that may contribute to breathing problems.

▶ See also **Prematurity** • **Tobacco-Related Diseases**

Resources

Books and Articles

Horchler, Joani. *SIDS and Infant Death Survival Guide: Information and Comfort for Grieving Family and Friends and Professionals Who Seek to Help Them*, 3rd ed. Hyattsville, MD: SIDS Educational Services, 2003.

Parks, Peggy J. *SIDS*. Detroit, MI: Lucent Books, 2009.

Organizations

Eunice Kennedy Shriver National Institute of Child Health and Human Development. 31 Center Drive, Building 31, Room 2A32, MSC 2425, Bethesda, MD, 20892-2425. Toll free: 800-370-2943. Web site: <http://www.nichd.nih.gov/sids/sids.cfm>.

First Candle. 1314 Bedford Avenue, Suite 210, Baltimore, MD, 21208. Toll free: 800-221-7437. Web site: <http://www.sidsalliance.org>.

National Sudden Infant Death Resource Center. 2115 Wisconsin Ave., NW, Washington, DC, 20007. Toll free: 866-866-7437. Web site: <http://www.sidscenter.org>.

Sudden Infant Death Syndrome Network, Inc. PO Box 520, Ledyard, CT, 06339. Web site: <http://sids-network.org>.

Suicide

Suicide is the intentional taking of a person's own life.

Shocking Statistics

There are more suicides than murders and more than twice as many suicides as deaths from acquired immunodeficiency syndrome (AIDS*) in the United States every year, yet suicide gets far less press attention than murder or AIDS. Talking about suicide makes people uncomfortable, perhaps because there are religious prohibitions against suicide, because suicide is thought of as a shameful act, or because many people simply cannot imagine why someone would intentionally take his or her own life.

Who Commits Suicide?

Suicide results from many factors, some of which are complicated and not well understood. It is not clear or predictable why the setbacks, losses, or difficulties that would lead one person to feel unhappy may push another person to consider suicide.

It is estimated that more than 30,000 Americans die as the result of suicide each year, whereas about 20,000 people are murdered. Some experts, however, believe that the number of suicides is even higher. Many so-called accidents, such as self-inflicted gunshot wounds or single-car crashes, actually may be unrecognized or unreported suicides. Although no official record is kept of suicide attempts, it is estimated that there are 25 attempts for each completed suicide. Overall, suicide is ranked eleventh as a cause of death in the United States, but among the young, suicide ranks third.

Although more women than men attempt suicide, about four times more men die, because they use more deadly means. Men of European ancestry committed 69 percent of all suicides in 2005, whereas women of European ancestry accounted for about 18 percent of these deaths. The rate of suicide among people of Native American ancestry is particularly high (about 12 per 100,000). The suicide rate among men of African ancestry fell steadily between 1996 and the early 2000s. Age is another factor in suicide. Among people 65 years of age and older, the rate of suicide among men of European heritage increases steadily with age. Elderly men (older than 85) of European heritage have a suicide rate that is 2.5 times the national male average. Various factors explain why the rate of suicide is among people of different ethnic backgrounds, gender, and ages. Factors include increased rates of alcoholism, poverty, loneliness, and violence for particular groups at particular stages of life.

Young people have a higher than average rate of suicide. Suicide is the third leading cause of death among people 15 to 24 years old. The 2003 Youth Risk Behavior Surveillance Survey found that 16.9 percent of high school students reported seriously considering suicide. Meanwhile, the number of children ages 10 to 14 committing suicide increased sharply between 1981 and the early 2000s. The most common methods of committing suicide are by intentionally taking a drug overdose (prescription or over-the-counter medicines), inhaling carbon monoxide from car exhausts, or using guns.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

What Factors Make People More Likely to Commit Suicide?

About 90 percent of people who commit suicide have a diagnosed psychiatric disorder. Depression and substance abuse (either alone or in combination) are the two most common factors that play a part in suicide. This does not mean that everyone who has depression or an alcohol or drug problem will consider committing suicide. The majority of people with these problems are not suicidal.

People who are more likely to kill themselves may also have the following:

- Have previously attempted suicide
- Live alone and have no social support network
- Have chronic (long-lasting or recurring) physical pain or a terminal (life-ending) illness
- Have a family history of suicide
- Be unemployed
- Be impulsive
- Keep a gun in the home
- Have spent time in jail
- Have experienced family violence, child abuse, or sexual abuse

What Are the Signs that a Person Is Thinking of Committing Suicide?

People who talk about killing themselves are at risk for committing suicide. Most people who attempt suicide have given clues about their intentions before they acted on them. It is important to take seriously any talk about suicide or any indication that suicide is a possibility.

Common warning signs that a person is thinking about suicide include the following:

- Talking about death or making suicide threats
- Making such statements as “You would be better off without me” or “I’m no good to anybody” (even if these are said jokingly)
- Having any of the symptoms or signs of depression
- Exhibiting major personality changes or unexplainable odd behavior
- Making a will or giving away cherished possessions
- Seeking isolation and becoming uncommunicative
- Being fascinated with death
- Taking a sudden interest in religion if previously not religious or rejecting religion if previously devout

Why Do People Commit Suicide?

No one can explain why some people commit suicide and others do not. One theory is that suicide is an act of rage, an expression of intense anger at

oneself and/or others. Another theory is that people may commit suicide because they feel they have no other choice. Hopelessness and distorted thinking may prevent a person from seeing solutions to their problems.

For a mentally healthy person, the idea that a person would have no choice except to commit suicide is absurd. But depression, substance abuse, and other mental illnesses, such as schizophrenia*, alter the healthy mind and cloud people's thinking. People with these problems may feel that they are in a deep, dark hole from which there is no escape and that life is so painful that there are no alternatives except death.

There may be inherited tendencies for depression, schizophrenia, alcoholism, substance abuse, and certain personality disorders*. All of these problems can increase a person's vulnerability to suicidal thoughts when things go wrong. Some studies suggest that the brain chemistry of people who commit suicide is abnormal. Some research has sought to examine the effects of certain medications that alter brain chemistry in a way that could decrease suicidal behavior.

What Should Others Do If Someone Is Suicidal?

People who are thinking about committing suicide need professional help. They have usually sunk so deeply into their mental and emotional black holes that they may be unable to recognize that they are in trouble or to seek help on their own. It is important to pay attention when people talk about wanting to die and to take their words seriously. Having another person approach the subject directly is often a relief to them. It is sometimes thought that speaking to people about their possible wish to commit suicide will "put thoughts in their heads." But people who talk about suicide often are already thinking about suicide.

Professional help is available through suicide prevention and crisis intervention centers, mental health clinics, hospitals and emergency rooms, family doctors, health maintenance organizations, mental health practitioners, and members of the clergy. When a person is possibly suicidal, it is a good idea to talk to another mature, responsible person and ask that person to join in helping to deal with the crisis. Many telephone books have community service sections that list suicide and mental health crisis hotlines. Immediate help can be obtained by calling emergency services (911 in most communities).

Other ways of possibly minimizing the risk of suicide include the following:

- Removing guns and ammunition from the house
- Locking up medications and alcohol
- Staying with the person, because suicide is an act most often performed alone
- Talking calmly, without lecturing, being judgmental, or pointing out all the reasons a person has to continue living

Suicide places an intense emotional burden on the survivors. People who have been close to someone who has attempted or completed suicide

* **schizophrenia** (skit-so-FREE-nee-ah) is a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors, which distort their view of reality.

* **personality disorders** are a group of mental disorders characterized by long-term patterns of behavior that differ from those expected by society. People with personality disorders have patterns of emotional response, impulse control, and perception that differ from those of most people.

might consider mental health counseling to help them to deal with their own emotions.

▶ *See also* **Bipolar Disorder • Brain Chemistry (Neurochemistry) • Death and Dying • Depressive Disorders • Substance Abuse**

Resources

Books and Articles

Esherick, Joan. *The Silent Cry: A Teen's Guide to Escaping Self-Injury and Suicide*. Philadelphia, PA: Mason Crest, 2005.

Giddens, Sandra. *Frequently Asked Questions about Suicide*. New York: Rosen, 2009.

Marcovitz, Hal. *Teens and Suicide*. Philadelphia, PA: Mason Crest, 2004.

Powell, Jillian. *Self-Harm and Suicide*. Pleasantville, NY: Gareth Stevens, 2009.

Shannon, Joyce Brennfleck, ed. *Suicide Information for Teens: Health Tips About Suicide Causes and Prevention: Including Facts about Depression, Risk Factors, Getting Help, Survivor Support, and More*. Detroit, MI: Omnigraphics, 2005.

Organizations

American Psychiatric Association. 1000 Wilson Boulevard, Suite 1825, Arlington, VA, 22209. Toll free: 888-35-PSYCH. Web site: <http://www.psyh.org>.

National Center for Injury Prevention and Control. 4770 Buford Highway NE, Mailstop K65, Atlanta, GA, 30341-3724. Telephone: 770-488-1506. Web site: <http://www.cdc.gov/ncipc/dvp/Suicide/default.htm>.

National Institute of Mental Health. 6001 Executive Boulevard, Room 8148, MSC 9663, Bethesda, MD, 20892-9663. Telephone: 301-443-4513. Web site: <http://www.nimh.nih.gov>.

Supraglottitis *See Epiglottitis.*

Swimmer's Ear *See Otitis (Ear Infections).*

Syncope *See Fainting (Syncope).*

Syphilis

Syphilis (SIH-fih-lis) is a sexually transmitted disease that, if untreated, can lead to serious lifelong physical problems, including blindness and paralysis.*

What Is Syphilis?

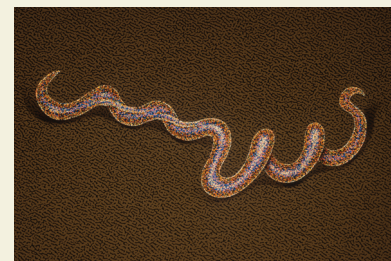
Syphilis is a disease that is caused by the bacterium *Treponema pallidum* (treh-puh-NEE-muh PAL-ih-dum). The disease develops in three distinct phases. The first, or primary, stage is marked by a chancre*. In the secondary stage, a rash develops. There can be an interval of months to years for late syphilis to develop, if early stages are not detected and treated. By the third stage, also known as the tertiary stage, the disease can cause widespread damage to the body, affecting the brain, nerves, bones, joints, eyes, heart, and other organs. Syphilis does not advance to this point in all infected people, and it does so only if it has not been treated adequately during either of the two earlier stages.

Without treatment, syphilis can be fatal. It can also have serious consequences for the fetus* of an infected woman. If a pregnant woman has syphilis, she can pass it to her unborn offspring, a condition known as congenital* syphilis. Because the immune system* of a baby is not developed fully until the infant is well into the first year of life, infection with syphilis bacteria can lead to severe complications. Among pregnant women who are infected but are not treated, up to 80 percent of their fetuses may become infected, and up to 40 percent may die before or shortly after birth.

How Common Is Syphilis?

Syphilis was rampant in the United States until the antibiotic penicillin was introduced in the 1940s. After that, the number of syphilis cases dropped. The reduction in the rate of primary and secondary syphilis in the United States was particularly noticeable between 1990 and 2000, when it fell nearly 90 percent. By 2000 the rate was at its lowest level since reporting began in 1941, according to the Centers for Disease Control and Prevention (CDC). After that, syphilis cases rose. Between 2001 and 2006, the CDC reported a particular increase among men, going from a rate of 3.0 cases per 100,000 to 5.7 cases per 100,000 population. The CDC reported that more than 60 percent of new infections occurred in men who have sex with men. Among women, the rate also rose, although much more slowly. The rate was 0.8 cases per 100,000 in 2004, 0.9 cases per 100,000 in 2005, and 1.0 case per 100,000 in 2006.

The CDC launched a “National Plan to Eliminate Syphilis,” which worked on many fronts to reduce the numbers. Some of these included enhancing public health services and assisting in syphilis-prevention efforts directed at targeted cultural groups.



▲ The corkscrew-shaped bacterium *Spirochete Treponema pallidum* causes syphilis. *Chris Bjornberg/Photo Researchers, Inc.*

A Pox of Many Names

Over the centuries, the disease syphilis has been called by many names. The term “great pox” was used to differentiate syphilis from smallpox. The name “syphilis” seems to have originated in a 1530 poem about a shepherd named “Syphilis,” which was written by the Italian physician Girolamo Fracastoro (Fracastorius) (1478–1553). The poem was titled “Syphilis, sive morbus Gallicus” (meaning “Syphilis, the French disease”).

In his play *Timon of Athens*, William Shakespeare (1564–1616) refers to syphilis as the “infinite malady.”

Cultural embarrassment caused many nations to refer to syphilis as the disease of another national group. The English and Germans called it the “French pox.” The Russians suffered from the “Polish sickness.” The Poles identified syphilis as the “German sickness.” The French named it the “Neapolitan sickness” (meaning Italian or from the area around Naples, Italy). The Flemish, Dutch, Portuguese, and North Africans caught the “Spanish” or “Castilian sickness.” Meanwhile, the Japanese referred to syphilis as the “Canton rash” or the “Chinese ulcer.”



▲
Secondary syphilis. If syphilis is not treated in its first phase, it can progress to its second stage a month or two later in which a rash may appear on the palms of the hands and the soles of the feet. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

Is Syphilis Contagious?

Syphilis is a sexually transmitted disease (STD) that spreads from person to person through vaginal*, oral*, or anal* sexual intercourse. A pregnant female can also pass the disease to her fetus. Syphilis is contagious during its first and second stages, and sometimes in the early latent period, which is described below. People are most contagious, however, during the second stage of the infection.

What Are the Signs and Symptoms of Syphilis Infection?

Syphilis has been called “the great imitator,” because its symptoms can resemble those of many other diseases. Not all people have obvious symptoms, but in those who do, signs of disease appear 10 to 90 days after being infected. The first symptom is a small, usually painless sore known as a chancre that appears where the syphilis bacterium entered the body, such as on the penis or the lips of the vagina*. Without treatment, chancres heal on their own within six weeks. A person who is infected may never even notice a chancre, especially if it is inside the vagina or the rectum*.

HOW SYPHILIS CHANGED THE FACE OF MEDICAL RESEARCH

During the middle decades of the 20th century syphilis was the subject of what became known as the most infamous public health study ever carried out in the United States. From 1932 to 1972, the U.S. Public Health Service conducted a study in Macon County, Alabama, to learn more about the long-term consequences of the disease. Six hundred poor African American men, 399 of them infected with syphilis, participated in the study in exchange for free medical exams, free meals, and burial insurance.

The Tuskegee Syphilis Study became notorious because local doctors who participated in the study were instructed not to treat the men’s infections, even after an easy cure with penicillin became widely available in 1947. Although the men had agreed to be part of the project, they were never told they would not be treated fully for their condition. They were simply told that they were part of a study of “bad blood,” a local term used for several illnesses.

Public outrage erupted in 1972 when it became known that men with syphilis in the study had

been allowed to remain untreated so that doctors could investigate the progression of the disease, and the project was stopped. That came too late for the men, however, and many had already been disabled permanently or had died. In the wake of the study, the government moved quickly to adopt policies that protect people who take part in research programs. In 1974, a new law created a national commission to set basic ethical standards for research. New rules also required that participants in government-funded studies must be made fully aware of how a study will proceed and must voluntarily agree to take part in it. In addition a review process ensures that any study involving humans meets ethical standards before it begins.

Of course, these changes could not reverse the physical and emotional harm done to the men in the Tuskegee Syphilis Study and to their families. In recognition of that harm, President Bill Clinton in 1997 offered an apology to the survivors, families, and descendants of those men on behalf of the U.S. government.

One to two months after the chancre fades, the disease moves to its second stage. In this phase, a rash of rough, reddish or brownish spots appears on the body, including the soles of the feet and the palms of the hands. The rash may be so faint that it is barely noticeable. Second-stage symptoms of syphilis may also include fever, headache, extreme tiredness, sore throat, muscle aches, swollen lymph nodes*, weight loss, hair loss, and ulcers* on mucous membranes* in the mouth and on the genitals*. Wart-like lesions* may appear on the vagina or anus. These symptoms also disappear on their own, fooling many people into thinking that they have had a common viral illness.

After the second-stage symptoms clear up, the disease enters a latent, or hidden, period in which the patient shows no signs of illness. The latent period can last for many years, and in some infected people the bacteria do no further damage. In about one-third of people who reach the latent period, the disease progresses to its final stage. This phase has no symptoms at first, but as the bacteria invade and damage nerves, bones, and the heart and other organs, the patient may experience dizziness, headaches, seizures*, dementia*, loss of coordination, numbness, increasing blindness, and paralysis. The disease also can eat away at tissue in the mouth and nose, disfiguring the face. This last stage of the disease can begin two to 40 years after a person is first infected.

Babies who are born with syphilis may have symptoms right away or may show signs of the disease within a few weeks or months. These symptoms include so-called failure to thrive*, or a failure to gain weight and grow at the expected rate; irritability; fever; rash; a nose without a bridge (known as saddle nose); bloody fluid from the nose; and a rash on the palms, soles, or face. As these children grow older, they may become blind and deaf, and may have notched teeth (called Hutchinson teeth). Bone lesions may arise, and lesions and scarring may appear around the mouth, genitals, and anus.

How Do Doctors Diagnose Syphilis?

If a patient has a chancre or other lesion, the doctor collects a sample of fluid from the sore to examine under a special microscope. Syphilis bacteria in the fluid are visible under magnification. The doctor also may take a blood sample to look for antibodies* to the bacterium. If neurosyphilis (nur-o-SIH-fih-lis), which is syphilis that has progressed to the point that it affects the brain, spinal cord, and nerves, is suspected, the doctor may also order tests of the spinal fluid to look for antibodies. Routine prenatal care for pregnant women includes a screening for syphilis.

How Is Syphilis Treated?

Even though visible signs of the infection clear up on their own, doctors provide treatment for syphilis. Doing so prevents the disease from progressing to the late, potentially much more harmful stage, and in pregnant women, prevents infants from suffering damage caused by the infection.

- * **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.
- * **chancre** (SHANG-ker) is a usually painless sore or ulcer that forms where a disease-causing germ enters the body, such as with syphilis.
- * **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.
- * **congenital** (kon-JEH-nih-tul) means present at birth.
- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.
- * **vaginal** (VAH-jih-nul) refers to the canal in a woman that leads from the uterus to the outside of the body.
- * **oral** means by mouth or referring to the mouth.
- * **anal** refers to the anus, the opening at the end of the digestive system through which waste leaves the body.
- * **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.
- * **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

- * **ulcers** are open sores on the skin or the lining of a hollow body organ, such as the stomach or intestine. They may or may not be painful.
- * **mucous membranes** are the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.
- * **genitals** (JEH-nih-tuls) are the external sexual organs.
- * **lesions** (LEE-zhuns) is a general term referring to a sore or a damaged or irregular area of tissue.
- * **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.
- * **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.
- * **failure to thrive** is a condition in which an infant fails to gain weight and grow at the expected rate.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

Doctors can easily treat early-stage syphilis with antibiotics. They advise people who are infected with syphilis to notify all their recent sexual partners so that these people can be tested for the disease. Patients with advanced cases of the disease often need hospitalization. They also receive antibiotics, although medications cannot reverse damage already done to the body.

How Long Does Infection Last?

A single dose of antibiotics can clear up syphilis infections that are less than a year old. Longer-term cases require longer courses of treatment. Congenital syphilis also needs a longer course of treatment. Without treatment, the disease can last for years or even decades.

Does the Disease Have Complications?

Untreated cases of syphilis can lead to destructive tissue lesions known as gummas (GOOM-ahz) on the skin, bones, and organs; seizures; damage to the spine that can result in paralysis; heart problems; damage to blood vessels that can lead to stroke*; and death. According to the CDC, a person with syphilis has a two- to five-fold greater risk of acquiring human immunodeficiency (ih-myoo-no-dih-FIH-shen-see) virus (HIV), the virus that causes acquired immunodeficiency syndrome (AIDS), an infection that weakens the immune system. The reason for this increased risk is that open sores make an easy entry for HIV during sexual contact. Also, people infected with HIV are more likely to experience neurological* complications of syphilis. In infants, syphilis can lead to hearing loss, blindness, neurological problems, and death.

Can Syphilis Be Prevented?

Using latex condoms or not having sex, especially with someone who is known to be infected, can prevent the spread of syphilis and other STDs. To be effective, the condom has to cover all syphilis sores. Contact with sores in the mouth or on other uncovered areas, such as the rectum, can spread the disease. Doctors advise pregnant women to be tested and, if needed, treated for syphilis to minimize the risk of passing the disease to the developing fetus.

▶ See also **Gonorrhea • Sexually Transmitted Diseases (STDs)**

Resources

Books and Articles

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Parascandola, John. *Sex, Sin, and Science: A History of Syphilis in America*. Westport, CT: Praeger, 2008.

Winters, Adam. *Syphilis*. New York: Rosen, 2007.

Organizations

American Social Health Association. P.O. Box 13827, Research Triangle Park, NC, 27709. Telephone: 919-361-8400. Web site: http://www.ashastd.org/learn/learn_syphilis_facts.cfm.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: <http://www.cdc.gov/std/syphilis/STDFact-Syphilis.htm>.

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web site: <http://womenshealth.gov/faq/syphilis.cfm>.

Systemic Lupus Erythematosus *See Lupus.*

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

* **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.

T

Tachycardia See *Dysrhythmia*.

Tapeworm

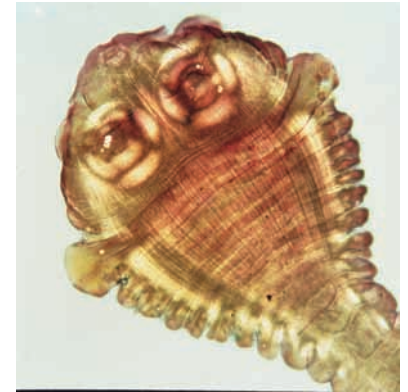
A tapeworm is a long, flat, intestinal worm found in humans and many other animals.

What Are Tapeworms?

Tapeworms are long, flat, intestinal worms called cestodes, found in humans and many other animals. Tapeworms do not have an intestinal tract, they absorb nutrients through their body surface. Human tapeworm infestations may be caused by eating meat or fish contaminated with tapeworm larvae* but also by ingesting soil or water contaminated with human fecal matter containing the eggs. Meat contaminated with tapeworm larvae has larvae enclosed in cyst* form within the meat. The larvae are worms at an intermediate stage of the life cycle between eggs and adulthood. They burrow into the animal tissue and form fluid-filled cysts, which are protective capsules. Like other intestinal parasites*, these worms frequently cause infestations in areas with poor sanitation, where livestock animals are exposed to contaminated soil or fish to contaminated water, and have the parasites within their body tissues. Humans are either infested through ingestion of eggs or larvae. The tapeworms mature within the intestinal tract of the human and lay new eggs, which are released into the fecal matter and passed out of the body to begin the cycle again. Tapeworm infection may be prevented by thoroughly cooking meat until juices run clear and the centers are no longer pink or raw. Doing so ensures that any tapeworm cysts in the meat are destroyed.

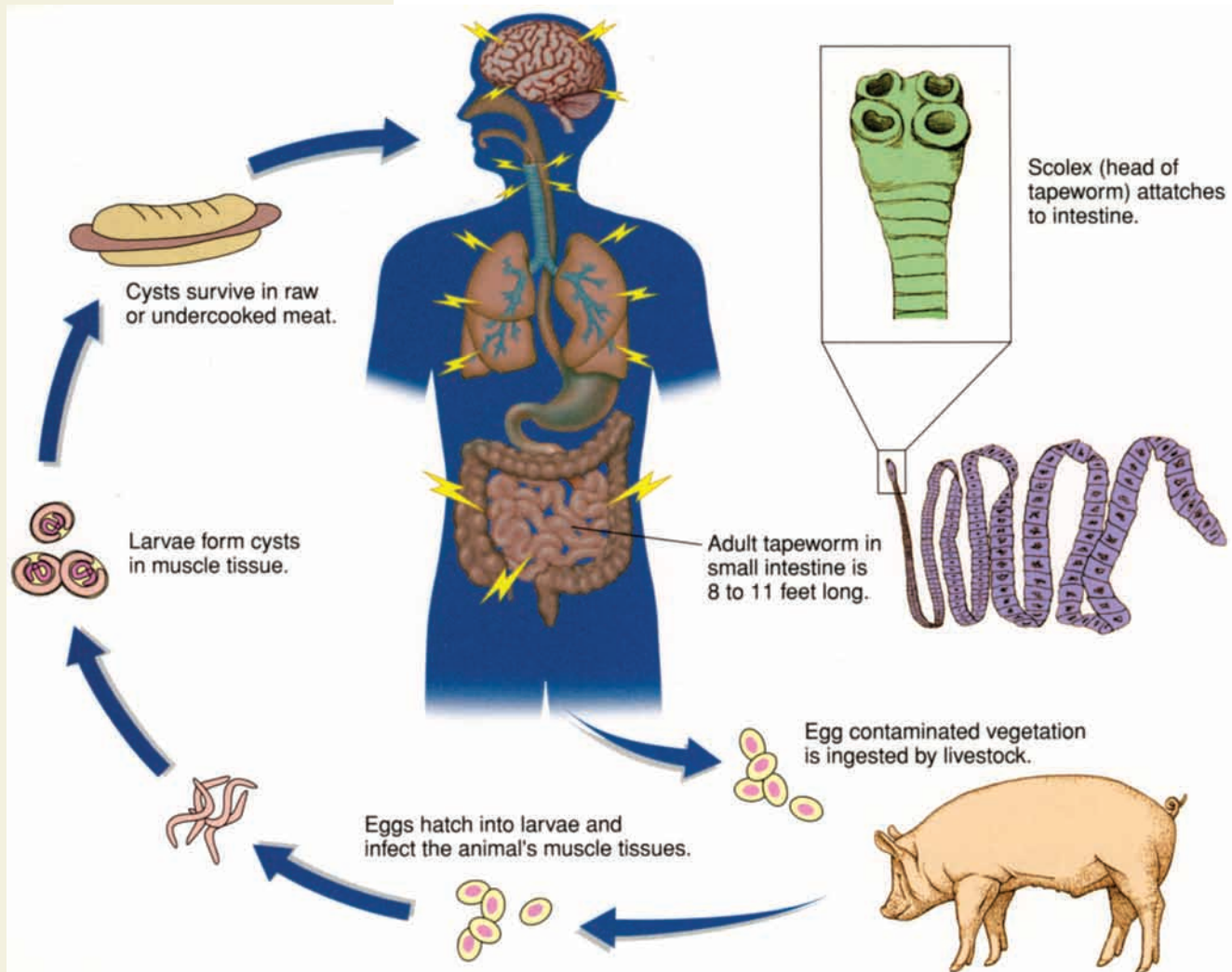
What Are the Types of Tapeworm?

There are three common species of tapeworms: *Taenia saginata* (beef tapeworm), *Taenia solium* (pork tapeworm), and *Diphyllobothrium latum* (freshwater fish tapeworm). After ingesting contaminated tapeworm encysted meat or fish, the larvae travel to the intestines*, where they latch onto the lining of the intestines and gradually grow into adults. Symptoms of a tapeworm infestation are often mild or nonexistent but



▲ The head of the beef tapeworm *Taenia saginata*, which is where the worm attaches to the intestine. Alfred Pasiekal Photo Researchers, Inc.

- * **larvae** (LAR-vee) are the immature forms of an insect or worm that hatches from an egg.
- * **cysts** (SISTS) are shell-like enclosures that contain small organisms in a resting stage.
- * **parasites** (PAIR-uh-sites) organisms such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.
- * **intestines** are the muscular tubes that food passes through during digestion after it exits the stomach.



▲
Life cycle of the pork tapeworm.
Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

can include abdominal pain, loss of appetite, diarrhea, tiredness, weight loss, and malnutrition. In individuals without symptoms tapeworm infestation is often not noted until pieces of worm are found in the stool or undergarments.

Beef, fish, and pork tapeworms Beef and fish tapeworms generally remain limited to the human gastrointestinal tract and usually only migrate to further tissues in animals. The pork tapeworm is unique because it is known for leaving the human gastrointestinal tract in larval form and migrating to other parts of the human body to create cysts of worm larvae in human body tissues. Whereas cysts may form in any body tissue, the most commonly affected part of the body is the central nervous system*, including the brain. The condition of having a tapeworm cyst in body tissues is called cysticercosis. Having one in the brain is known as neurocysticercosis and may cause seizures*, blindness, or other nervous system abnormalities. Cysts may also form in the heart, eye, or other locations. If

the encysted larvae die, the body may calcify (deposit calcium salts in) the region as part of the healing process. Calcified cysts may also cause health problems.

The fish tapeworm is often noted for causing vitamin B12 deficiencies. In the human body, vitamin B12 is absorbed in the end portion of the small intestines known as the ileum. The closer the fish tapeworm physically is to the ileum, the more severe the vitamin B12 deficiency in the person serving as its host. This vitamin is necessary for red blood cells to function. Vitamin B12 deficiency causes a type of anemia, or red blood cell deficiency, known as pernicious anemia. Because the body tissues are not getting enough oxygen, the individual with pernicious anemia feels tired and weak and may even have nerve damage if the anemia is bad enough. Pernicious anemia responds well to vitamin therapy.

The largest tapeworms can reach an amazing size, measuring more than 45 feet long in some cases. The adult beef tapeworm is usually 15 to 30 feet long (4.5 to 9 meters). An infected person usually has only one or two worms. The tapeworms use their head, called the scolex, to attach themselves to the intestinal wall. They have 1,000 to 2,000 body segments, called proglottids, each containing 80,000 to 100,000 eggs. The eggs can survive for months or years in the environment outside the human body. If humans eat raw or undercooked beef containing cysts, the cysts develop over a two-month period into adult tapeworms. Adult beef tapeworms can live for more than 30 years.

The adult pork tapeworm is about half as long as the beef tapeworm, usually eight to 11 feet (2.5 to 3.5 meters) long. It also has a scolex for attaching to the intestinal wall and a body of about 1,000 proglottids. Each proglottid contains about 50,000 eggs. Adult pork tapeworms can live up to 25 years.

The adult fish tapeworm is from 3 to 49 feet long (one to 15 meters) and is the longest human tapeworm. They have 3,000 to 4,000 proglottids that are wider than they are long, giving this tapeworm the name broad tapeworm. The fish tapeworm affects freshwater fish as well as some salt-water fish that have a freshwater component to their lifecycle (such as salmon). Fish tapeworm infestations are most common in societies that consume large amounts of raw or pickled fish.

How Is Tapeworm Infestation Diagnosed and Treated?

Eggs and proglottids can be seen in stool samples by microscopic examination. In order to differentiate between a beef, pork, or fish tapeworm, a scolex has to be removed and examined. This is seldom done, as doctors usually can prescribe the same medication for all types of tapeworm infestation. Stool is checked at three and six months after treatment to ensure that the parasite is gone.

Cysticercosis is diagnosed by examining the muscles or brain with a CT scan*, which uses x-rays and computers to view structures inside the body that contain cysts. Blood tests for antibodies, which are specific

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

proteins the body makes to fight the tapeworm infestation, can confirm the diagnosis. Tapeworm infestations are treated with one of various types of anti-worm drug called anthelmintics (ant-HEL-min-tics). Some anthelmintics work only in the gastrointestinal tract while others affect body tissues. Cysticercosis can be treated with some types of anthelmintics, but in rare instances cysts may be removed surgically.

▶ See also **Parasitic Diseases: Overview** • **Worms: Overview**

Resources

Books and Articles

Allman, Toney. *Parasites! Tapeworms*. San Diego, CA: KidHaven Press, 2003.

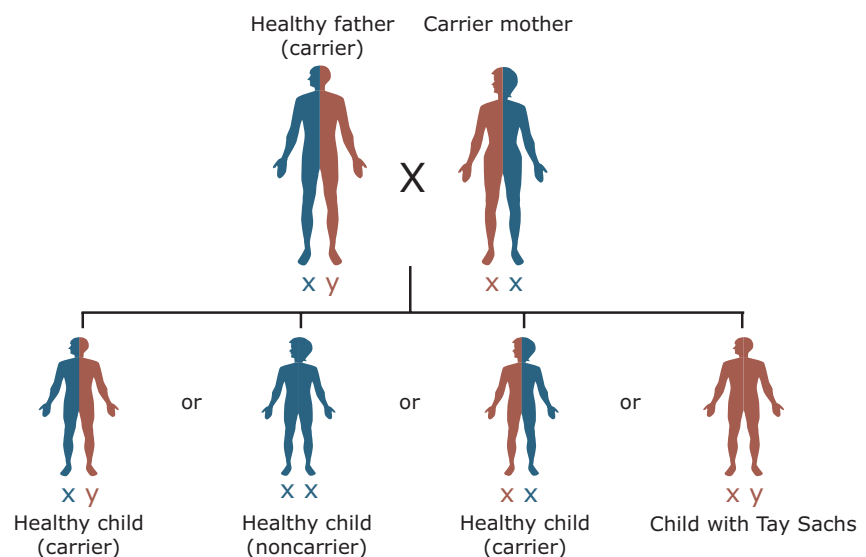
Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Toll free: 888-346-3656. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/001391.htm>; <http://www.nlm.nih.gov/medlineplus/ency/article/001378.htm>.

Tay-Sachs Disease

Tay-Sachs disease is a rare inherited disorder that results in slow destruction of the central nervous system (brain and spinal cord).



▶ People inherit Tay-Sachs disease when they inherit a defective gene from both parents, resulting in two defective genes that make the body unable to produce Hex-A correctly. People who have only one defective gene are called carriers. Carriers do not have the disease, because they have inherited one healthy gene to code for Hex-A, but they may pass the defective gene on to their children. If both parents are carriers, each child born to them has a 1 in 4 likelihood of having the disease. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

What Is Tay-Sachs Disease?

Tay-Sachs disease is a rare metabolic* disorder with severe neurologic (nervous system) symptoms. The term “metabolic” refers to the body’s chemical processes that produce protein and other substances and break down nutrients to release energy. Tay-Sachs disease is a metabolic disorder because it is caused by the absence of the enzyme* (a type of protein) hexosaminidase A (Hex-A). Hex-A is necessary for breaking down fatty substances called lipids. Without Hex-A, these lipids build up in, and eventually destroy, the nerve cells in the brain. Ultimately, the nervous system stops functioning properly.

How Does Tay-Sachs Disease Affect the Body?

Classical Tay-Sachs The most common form of Tay-Sachs disease (classical Tay-Sachs) affects children and usually is fatal. It is caused by a complete lack of Hex-A. Destruction of nerve cells begins before birth, but affected babies do not begin to lose nerve function until they are about six months old. By age two, the child may have seizures* and begins to lose skills such as crawling, sitting, turning over, and reaching for objects. Eventually, the child will be blind, paralyzed, and mentally retarded. Children with this form of Tay-Sachs disease do not live past five years of age.

A variation of this scenario occurs when children develop symptoms between the ages of two and five years of age rather than as an infant. The same symptoms emerge, but the disease progresses more slowly. Children with this form usually die by age 15.

Late onset Tay-Sachs (LOTS) Late onset Tay-Sachs disease (LOTS) is less common than the infantile form. It affects teenagers and adults in their twenties and thirties by causing a gradual loss of nerve function. People with LOTS have low levels of Hex-A rather than a complete lack of it. As LOTS develops, people affected by it may grow clumsy, uncoordinated, and moody. They may experience muscle weakness, twitching, slurred speech, and intellectual impairment. The symptoms vary in type and severity from person to person. Because this form develops so gradually, life expectancy of affected people seems to be similar to that of unaffected people.

How Do People Get Tay-Sachs Disease?

Tay-Sachs disease is caused by a mutation (abnormal change) in the gene that codes for Hex-A. It is a recessive trait, which means that people will have the disease if they have two copies of the defective gene, but they will not have the disease if they have at least one unaffected copy. People with one normal copy and one defective copy are called carriers, because they can pass the disease on to their children.

Just about anyone can be a carrier of the gene for Tay-Sachs disease. In the general population, about 1 in 250 people carries the gene. However, some populations of people include more carriers than others. For

* **metabolic** (meh-tuh-BALL-ik) pertains to the process in the body (metabolism) that converts food into energy and waste products.

* **enzyme** (EN-zime) is a protein that helps speed up a chemical reaction in cells or organisms.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

WHAT'S IN A NAME?

Tay-Sachs disease was named for two scientists working on opposite sides of the Atlantic Ocean.

Warren Tay (1843–1927) was a British eye doctor. In 1881 he described a patient with a cherry red spot on the retina (the structure inside the eye that receives light) of the eye. This spot is characteristic of the classical form of the disease.

The American neurologist (nerve and brain specialist) Bernard Sachs (1858–1944) described the changes in cells caused by the disease. He also recognized that it was an inherited condition that ran in families and that most babies with the disease were of eastern European Jewish descent.

example, 1 in 27 people of eastern European Jewish (Ashkenazi) descent in the United States is a carrier. People of French-Canadian ancestry from one part of Quebec and the Cajun population in Louisiana also have a higher than usual risk of carrying the Tay-Sachs gene.

Is There a Cure for Tay-Sachs Disease?

Although researchers look for a way to prevent or treat Tay-Sachs disease, as of 2009 no treatment or cure was known. However, tests have been developed that allow people to find out if they carry the defective gene. Blood tests can determine the level of Hex-A in people's blood (carriers have about half as much as noncarriers), and DNA tests may find evidence of mutations in the Hex-A gene. Testing is particularly useful for people who have had relatives with Tay-Sachs disease and for people in high-risk populations. Finding out about risk before having a baby can prevent an afflicted child from suffering and prevent the parental anguish of watching a child develop and then die from Tay-Sachs disease.

Prenatal tests also exist for women who already are pregnant. The amniotic fluid (the fluid in which the fetus develops) or the chorionic villus (structures inside the mother's uterus) both contain fluid from the developing baby that can be sampled and tested for the presence of Hex-A. If Hex-A is present, that means that the fetus does not have Tay-Sachs disease.

▶ See also **Genetic Diseases • Metabolic Disease**

Resources

Books and Articles

Walker, Julie. *Tay-Sachs Disease*. New York: Rosen, 2007.

Organizations

March of Dimes. 1275 Mamaroneck Avenue, White Plains, NY, 10605.
Telephone: 914-997-4488. Web site: http://www.marchofdimes.com/pnhec/4439_1227.asp.

National Tay-Sachs and Allied Diseases Association. 2001 Beacon Street, Suite 204, Brookline, MA, 02146. Toll free: 800-906-8723.
Web site: <http://www.ntsad.org>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Toll free: 800-352-9424. Web site: <http://www.ninds.nih.gov/disorders/taysachs/taysachs.htm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Toll free: 888-346-3656. Web site: <http://ghr.nlm.nih.gov/condition=taysachsdisease>.

TB *See Tuberculosis.*

Teeth, Impacted *See Impacted Teeth.*

Temperature *See Fever.*

Temporomandibular Joint (TMJ) Syndrome

Temporomandibular (tem-po-ro-man-DIB-yoo-lar) joint syndrome refers to symptoms caused by problems with the joint that joins the jawbone to the skull.

What Is Temporomandibular Joint Syndrome?

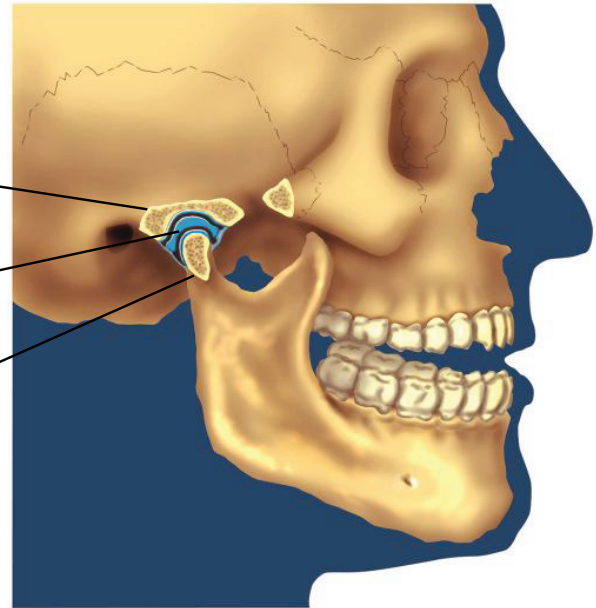
The temporomandibular joint (TMJ) is the name for the jaw joint, one of which is located on each side of the head. These joints connect the lower jaw, or mandible (MAN-di-bul), to the temporal (TEM-po-ral) bone, which is one of a pair of bones that form the lower part of the skull. The temporomandibular joint acts as both a hinge and a gliding joint; together the pair of joints allow the jaw to open and close and to slide from side to side.

Side view of a temporomandibular joint.
*Illustration by Frank Forney. Reproduced
by permission of Gale, a part of Cengage
Learning.*

Temporal bone (cut)

Temporomandibular
joint

Mandible (cut)



* **whiplash injuries** describe general injuries to the spine and spinal cord at the junction of the fourth and fifth vertebrae (VER-te-bray) in the neck occurring as a result of rapid acceleration or deceleration of the body.

* **arthritis** (ar-THRY-tis) refers to any of several disorders characterized by inflammation of the joints.

Temporomandibular joint syndrome refers to cases in which the joints do not function properly. This syndrome may cause pain, difficulty opening and closing the mouth, or problems with chewing and swallowing, as well as other symptoms.

What Are the Causes of Temporomandibular Joint Syndrome?

TMJ syndrome can be caused by dislocated temporomandibular joints or by inherited problems with the joints. In the condition called bruxism (BRUK-siz-um), some people grind their teeth during sleep or times of stress, which can lead to TMJ syndrome. Malocclusion (mal-o-KLOO-zhun), when teeth do not fit together properly; whiplash injuries* from car accidents; being hit on the head or jaw; and arthritis* are other causes of TMJ syndrome.

What Are the Symptoms of Temporomandibular Joint Syndrome?

Because the TMJ is located near many important nerves going between the brain and many parts of the body, the symptoms can be felt in parts of the body that do not seem related to the TMJ. Millions of Americans report some of the following symptoms:

- Frequent headaches
- Pain in the face, sinuses, ears, eyes, teeth, neck, and back
- Clicking sounds in the jaw
- Difficulty in opening or closing the mouth
- Trouble chewing or swallowing

How Is Temporomandibular Joint Syndrome Diagnosed and Treated?

Doctors or dentists ask the patient to describe the symptoms and then they examine the patient. Sometimes, x-rays and MRIs* are used to examine the joints to diagnose TMJ syndrome.

Hot compresses and over-the-counter pain medications may help relieve TMJ syndrome. Stress management and mouth guards worn at night can help eliminate teeth grinding and its effects.

▶ See also **Arthritis • Headache**

Resources

Organizations

National Institute of Dental and Craniofacial Research. 45 Center Drive, MSC 6400, Bethesda, MD, 20892. Telephone: 301-496-4261. Web site: <http://www.nidcr.nih.gov/OralHealth/Topics/TMJ>.

TMJ Association. P.O. Box 26770, Milwaukee, WI, 53226-0770. Telephone: 262-432-0350. Web site: <http://www.tmj.org>.

Tendinitis See *Repetitive Stress Syndrome*.

Tennis Elbow See *Repetitive Stress Syndrome*.

Testicular Cancer

Testicular (tes-TIK-yoo-lar) cancer occurs when cells in the testicle (TES-ti-kul), one of the two male sex glands located in the scrotum below the penis, divide without control or order, forming a tumor*. Over time, these cancer cells can spread to other parts of the body.*

Lance Armstrong's Story

In 1996, champion bicyclist Lance Armstrong (b. 1971) noticed that one of his testicles was enlarged. When he began coughing up blood, he went to his doctor. After discovering that he had cancer* in his testicle, he underwent an operation to remove the testicle. During the operation, doctors performed a CT scans*, which showed that the cancer had metastasized

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

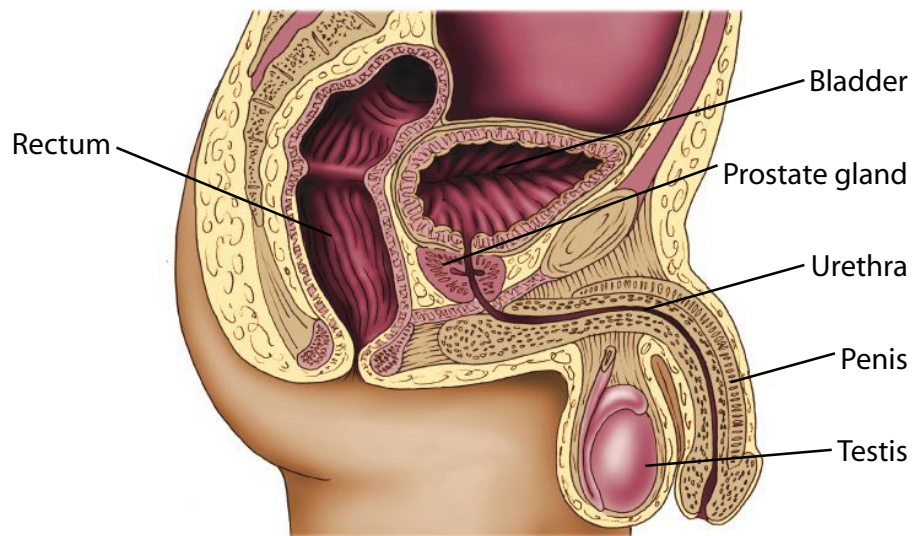
* **scrotum** (SKRO-tum) is the pouch on a male body that contains the testicles.

* **tumor** (TOO-mor) is an abnormal growth of body tissue that has no known cause or physiologic purpose. A tumor may or may not be cancerous.

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

Anatomy of the human male reproductive system showing the position of the testis. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

(spread) to his abdomen, lungs, and brain. Lance immediately began an alternative chemotherapy* regimen to destroy the cancerous cells. He was given a 50 percent chance of survival.

For the next several months, Armstrong underwent chemotherapy in the hope that it would destroy the cancer. Fortunately, Armstrong was declared cancer free in 1997. Over the next year, Armstrong trained hard to get back into shape for cycling, and in 1998, he made his comeback by finishing fourth in the Vuelta a Espana, a three-week race in Europe. A year later, Armstrong won the Tour de France, which he went on to win every year following until 2005, shattering records.

In 1997, before he even knew if he would survive cancer, Armstrong established the Lance Armstrong Foundation, a nonprofit intended to inspire and empower all people who are affected by cancer. As of 2009, it had raised more than \$250 million for cancer awareness, research, prevention, screening, and treatment.

“Livestrong,” the motto of the Lance Armstrong Foundation, became a symbol of hope and perseverance worldwide. The simple yellow logo printed on wristbands, clothing, and even laptop computers.

What Is Testicular Cancer?

The testicles, also called the testes or male gonads, are the male sex glands located below the penis in a pouch of skin called the scrotum. The testicles are the body’s main source of male hormones*, which control the development of the reproductive organs and male sex characteristics such as body and facial hair, low voice, and muscular arms. They also produce and store sperm (the tiny, tadpole-like cells that fertilize the female egg).

Testicular cancer usually begins when cells begin to divide without control or order, forming a tumor. Cells can break away from the tumor

and enter the blood or the lymph, an almost colorless fluid produced by tissues all over the body. The fluid passes through lymph node*, the bean-shaped organs that filter the lymph, fight infection, and produce certain kinds of blood cells. When testicular cancer spreads, cancer cells usually are found in the nearby lymph nodes, the liver*, or the lungs.

What Makes Early Detection Important?

Like most types of cancer, testicular cancer can be treated most easily when it is found early. That is why doctors encourage all teenage boys and men to perform monthly testicular self-examination (TSE), which involves rolling each testicle between the fingers and thumb. The testicles are smooth, oval-shaped, and rather firm, and men who examine themselves regularly become familiar with the way their testicles feel. If any change occurs, it should be reported to a doctor. For many men, it takes time to get comfortable with doing TSE, but it is the best way to find a lump early. This usually is the first sign of testicular cancer.

Other possible symptoms of testicular cancer include the following:

- Any enlargement of a testicle
- A feeling of heaviness in the scrotum
- A dull persistent ache in the lower abdomen or the groin
- A sudden collection of fluid in the scrotum
- Pain or discomfort in a testicle or in the scrotum

It is important for all men to be aware of these symptoms, because doctors cannot predict who will get testicular cancer and who will not. As of 2009, the cause of testicular cancer was not known. Boys who are born with undescended testicles (located in the lower abdomen, rather than in the scrotum) have a higher risk of developing testicular cancer later in life. However, it usually develops for no apparent reason.

How Is Testicular Cancer Diagnosed?

Doctors begin by examining the scrotum and testes carefully and ordering urine and blood tests. These tests can help determine whether an infection or some other disorder might be causing the symptoms. Also, if a tumor is present, certain substances in the blood may be found at elevated levels. These substances are called tumor markers, because they often are found in abnormal amounts in patients with some types of cancer. The doctor may also order tests that create images of the inside of the body, such as a CT scan or an ultrasound*.

After all of these tests, the doctor can be reasonably certain about the diagnosis. However, the only sure way to determine whether cancer is present is to examine a sample of tissue under a microscope. In an operation, surgeons remove the affected testicle.

Once cancer is diagnosed, doctors need to figure out whether it has spread to other parts of the body and formed metastases*. They may perform other tests to look for cancer elsewhere. Because the cancer frequently

* **lymph node** (LIMF) a small, bean-shaped mass of tissue containing immune system cells that fight harmful microorganisms. The lymph node may swell during infections.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **metastases** (me-TAS-ta-seez) are new tumors formed when cancer cells from a tumor spread to other parts of the body.

* **prosthesis** (pros-THÉE-sis) is an artificial substitute for a missing body part. It can be used for appearance only or to replace the function of the missing part (as with a prosthetic leg).

spreads through the lymph nodes in the abdomen, these may be removed and then checked for cancer cells.

How Is Testicular Cancer Treated?

The removal of the testicle, which is necessary to diagnose the cancer, is also the first step in treating it. In addition, tumors that have spread to other parts of the body may be removed partly or entirely by surgery. In most cases, surgery will be followed by radiation therapy, which focuses high-energy rays on the remaining tumor to kill cancer cells and stop their growth.

In some cases, chemotherapy may be used either before or after surgery. During chemotherapy, anticancer drugs are given by mouth or by injection into a muscle or vein.

Life after Testicular Cancer

Fortunately, this disease responds well to treatment, even when it has spread from the testicle to other parts of the body. Men who have had testicular cancer need to see their doctors for regular follow-up appointments to make sure that the cancer has not returned.

A man with one healthy testicle can still have sex and father children. Radiation therapy and chemotherapy may cause a temporary drop in sperm production, but it usually returns to normal within a few months. Patients who are concerned about how they look can also have an artificial testicle, called a testicular prosthesis*, placed in the scrotum. It looks and feels just like a normal testicle.

▶ See also **Cancer: Overview • Prostate Problems**

Resources

Books and Articles

Armstrong, Lance, and Sally Jenkins. *It's Not about the Bike: My Journey Back to Life*. New York: Penguin, 2001.

Johanson, Paula. *Frequently Asked Questions about Testicular Cancer*. New York: Rosen, 2008.

Verville, Kathleen. *Testicular Cancer*. New York: Chelsea House, 2009.

Organizations

Lance Armstrong Foundation. P.O. Box 161150, Austin, TX, 78716. Telephone: 512-236-8820. Web site: www.livestrong.org.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 306A, Bethesda, MD, 20892. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov/cancertopics/types/testicular>.

Testing and Evaluation

Evaluation (ee-val-yoo-AY-shun) is the process of examining a problem or condition so that it can be understood and diagnosed. Testing is one of the ways to evaluate possible behavioral and mental health problems. Tests also can be used to measure normal abilities, such as intelligence, personality, certain brain functions, learning capabilities, and school progress.

Neal's Story

Neil was glad that he had remembered to bring an extra pencil with him to school today. He tapped it nervously on the desk while the teacher passed out booklets for the standardized test his class was about to take. Even though he knew this test did not count for his report card, he wanted to do well. As soon as the teacher finished giving the instructions, Neil opened the test booklet and began to read the first question.

What Are Standardized Tests?

A standardized test is a test that is given under the same conditions to everyone who takes it. The questions on the test, the instructions, the time allowed for taking the test, and the rules for scoring it are the same every time the test is given and for every person who takes it. For example, students in classrooms across the country may take the same standardized test to measure school progress. At each school the same test booklets, answer sheets, and instructions are used.

Standardized tests make it possible to compare the scores of a large group of people. For example, the math scores of all sixth grade students in the United States can be compared using a standardized test. It would not be possible to make such comparisons with the tests teachers make separately for their own classes, because those tests most likely would differ in ease or difficulty or might include different material. Using such tests, it would not be possible to make fair comparisons among students in different classes.

What Does a Score on a Standardized Test Mean?

The results of a standardized academic (schoolwork) test can show how well a student scored in certain subjects, such as reading comprehension (com-pree-HEN-shun) or math problem solving, compared with other students in the same grade throughout the country. Scores usually are given as percentiles in this type of test. For example, a student may score in the 86th percentile in reading comprehension, which means that the student can read and understand the readings as well as, or better than, 86 percent of all the students in the same grade who were tested.

What Do Standardized Tests Measure?

There are many types of standardized tests. Different tests measure different factors. There are standardized tests that can measure students regarding their academic progress, intelligence, memory, and behavior capabilities. Some standardized tests are given to a whole group of people at once, whereas others are given individually. Group tests generally are given in a classroom, such as tests that measure school progress. Scores show how well a student is doing in academic subjects compared with all other students in the same grade. A typical standardized test to measure academic progress consists of a test booklet with multiple-choice questions and a separate answer sheet on which the student fills in a circle to mark the correct answer.

Group standardized tests can measure academic progress at every level. Colleges and universities often use these tests to help decide whether to accept an individual as a student. For example, colleges and universities often require applicants to take the standardized test called the Scholastic Aptitude Test (SAT), graduate schools may require the standardized test called the Graduate Record Exam (GRE), and medical schools usually require the standardized test called the Medical College Admission Test (MCAT). Scores from these tests help a college or university compare the abilities of students who are applying and decide which students to accept. These tests measure how much a student has learned in school and how well a student can solve problems, as well as other learned skills or natural aptitudes that may predict that a given applicant will be a good student. Tests are just one measure of someone's capabilities, and they are generally just one of several factors used in evaluating an applicant for a college or university.

What Are Psychological Tests?

Some tests are given only by psychologists (sy-KAH-lo-jists), and they are called psychological (sy-ko-LAH-ji-kal) tests. Among the most common psychological tests are those that measure intelligence. Intelligence tests are examples of standardized psychological tests. Some other psychological tests are not standardized, but they can still provide important information about a person's personality, feelings, ideas, and concerns and can help evaluate and diagnose problems they may have. Most psychological tests are given individually and involve a face-to-face meeting with the psychologist during testing.

One commonly used psychological test to measure intelligence (IQ) in childhood is the Wechsler Intelligence Scale for Children (ages 6–16). There is also the Wechsler Adult Intelligence Scale, which can be given to anyone over 16 years of age. Intelligence tests also can help evaluate a person for possible learning disabilities, attention problems, and mental retardation. These tests can accurately measure a person's intelligence under most circumstances, but some factors may prevent individuals from scoring their best, such as not feeling well or being extremely nervous about

taking the test. The psychologist takes these possibilities into account and decides whether the test on that day should be considered an accurate reading of the person's true capabilities.

Placing Students in the Right Classroom

Paula was not sure what to expect when it came time for her to meet with Dr. James, the school psychologist. She knew there would be tests, but she did not know what type. As she walked from her classroom to Dr. James's office, she felt just a little nervous. But as Dr. James showed her what to do, Paula felt more at ease. Paula found that taking the tests was interesting. Some parts were easy, and others were more difficult. There were vocabulary words, number problems, puzzle pieces to put together, and pictures to arrange in order. There were about a dozen tests in all. Dr. James asked Paula to work quickly but carefully, and she used a stopwatch to time how long it took Paula to do certain parts of the test, such as arranging blocks to match a design. Paula was excited when, a few weeks later, she found out that she had done well enough on the tests to be placed next year in a class for gifted students. The test Paula had taken was the Wechsler Intelligence Scale for Children.

Paula's best friend, Kim, took the same tests, as well as some others, with Dr. James, but for a different reason. Kim had been having trouble with her schoolwork and was finding it hard to remember what she read. In Kim's case, the tests helped Dr. James diagnose a learning disability. The tests showed that although Kim was quite intelligent, her learning disability was preventing her from doing her best work. Kim started to go to a learning support class and knew it was helping when she got a B+ on her reading test.

What Are Personality Tests?

Certain psychological tests assess personality. Some personality tests are standardized, whereas others are not. An example of a standardized personality test is the Myers-Briggs Type Indicator (MBTI), which can measure a person's usual personality style. Although this test is designed for adults, it can be used for teens, and there are variations designed for younger children. Another standardized personality test for older teens and adults is the Minnesota Multiphasic Personality Inventory—Adolescent (MMPI-A), which helps identify problems with personality.

Projective tests also give information about someone's personality. Projective tests are not standardized, but psychologists follow certain guidelines for scoring and interpreting them. Projective tests usually include pictures that could have many possible meanings. People are asked to say what they see in the picture or to tell a story about it. Examples are the Thematic Apperception Test (TAT) for older teens and adults and the Children's Apperception Test (CAT) for younger children. The Rorschach Test is a projective test in which individuals are shown a series of inkblot designs on cards and asked what they see in the inkblot. These tests

- * **reaction speed** is the time it takes to respond to a stimulus.
- * **dementia** (dih-MEN-sha) is a loss of mental abilities, including memory, understanding, and judgment.
- * **battery** in this case refers to a group of related tests that are given together.
- * **vocational** (vo-KAY-shun-al) means relating to training in a particular job skill.
- * **attention deficit hyperactivity disorder**, or ADHD, is a condition that makes it hard for a person to pay attention, sit still, or think before acting.

are called projective tests because people project their own imagination, ideas, and personality onto the inkblots or pictures.

What Are Neuropsychological Tests?

A specialized group of psychological tests measure brain capacities that can affect a person's behavior. These tests can help evaluate brain damage. These neuropsychological (nur-o-sy-ko-LAW-ji-kal) tests can measure such brain functions as memory, attention, eye-hand coordination, mental processing, and reaction speed*. Neuropsychological tests may be used to evaluate the effects of a brain injury, brain infection, or stroke or to assess individuals who have problems with memory, balance or learning or people who might have dementia*. Examples of neuropsychological test batteries include the Halstead-Reitan and the Luria-Nebraska tests. Each battery* includes a number of tests that are analyzed to find a pattern of functions. For example, some tests might examine language functions (left brain activities), some might compare motor coordination with each hand (comparing how each side of the brain works), and some might evaluate rapid decision making and problem solving (examining frontal brain regions).

Other Tests

Adaptive behavior tests can measure people's capabilities to care for themselves and carry out other types of behavior important for daily living, such as counting money, shopping, and taking public transportation. They also can assess various job skills. Adaptive behavior tests often are used to evaluate the strengths, capabilities, and needs of individuals who have a developmental disability.

Vocational* tests can assess people's interests, skills, and aptitudes for particular jobs. There are also many kinds of tests that allow people to choose words or phrases that best describe themselves. Such "self-report" tests include checklists about behavior, feelings, or problems. These checklists can help identify important issues and start a discussion with a mental health professional who may be evaluating individuals' needs and how best to help them. For example, a self-report measure to examine possible attention deficit hyperactivity disorder* might include symptoms of hyperactivity, impulsivity, and poor concentration. Scores are rated against how others self-report to give an indication of how significant the symptom pattern might be within a person's age group.

Evaluation Interviews

Tests are not the only means of finding out about a person. In fact, the most commonly used method of evaluation by psychologists and other mental health professionals is the interview. Interviewing, which consists of questions and answers and in-depth discussion, is an important and effective way to evaluate a person's emotional and behavioral condition. Mental health professionals are trained to use interviews to understand the many aspects of someone's situation and to begin to diagnose possible problems.

How Can Evaluation and Testing Help?

Evaluation, which sometimes includes testing, is the first step toward diagnosing a person's mental health condition and possible behavioral, emotional, or learning problems. Evaluation and testing lead to a greater understanding of a problem or condition and pave the way for effective treatment. Evaluation and testing also can provide greater understanding of a person's intelligence, vocational interests, aptitudes, and learning needs, so that an educational plan can be put in place that is best suited to that person's strengths and needs.

What Are the Limitations of Evaluation and Testing?

The limitations of evaluation and testing begin with the expressed purpose through which each method has been designed. A method that may be quite effective for one analysis may be highly inaccurate for a related concern. For example, the Stanford-Binet Intelligence Test is accurate for identifying how one's intellectual ability relates to the average. However, the Stanford-Binet could not identify the presence of a learning disability if someone was scoring below average. The validity of the test is compromised if the test is used in a way that is not intended for its use. Most tests are not designed to be administered too often in a short period of time. If a child were sick on the day of the first administration, a second administration can be scheduled shortly after the first. However, if someone were taking the test over and over trying to improve his/her score, the results would not be accepted as valid. The results could be skewed in a higher direction because the student became more familiar with the content. By contrast, the results could be skewed in a lower direction if the student became bored with the constant administrations.

The results of the evaluation and testing could be limited by unfounded assumptions regarding the constructs being tested. For example, the traditional view of intelligence has been that it is a fixed capability. If someone were to use the results of the intelligence test to promote this misconception, it would greatly limit the use of the test results. The practical application of the construct is, of course, a better measure of the construct than any test. The best validation of any intelligence test is its correlation with a student's adaptation to school. Adaptation to school has many influences. Changing any of these influences can help the student better adapt to school. Therefore, the practical application of intelligence would be improved.

How Well Do These Techniques Perform in Terms of Outcomes?

Evaluation and testing instruments are constantly updated and revised as their common use and expectations change. If some instrument was not producing the expected outcomes, it would surely be rejected as the problems become identified. Many research projects rely on the effectiveness

of these instruments and techniques and are constantly reporting how they can be modified or under what conditions they should be used. In spite of this constant research and evaluation of the effectiveness of tests and techniques, there are still some general concerns.

Tests that rely on a high predictive value include the SAT, the GRE, and the MCAT. These tests have the goal of predicting how well a student will do in college as part of the college's evaluation of the student for admission. The evidence for the test's sole effectiveness is inconclusive. However, using the scores from these tests in coordination with other predictive measures such as the student's current Grade Point Average appears to be an effective means of predicting the student's first semester as a freshman for the SAT or the first semester in graduate school for the GRE or MCAT. Most colleges and university do not use the scores from these tests alone for determining admissions but find that they do contribute to the effectiveness of the overall decision-making process.

In the early 2000s the Myers-Briggs remained a popular personality test, even though it was designed originally in 1962. The purpose of the Myers-Briggs is different from many other tests as the results are meant to be used by the person taking the test. The result of the Myers-Briggs is one of 16 personality types, each with a description of preferences. Recognizing one's preferences can help in developing relationships with others and in exploring possible careers. The debatable value of the Myers-Briggs is that its concept of personality is different from the traditional view of personality. The Myers-Briggs test produces mutually exclusive types whereas the traditional personality types are based on a continuum of various traits. The Myers-Briggs approach sees personalities as qualitatively different whereas the traditional approach sees personalities as quantitatively different.

In general, projective techniques are accepted as being just as accurate for what they are meant to produce as standardized tests are. However, there are conflicting reports of the validity of projective techniques. One perceived threat in using the projective techniques with children is that children may fake their responses, thus hiding their true self. Also, the situation and the examiner's manner may influence the child's responses. Moreover, the lack of norms for these types of tests leads clinicians to rely on an individualized interpretation.

In spite of these weaknesses, the projective techniques remained popular with clinicians in the early 2000s. One reason is that the techniques work well as an "ice breaker" to therapy. Using these techniques helps to build rapport between the clinician and the children being evaluated. Another reason is that many clinicians use these techniques as part of a structured interview. The clinicians who use these techniques are looking for broad information while recognizing the low precision of the measures. The results then are treated like clues that can be further pursued later in therapy. No serious decision or immediate action would be based solely on the results of any one of these tests.

How Are These Evaluations Evaluated?

These evaluations need to be evaluated through constant monitoring and observation. Every testing instrument is evaluated through research efforts such as replicating the original research that developed the instrument. However, the reliability and validity established relate only to the instrument and not to its use or result in any given situation. No matter how well the evaluation of the test or technique might be in general, the test cannot guarantee an accurate evaluation for any individual. Each diagnosis has to be accepted as a hypothesis that is tested through constant updates of the student's situation or condition.

What Kind of Biases Have Been Found in These Methods?

Standardized tests are developed through constant updating of statistics for a specified population through a process called "norming." These tests are expected to be free from bias for the population for which it has been normed. However, the degree to which the normed population is described varies among the many tests available. For instance, if the population is given as American students in specified grade or range of grades, there should be some recognition for the diversity of ethnic groups among modern American students. Because there was no serious recognition of gender differences before the 1980s, if the test has not been normed since the early 1980s, there may be some gender bias.

There are other chances of bias in standardized tests, even the ones that have been normed properly. Most tests rely on questions that present an example or small story, often with a character's gender or ethnicity identified in some way. If these examples or stories promote gender or ethnic stereotypes, certain test takers may feel that the test was not meant for someone like them. Such stereotypes could be promoted if all the female characters are depicted as involved in traditional feminine roles or if every minority character is depicted as in trouble.

Another source of bias is called item bias in which the wording of the test question leads students of the same minority backgrounds to choose the same specific wrong answer over the right answer that they would have chosen had the wording been different. An example of item bias would be if a question on a standardized test required the test-taker to quickly recognize if the wife of a duke is a "duchess" or a "dutchess". Otherwise knowledgeable students from Dutchess County, New York, may not recognize the misspelling in the time allowed. They would have to ignore the spelling that is common to them in a way that students in other parts of the country would not. Therefore, the question would be testing something different for the Dutchess County students than for the other students taking the same standardized test. Similarly, the test question could use a term that may have a different meaning for members of a minority group. Usually the test publisher will catch these incidents of item bias for each administration of the test. There are some basic analytical

methods to determine if all (or most) of the high test takers of a specific minority are choosing the same wrong answer on a particular question.

The use of standardized tests also may introduce a bias in comparing people with different test-taking skills. Students with limited English proficiency may not do as well on the test as an English-speaking student with similar characteristics (e.g. intelligence or achievement). The limited-English students will need more time to demonstrate their capability. Similarly, using a standardized test to compare students who are currently in school with adults who have been out of school for years may not be appropriate. The adults would not be as practiced in answering test questions as the students would be. This can be seen in the results of cross-sectional studies of age-related differences in intelligence. Young people were compared with middle-age and elderly people. The results demonstrated that the older the participant was, the more likely the intelligence score would be low. This reduction in intelligence has not been seen in other studies of age-related differences. Therefore, the difference must be a function of the testing situation or the test used to measure intelligence.

Projective tests are not free from cultural or gender bias; however, they have a new set of biases not seen in the standardized tests. Because the interpretation of the test rests on the judgment of the test administrator, there are openings for various subjective biases. The first bias is researcher bias, which occurs when test interpreters believe that they know what the outcome will be. Test interpreters may make small recording errors that lead the results to support the pre-established judgment. Additionally, test interpreters may pay more attention to those results that coincide with the pre-established judgment and ignore those results that go against it. If test interpreters are the same individuals as the test administrators, they may ask leading questions or give subtle hints to what the “correct” response is.

Another source of bias in the administration of projective tests is the social desirability on the part of individuals being tested. Social desirability occurs when individuals who are being tested respond with what they think are the socially acceptable response and not what they truly feel or think. Individuals may also think that the testing is leading to a predetermined end and may respond in a way that they believe will bring about that end. If individuals being tested perceive that the test administrator or interpreter has already decided what the results are, they may infer cues from the administrator and respond accordingly.

Resources

Books and Articles

Braaten, Ellen, and Gretchen Felopulos. *Straight Talk about Psychological Testing for Kids*. New York: Guilford, 2004.

Gregory, Robert J. *Psychological Testing: History, Principles, and Applications*, 5th ed. Boston: Pearson/Allyn and Bacon, 2007.

Organizations

American Psychological Association. 750 First Street NE,
Washington, DC, 20002-4242. Toll free: 800-374-2721.
Web site: <http://www.apa.org/topics/topicstest.html>.

Association for Psychological Science. 1133 Fifteenth Street NW,
Suite 1000, Washington, DC, 20005. Telephone: 202-293-9300.
Web site: <http://www.psychologicalscience.org>.

Tetanus (Lockjaw)

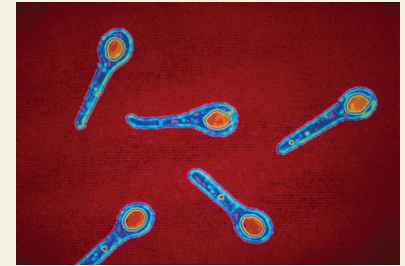
Tetanus (TET-nus) is a serious bacterial infection that affects the body's central nervous system. Tetanus, also known as lockjaw, can lead to muscle rigidity, convulsions*, and death.*

What Is Tetanus?

Tetanus is a disease caused by infection with *Clostridium tetani* (klos-TRIH-dee-um teh-TAH-nye) bacteria, which are found all over the world in soil, dust, and some animal feces (FEE-seez, or bowel movements) and even on human skin. The bacteria can enter the body through any type of wound, such as a scratch or deep cut. Infection begins after bacterial spores* have moved deep within the body and become active. *Clostridium tetani* bacteria are anaerobic (ah-nuh-RO-bik), meaning that they grow best in places with very little oxygen—so the deeper they travel into the body, the better their chances of survival.

Once tetanus spores become active, the bacteria begin producing a toxin (a poisonous substance) called tetanospasmin (teh-tuh-no-SPAZ-min), which attaches to the nerves around the area of the wound. The tetanus toxin also can spread to the spine and attach to the ends of nerves of the spinal cord and at neuromuscular junctions (where nerves meet muscles). The toxin blocks the release of a neurotransmitter (nuro-trans-MIH-ter), a chemical that carries a signal from nerves to other nerves or muscles. This block affects the messages that the muscles receive, resulting in severe muscle spasms* that can be powerful enough to tear muscles apart.

There are three types of tetanus infection. Local tetanus is limited to the area of the wound; cephalic (seh-FAH-lik) tetanus is an uncommon form that affects the nerves of the face after a head injury or, rarely, a long-lasting ear infection; and generalized tetanus affects much of the body and accounts for the majority of tetanus cases. Neonatal* tetanus is a generalized form of the infection that occurs in newborns. It is caused by bacteria contaminating the stump of the umbilical cord*,



▲
Clostridium tetani spores magnified 2,000 times. Peter Arnold, Inc./Alamy.

* **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

* **spores** are a temporarily inactive form of a germ enclosed in a protective shell.

* **spasms** (SPAH-zumz) are involuntary muscular tightening or contractions.

* **neonatal** (ne-o-NAY-tal) means pertaining to the first 4 weeks after birth.

* **umbilical cord** (um-BIH-lih-kul) is the flexible cord that connects a baby to the placenta, the organ that unites the unborn child to the mother's uterus, the organ in which the baby develops.

* **sterilize** (STAIR-uh-lyze) is to eliminate all live bacteria or microorganisms from something, usually through the use of heat, pressure, chemicals, or other antimicrobial agents.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

* **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **immune globulin** (ih-MYOON GLAH-byoo-lin), also called gamma globulin, is the protein material that contains antibodies.

* **respiratory system** or respiratory tract, includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body.

* **respirator** is a machine that helps people breathe when they are unable to breathe adequately on their own.

particularly if the cord has been cut with an instrument that has not been sterilized*.

How Common Is It?

Tetanus occurs around the world but is found frequently in densely populated areas that have hot, damp climates. The disease is rare in the United States primarily because of vaccination*. Nearly all reported cases of tetanus occur in people who have never been vaccinated or who have not had a booster shot in the previous 10 years. Neonatal tetanus infection is rare in developed countries because of improved surgical techniques, but there are hundreds of thousands of deaths from tetanus annually worldwide, mostly in developing countries. Intravenous* drug abusers, such as people who inject heroin, are at a higher risk of contracting the disease.

Is Tetanus Contagious?

Tetanus is not spread from person to person. Bacterial spores must enter a wound for the infection to spread.

What Are the Signs and Symptoms of Infection?

Symptoms of tetanus appear from 3 to 21 days or longer after infection, but usually they develop within seven days. In about 50 percent of generalized cases of tetanus, the first sign is trismus, or stiffness in the jaw muscles (also known as lockjaw), followed by a stiff neck, shoulder, or back; trouble swallowing; and fever. Spasms can soon spread to the abdominal* muscles, upper arms, and thighs. Other symptoms include sweating, high blood pressure, and periods of rapid heartbeat. The closer the infection is to the central nervous system, the sooner the symptoms appear. The earlier the symptoms begin to appear, the greater the risk of death.

How Do Doctors Make the Diagnosis?

The diagnosis is made based on the presence of symptoms and the patient's history (for example, getting a wound by stepping on a soil-contaminated nail). Laboratory tests are not useful in determining whether a patient has tetanus. A culture* of the wound can be done, but these cultures generally do not show the bacteria.

What Is the Treatment for Tetanus?

Typically, tetanus infection is treated in a hospital. Treatment begins with giving the patient tetanus immune globulin* to control or reverse the effects of toxin that has not yet attached itself to nerve endings. Penicillin or other antibiotics also may be given to kill the bacteria. Cleaning the wound and removing dead tissue, in some cases by surgery, is important in ridding the body of invading bacteria. Muscle spasms can be treated with muscle relaxants. Respiratory system* support, provided by a respirator* may be necessary to help maintain breathing if the respiratory muscles have been affected.

How Long Does Tetanus Last?

Symptoms may last three to four weeks, although complete recovery can take several months. Tetanus can be mild, but in most cases the illness is severe and death may occur even after treatment has begun. Tetanus usually requires a long stay in the intensive care unit of the hospital.

What Are the Complications?

Complications of the illness include spasms of the vocal cords and the muscles that control breathing, which can lead to difficulty breathing; fractures in the long bones or the spine from severe muscle spasms and convulsions; high blood pressure; abnormal heart rhythm; secondary infections, such as sepsis* and pneumonia (inflammation of the lung); a blood clot* in the lungs; and death. In the United States, 10 to 20 percent of reported tetanus cases are fatal. Unvaccinated children and the elderly are at greater risk of dying if they become infected with tetanus bacteria.

Can Tetanus Be Prevented?

Immunization is the best means of preventing tetanus. The vaccination usually is given in combination with other vaccines: the DTaP (diphtheria*/tetanus/acellular/pertussis*) form for children and the Td (tetanus/diphtheria) form for adults. A series of shots is required to develop immunity to tetanus toxin, followed by booster shots every 10 years. In some cases of unclean wounds, a booster is given after the injury to help prevent tetanus.

▶ See also **Skin and Soft Tissue Infections**

Resources

Books and Articles

Guilfoile, Patrick. *Tetanus*. New York: Chelsea House, 2008.

Organization

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/vaccines/vpd-vac/tetanus/default.htm>.

- * **sepsis** is a potentially serious spreading of infection, usually bacterial, through the blood-stream and body.
- * **blood clot** is a thickening of the blood into a jelly-like substance that helps stop bleeding. Clotting of the blood within a blood vessel can lead to blockage of blood flow.
- * **diphtheria** (dif-THEER-e-uh) is an infection of the lining of the upper respiratory tract (the nose and throat). It is a serious disease that can cause breathing difficulty and other complications, including death.
- * **pertussis** (per-TUH-sis) is a bacterial infection of the respiratory tract that causes severe coughing.

Thalassemia

Thalassemia is a genetic blood disorder. People with thalassemia have too few red blood cells and lower-than-normal hemoglobin.



Distorted red blood cells in the inherited blood disorder thalassemia. Affected red blood cells are variously shaped and fragile; they rapidly break up as they move through the body. *John Bavosi/Photo Researchers, Inc.*

* **hemoglobin** (HE-muh-glo-bin) is the oxygen-carrying pigment of the red blood cells.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **platelets** (PLATE-lets) are tiny disk-shaped particles within the blood that play an important role in clotting.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

What Is Thalassemia?

Thalassemia is a blood disorder that runs in families. People who have thalassemia have too few red blood cells and lower hemoglobin* than normal.

What Causes Thalassemia?

The type of thalassemia that individuals develop depends on which chain of the hemoglobin is affected. If the alpha chain is defective, alpha-thalassemia results; if the beta chain is defective, beta-thalassemia results. The severity and specifics of the disease also depend on how many defective genes individuals have.

In the case of alpha-thalassemia, one defective gene does not cause individuals to develop any of the symptoms of thalassemia, although they can go on to pass that same defective gene on to offspring. Inheriting two defective genes results in a condition called alpha-thalassemia minor, with only very mild symptoms. Three defective genes results in a condition called hemoglobin H disease, which causes moderately severe symptoms. Four defective genes is termed alpha-thalassemia major or hydrops fetalis, which is fatal to offspring in utero or within a short time after birth.

In the case of beta-thalassemia, one defective gene results in beta-thalassemia minor, which causes mild symptoms; two defective genes results in beta-thalassemia major (also known as Cooley's anemia), which causes moderately severe symptoms. Babies with this condition are usually

ABOUT THE BLOOD AND HEMOGLOBIN

Blood is made up of a watery substance called plasma, in which circulate the various types of blood cells: red blood cells (mainly responsible for delivering oxygen to the tissues), white blood cells (involved in immune system* response), and platelets*.

Red blood cells contain hemoglobin, a complex, iron-rich protein that is responsible for picking up oxygen molecules from the lungs, delivering oxygen to all of the tissues throughout the body, picking up carbon dioxide (a waste product) from all of the tissues, and taking the carbon dioxide back to the lungs where it can be dissipated during exhalation. Too little hemoglobin in the bloodstream is called anemia*.

Hemoglobin is made up of two types of protein chains, called alpha and beta chains. Defects in alpha chains result in alpha-thalassemia; defects in beta chains result in beta-thalassemia. The production of alpha chains requires four different genes* (two from each parent), whereas production of beta chains requires only two different genes (one from each parent).

asymptomatic at birth but develop symptoms of the disease during their first year.

Who Gets Thalassemia?

Thalassemia is one of the most common genetic* conditions. It occurs worldwide, but most commonly affects people of Greek, Italian, Middle Eastern, Asian, and African descent. Alpha-thalassemia is particularly common among descendants of people who come from Southeast Asia, China, and the Philippines. People who already know that family members have the disease are obviously at very high risk of having the condition themselves or of passing it on to their offspring.

Some experts believe that the genetic defects of thalassemia have persisted because the abnormal red blood cell configurations actually provide some protection against malaria*, because the shape of the thalassemic red blood cells inhibits the entry of the malarial parasite into the cells. Malaria is a serious problem in all the geographic areas where thalassemia has the highest frequency.

What Are the Symptoms of Thalassemia?

Symptoms of thalassemia are those of anemia, including pallor, weakness, severe fatigue, shortness of breath, dizziness, fast heart rate, decreased appetite, unintentional weight loss, failure to thrive* in babies or poor growth and development in children. Other symptoms may include jaundice*, dark urine, bloated abdomen, fevers, diarrhea, smooth swollen tongue, and abnormalities of the facial bones.

How Is Thalassemia Diagnosed?

Thalassemia may be suspected based on the presence of characteristic symptoms, as well as due to knowledge of individuals' family history. A physical examination will reveal some of the characteristic signs of thalassemia. Blood tests can be done to demonstrate red blood cell abnormalities (in shape, size, and quantity), decreased levels of hemoglobin and iron, which is a major component of hemoglobin. Genetic testing may be performed to reveal the abnormal genes that are responsible for thalassemia.

How Is Thalassemia Treated?

Minor forms of thalassemia may have such mild symptoms that no treatment is required. In some cases, illness, stress, surgery, childbirth, or severe infections may prompt the need for a blood transfusion*.

Major forms of thalassemia may require regular blood transfusions. Unfortunately this treatment puts recipients at high risk of accumulating too much iron in the blood, which can be damaging to multiple organs, including the heart and liver. Drugs may be required to decrease the amount of iron in the blood (called iron chelators or chelating agents). Very severe complications from thalassemia may require a bone marrow* transplant or stem cell transplant.

* **genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.

* **malaria** (mah-LAIR-e-uh) is a disease spread to humans by the bite of an infected mosquito.

* **failure to thrive** is a condition in which an infant fails to gain weight and grow at the expected rate.

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

* **blood transfusion** is the process of giving blood (or certain cells or chemicals found in the blood) to a person who needs it due to illness or blood loss.

* **bone marrow** is the soft tissue inside bones where blood cells are made.

* **chorionic villus sampling** (KOR-ee-on-ik VIL-lus sampling) is a test in which a small tube is inserted through the cervix and a small piece of the placenta supporting the fetus is removed for genetic testing.

* **amniocentesis** (am-nee-o-sen-TEE-sis) is a test in which a long, thin needle is inserted in the mother's uterus to obtain a sample of the amniotic fluid from the sac that surrounds the fetus. The fetal cells in the fluid are then examined for genetic defects.

* **in vitro** in the laboratory or other artificial environment rather than in the living body.

* **oral** means by mouth or referring to the mouth.

* **yeast** (YEEST) is a general term describing single-celled fungi that reproduce by budding.

Can Thalassemia Be Prevented?

People who know that thalassemia runs in their families can undergo genetic counseling to ascertain their own risk of passing the condition on to their offspring. Once a baby has been conceived, prenatal tests can determine whether the fetus has the disease. Tests include chorionic villus sampling* or amniocentesis*

Assisted reproductive technology can also be used to try to avoid conceiving babies who have the genes for thalassemia. This technology requires in vitro* fertilization. Blastoplasts (cell masses that can develop into embryos) are tested for the presence of the thalassemia-causing genes, and only those without these genes (usually two) are then implanted into the woman's uterus.

▶ See also **Anemia, Bleeding, and Clotting**

Resources

Organizations

Cooley's Anemia Foundation. 330 Seventh Avenue, No. 900, New York, NY, 10001. Toll free: 800-522-7222. Web site: <http://www.thalassemia.org>.

March of Dimes. 1275 Mamaroneck Avenue, White Plains, NY, 10605. Toll free: 914-997-4488. Web site: <http://search.marchofdimes.com>.

Thrombosis See *Phlebitis and Venous Thrombosis*.

Thrush

Thrush is a fungal infection of the oral cavity. It usually manifests as raised white patches in the mouth and throat that may have the appearance of cottage cheese. The infection is usually caused by a Candida fungus (a fungus of the genus Candida), of which Candida albicans is the most common. Candida is also the type of fungus that causes most diaper rash and vaginal yeast* infections. Thrush may also be caused by a fungus of the genus Monila.*

What Is Thrush?

Thrush is an oral fungal infection. The most common causative agent, *Candida albicans*, is a single-celled fungus (single-celled fungi, or yeasts, reproduce by budding) that is a natural inhabitant of the mouth. Usually, the body maintains a natural balance of microbes* in the mouth. If that natural balance has been disturbed, however, *Candida* and other fungi may begin to grow in the warm moist environment of the mouth and throat. Other names for thrush are oral candidiasis (kan-di-DY-a-sis) and oral moniliasis (mon-i-LY-a-sis).

Thrush and the immune system Thrush is common in newborns. In older children, and adults, it may be a sign of an immune system* disorder. People whose immune systems have been damaged by HIV*, human immunodeficiency virus, the virus that causes AIDS*, for example, may develop thrush, as a properly functioning immune system is needed to maintain the natural balance of microbes in the mouth. Others at risk for thrush include individuals who are treated with antibiotics* for bacterial infections and people who use steroid inhalers for asthma*.

Neonatal thrush Infants may become infected during the birth process if their mothers have vaginal yeast infections, or they may get thrush from bottles or rubber nipples that have not been handled carefully, or from a family member or caregiver whose hands have been poorly washed. Thrush usually appears as whitish, smooth (even velvety) patches on the tongue, palate (roof of the mouth), inner cheeks, or throat. The whitish patches should not be scraped, as this will hurt the infant and leave behind an inflamed and possibly bleeding area, and infants may refuse to suck because of pain in the mouth. *Candida* also causes diaper rash, but the rash is reddish rather than white.

How Is Thrush Diagnosed and Treated?

A doctor can almost always diagnose thrush just by looking at the mouth and tongue. If uncertain, however, the doctor may perform a culture of one of the lesions. Thrush may be a sign of an immune system deficiency, and people with thrush or with suspected thrush should visit a doctor or dentist, who will be able to identify the yeast under a microscope if necessary, check for possible causes, and suggest ways to prevent its recurrence. For thrush in neonates and infants, treatment is often unnecessary. Doctors usually treat thrush with antifungal drugs* that is either taken orally or applied directly to the affected areas. They will also recommend careful hygiene, which includes frequent hand washing, frequent diaper changes, and the use of certain mouth washes.

In some people, thrush may progress to a full systemic disease, which is generally severe. This includes persons with HIV/AIDS, persons receiving chemotherapy* or immunosuppressant drugs, or persons with some other immune system disorder. The treatment for this type of often-severe



▲ *Candida albicans* coats the tongue of a person with thrush. ©Medical-on-Line/Alamy.

- * **microbes** (MY-krobes) are microscopic living organisms, such as bacteria, viruses and fungi.
- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.
- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.
- * **asthma** (AZ-mah) is a condition in which the airways of the lungs repeatedly become narrowed and inflamed, causing breathing difficulty.



▲ Bolivian man suffering from thyroid cancer. ©PHOTOTAKE Inc./Alamy.

* **antifungal drugs** (an-ty-FUNG-al drugs) are medications that kill fungi.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

* **endocrine** (EN-do-krin) refers to a group of glands, such as the thyroid, adrenal, and pituitary glands, and the hormones they produce. The endocrine glands secrete their hormones into the bloodstream, and the hormones travel to the cells that have receptors for them. Certain hormones have effects on mood and sometimes cause emotional swings.

candidiasis is intravenous* antifungal medication, which is administered in a hospital setting.

▶ See also **Oral Infections**

Resources

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: http://www.cdc.gov/nczved/dfbmd/disease_listing/candidiasis_gi.html.

University of Michigan Health System. 1500 E. Medical Center Drive, Ann Arbor, MI, 48109. Telephone: 734-936-4000. Web site: http://www.med.umich.edu/llibr/pa/pa_thrush_hhg.htm.

Thyroid Cancer

Thyroid cancer is a cancer that begins in the thyroid gland, one of the largest endocrine glands in the human body.

What is the Thyroid Gland?

The thyroid gland is a large, butterfly shaped gland that regulates the endocrine* (Ehn-doh-crin) system. It is located in the front of the throat, just below the Adam's apple. Normally, the thyroid cannot be seen or felt under the skin.

The thyroid gland has two kinds of cells: follicular cells and parafollicular cells, also called C cells. The follicular cells make thyroid hormones (T3 and T4), and the C cells make another hormone called calcitonin, which is involved with the regulation of calcium in the blood. The pituitary* gland, which is located in the brain, releases TSH, or thyroid stimulating hormone*. This hormone stimulates the follicular and C cells in the thyroid to create important hormones for the rest of the body. These hormones control factors that are regulated by metabolism, such as heart rate, blood pressure, body temperature, and energy consumption.

What Is Thyroid Cancer?

To understand thyroid cancer*, it is important to understand what cancer is. Cancer occurs when the cells in a certain part of the body undergo abnormal changes and start dividing without control or order,

forming tumors*. A tumor found on the thyroid is called a nodule. Nodules are usually felt under the skin by the patient or by a doctor during a routine exam. Sometimes, nodules can cause neck pain or a change in voice.

There are about 37,000 new cases of thyroid cancer every year in the United States. It is much more common in women than men. Up to 95 percent of thyroid nodules are noncancerous, or benign*, but a small percentage are cancerous, or malignant*. If detected early, thyroid cancer treatment is usually very successful. Thyroid cancer is one of the least deadly cancers.

What Are The Three Types of Thyroid Cancer?

There are three types of thyroid cancer:

- Papillary and follicular (fole-ik-U-lar) thyroid cancers make up the vast majority of thyroid cancer (80–90%). These types of cancers both begin in the follicular cells of the thyroid. These cancers tend to grow slowly and are therefore very treatable.
- Medullary thyroid cancers make up about 5 to 10 percent of all thyroid cancers. This type of cancer begins in C cells. If medullary thyroid cancer is found early, it is usually very treatable.
- Anaplastic thyroid cancer is the rarest form of the disease, and it makes up only about 1 to 2 percent of all cases. This cancer tends to metastasize (meh-tas-tah-size), or spread to other parts of the body, very quickly, making it much more difficult to treat.

What Are the Symptoms of Thyroid Cancer?

Sometimes, people who have thyroid cancer may not even know that there is anything wrong. Over time nodules may grow bigger. The vast majority of cases are detected when a patient feels a nodule in the neck. Most of these nodules (95 percent) are benign. Once thyroid cancer progresses, it may cause a variety of symptoms. These may include a change in voice, a lump on the thyroid that can be felt in the neck, enlarged lymph nodes*, pain or discomfort in the neck or ears, frequent coughing, or difficulty eating, swallowing, or breathing.

What Causes Thyroid Cancer?

As of 2009, scientists had not pinpointed what exactly causes thyroid cancer. There are, however, several known risk factors. These include the following:

- Gender. Thyroid cancer is about three times more likely to occur in women than in men.
- Age. Most cases of thyroid cancer are found in people between the ages of 20 and 60.
- Race. White people are more likely to be diagnosed with thyroid cancer than African Americans.

Did You Know?

Over 95 percent of all thyroid nodules are benign. Most people who are diagnosed with thyroid cancer have an excellent prognosis. The 5-year survival rate for thyroid cancer is about 97 percent.

* **pituitary** (pih-TOO-ih-tare-e) is a small oval-shaped gland at the base of the skull that produces several hormones—substances that affect various body functions, including growth.

* **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

* **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **benign** (be-NINE) refers to a condition that is not cancerous or serious and will probably improve, go away, or not get worse.

* **malignant** (ma-LIG-nant) refers to a condition that is severe and progressively worsening.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **genes** (JEENS) are chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.

* **endocrinologist** (en-do-krin-OL-o-jist) is a doctor who specializes in treating patients with hormone-related disorders.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **aspiration** (as-puh-RAY-shun) is the sucking of fluid or other material out of the body, such as the removal of a sample of joint fluid through a needle inserted into the joint.

- **Diet.** Thyroid cancer is most common in areas where people tend to eat foods that are very low in iodine, which is often not a problem in people who follow standard American diets.
- **Heredity.** Some people may be predisposed to thyroid cancer by inheriting a gene* called RET. But not all people who have the RET gene develop thyroid cancer.
- **Radiation.** People who are exposed to high doses of radiation may be at a higher risk of developing thyroid cancer.

How Is Thyroid Cancer Diagnosed?

Most thyroid cancers are detected when a patient or doctor feels nodules on the front of the neck. The doctor may request further testing to determine exactly what the nodule is. After nodules are found, patients are usually referred to a specialist called an endocrinologist*, who will do the following:

- Order tests such as x-rays, ultrasound*, and other imaging tests, which produce images of the thyroid gland and are used to determine the size and amount of nodules present on the thyroid.
- Order lab tests that can determine the amount of thyroid stimulating hormone (TSH), calcitonin, and calcium that is present in the blood.
- Perform a biopsy* to determine if the thyroid nodules are benign or malignant. A biopsy usually entails taking sample tissue and cells from the nodules with a needle, a process called needle aspiration*. Another doctor, called a pathologist, then looks at the tissue and cells under a microscope to determine whether they are cancerous.

What Are The Stages of Thyroid Cancer?

Using some of the same tests that are used during diagnosis, doctors are able to assign a stage to thyroid cancer. Staging is used to give patients a treatment plan and prognosis. There is a standard staging system that is used for all types of cancer called TNM. *T* refers to the size of the tumor and whether it has spread to nearby areas. *N* describes how much the tumor has spread to areas such as the lymph nodes. *M* indicates whether the cancer has spread to other major body organs, such as the lungs or brain.

The American Cancer Society uses the following chart on its web site to explain the complex staging system for thyroid cancer.

T categories for thyroid cancer:

- TX: Primary tumor cannot be assessed.
- T0: No evidence of primary tumor.
- T1: The tumor is 2cm (slightly less than an inch) across or smaller.
- T2: Tumor is between 2cm and 4cm (slightly less than 2 inches) across.

- T3: Tumor is larger than 4cm or has begun to grow into nearby tissues outside the thyroid.
- T4a: Tumor of any size and has grown extensively beyond the thyroid gland into nearby tissues of the neck.
- T4b: Tumor has grown either back toward the spine or into nearby large blood vessels.

For anaplastic thyroid cancers:

- T4a: Tumor is still within the thyroid and may be resectable (removable by surgery).
- T4b: Tumor has grown outside the thyroid and is not respectable.

N categories for thyroid cancer:

- NX: Regional (nearby) lymph nodes cannot be assessed.
- N0: No spread to nearby lymph nodes is noted.
- N1: Spread to nearby lymph nodes is noted.
- N1a: Spread to lymph nodes around the thyroid in the neck (cervical) is noted.
- N1b: Spread to lymph nodes in the sides of the neck (lateral cervical) or the upper chest (upper mediastinal) is noted.

M categories for thyroid cancer:

- MX: Presence of distant metastasis (spread) cannot be assessed.
- M0: No distant metastasis is noted.
- M1: Distant metastasis is present, involving distant lymph nodes, internal organs, bones.

By considering several specific aspects of TNM, a patient's age, and the type of thyroid cancer the individual has, doctors can assign a stage from I (1) through IV (4). As with most types of cancer, those that are detected in early stages before they have spread have a better prognosis.

How Is Thyroid Cancer Treated?

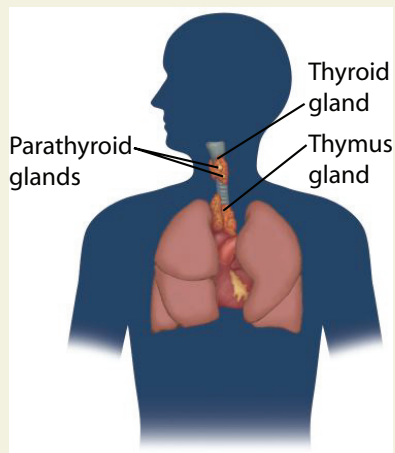
Once a diagnosis of thyroid cancer has been made, patients undergo a series of procedures. In order to get rid of the cancer, doctors must get rid of all of the cells that have been affected by the cancer. Doing so almost always includes the removal of the thyroid gland, which is called a thyroidectomy. Sometimes, doctors also remove nearby lymph nodes.

A few weeks after the thyroid has been removed surgically, patients may also be given treatment with radioactive iodine to destroy any remaining tissue of the thyroid that may have cancerous cells.

If thyroid cancer is diagnosed as advanced, patients may need to undergo chemotherapy* or radiation therapy.

Because the thyroid produces important hormones that the body needs to function properly, patients who undergo a thyroidectomy are placed on hormone replacement therapy for the rest of their lives.

* **chemotherapy** (KEE-mo-THER- α -pee) is the treatment of cancer with powerful drugs that kill cancer cells.



▲ Anatomy of the thyroid glands, parathyroids, and thymus. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **hormone** is a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

What Is the Prognosis for Thyroid Cancer?

Patients who are diagnosed with thyroid cancer are usually given an excellent prognosis. If treated quickly and appropriately, most cases of thyroid cancer have more than a 97-percent treatment success rate.

▶ See also **Cancer: Overview**

Resources

Books and Articles

Quickfacts Thyroid Cancer: What You Need to Know Now. Atlanta, GA: American Cancer Society, 2009.

Rosenthal, M. Sara. *The Thyroid Cancer Book* 2nd ed. Canada: Your Health Press, 2006.

Van Nostrand, Douglas, Gary Bloom, and Leonard Wartofsky, eds. *Thyroid Cancer: A Guide for Patients.* Pasadena, MD: Keystone Press, 2004.

Organizations

American Thyroid Association. 6066 Leesburg Pike, Suite 550, Falls Church, VA, 22041. Telephone: 703-998-8890. Web site: www.thyroid.org.

ThyCa: Thyroid Cancer Survivors' Association. P.O. Box 1545, New York, NY, 10159. Toll free: 877-588-7904. Web site: www.thyca.org.

Thyroid Disease

Thyroid disease is an impairment in the normal functioning of the thyroid, an important gland located below the chin at the base of the neck. A major function of the thyroid is to regulate metabolism, the biochemical processes in the body. Thyroid disease may speed up or slow down metabolism, producing a wide range of physical and mental symptoms.

What Is the Thyroid?

The thyroid is an H-shaped gland that has two main parts, or lobes, that lie on either side of the trachea (TRAY-key-a), or windpipe. The lobes are connected by a narrow segment called the isthmus. The principal hormone* produced by the thyroid is thyroxine. Production of this hormone is

in turn controlled by another hormone, called thyroid-stimulating hormone (TSH), secreted by the pituitary gland located at the base of the brain. Thyroxine is released into the bloodstream and controls the rate of metabolism*. In children, thyroid hormones are essential for normal growth and development.

What Is Thyroid Disease?

Disorders of the thyroid can cause overproduction of thyroid hormones (hyperthyroidism) or underproduction of thyroid hormones (hypothyroidism). Sometimes the thyroid becomes enlarged, a condition known as goiter.

Hyperthyroidism: a revving engine The most common type of hyperthyroidism, or thyrotoxicosis (thy-ro-tox-i-KO-sis), is Graves' disease, an autoimmune disease*, a disturbance of the immune system*. Antibodies* stimulate the thyroid to produce excessive quantities of hormone, thereby raising the rate of metabolism. Graves' disease can occur in people of any age, but the highest incidence is in women between 20 and 40 years of age.

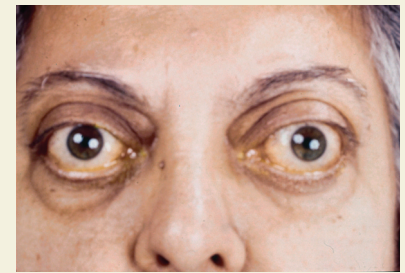
Symptoms of Graves' disease include an increased heart rate, nervousness and irritability, tremor, loss of weight, enlarged thyroid gland (goiter), abnormalities of the menstrual periods, sweating and heat intolerance, restless overactivity, and sleeplessness. Sometimes there is also exophthalmos (eks-off-THAL-mus), a condition in which the eyeballs protrude (bulge outward).

Less commonly, hyperthyroidism results from a form of thyroiditis (thy-roid-EYE-tus), an inflammation of the thyroid caused by a viral infection or by thyroid nodules (lumps or growths) that may produce excess hormones.

Hypothyroidism: a slowing down Whereas hyperthyroidism abnormally raises the metabolic rate, hypothyroidism slows it down too much. Many of the symptoms of hypothyroidism are thus the reverse of those seen in hyperthyroidism. The most common cause of hypothyroidism is Hashimoto's thyroiditis, which occurs most often in young and middle-aged women.

Hashimoto's thyroiditis, like Graves' disease, is an autoimmune disease. The immune system damages the thyroid rather than stimulating it, resulting in an underproduction of hormone. Symptoms of Hashimoto's thyroiditis include a slow heart rate, tiredness, muscular weakness, weight gain, abnormal menstrual periods, intolerance of cold, dry skin, hair loss, hoarseness, enlarged thyroid (goiter), and mental dullness. In more severe cases, there may be myxedema (mik-se-DEE-ma), a thickening and puffiness of the skin most noticeable in the face.

Less often, hypothyroidism is caused by surgical removal of part or all of the thyroid gland to treat other thyroid conditions, or by insufficient iodine in the diet, which is rare in developed countries.



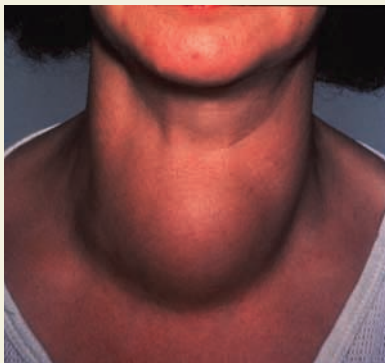
▲ Graves' disease causes exophthalmos or bulging of the eyes. *Chet Childs/Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **metabolism** (meh-TAB-o-liz-um) is the process in the body that converts foods into the energy necessary for body functions.

* **autoimmune disease** (aw-toh-ih-MYOON) is a disease in which the body's immune system attacks some of the body's own normal tissues and cells.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.



▲
Goiter of the neck. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **benign** (be-NINE) refers to a condition that is not cancerous or serious and will probably improve, go away, or not get worse.

* **puberty** (PU-ber-tee) is the period during which sexual maturity is attained.

IODIZED SALT

Goiter and other thyroid disorders sometimes result from too little iodine in the diet. In ancient Greece, iodine-rich seaweed was eaten to treat enlarged thyroid glands. In 1811, the French chemist Courtois identified iodine, which began being used internally in the treatment of thyroid disorders in 1821.

In 1922, the Swiss Goiter Commission introduced the first program of adding iodine to salt as a preventive measure against goiter in Switzerland. Also in 1922, Michigan physician David Murray Cowie (1872–1940) expressed interest in eliminating goiter by means of iodized salt. Cowie worked with the Michigan State Medical Society to have iodized salt placed on Michigan grocery shelves and, eventually, in stores across the United States. In areas with such programs, iodine deficiency is rarely seen.

When hypothyroidism occurs in infancy and is not treated, cretinism (KREET-in-izm) results. A child with cretinism has stunted growth and mental deficiency. Older children who have hypothyroidism show slowing of growth and delayed sexual maturation.

Goiter Goiter is not itself a disease. The term simply refers to enlargement of the thyroid, sometimes visible as a swelling in the front of the neck. Enlargement of the thyroid can be a sign of hyperthyroidism or hypothyroidism. It even can occur when thyroid function is normal.

A goiter can be seen in hyperthyroidism of Graves' disease, in which the thyroid enlarges due to stimulation of the gland by the malfunctioning immune system. In hypothyroidism, it enlarges as part of the body's attempt to produce enough hormone to compensate for damage done to it by the disease, or because of inflammation* caused by the disease, or both.

Goiter can also occur in parts of the world where there is inadequate iodine in the diet. Found in seafood and most table salt preparations, iodine is an element essential for the formation of thyroid hormones in the body.

Nodules Distinct swellings or lumps within the thyroid are called nodules. They are most common in women and their incidence increases with age. The large majority of thyroid nodules are benign*, but some may be cancerous. Thus they require prompt medical evaluation.

Sometimes the thyroid temporarily enlarges slightly during puberty* or pregnancy, without impairing its function or causing any other symptoms.

How Are Thyroid Diseases Diagnosed and Treated?

Diagnosis To diagnose a suspected thyroid disorder, the doctor takes a medical history and performs a physical examination. Blood samples usually are taken to measure the levels of thyroid hormones and TSH,

the pituitary hormone that stimulates the thyroid. The thyroid also may be checked using various scanning techniques. If a thyroid tumor is suspected, a sample of thyroid tissue may be removed for examination.

Treatment Most thyroid diseases are highly treatable. Hyperthyroidism may be treated with a single dose of radioactive iodine, which destroys overactive thyroid cells. Alternatively, antithyroid medications may be prescribed to suppress formation of thyroid hormones. Surgical removal of most of the thyroid is another treatment. Hypothyroidism is treated with hormone replacement medication, which typically is continued for life.

A goiter of uncertain cause may disappear on its own, or it may be small and not need treatment. Goiters caused by thyroid disease usually shrink with treatment. Occasionally, surgery is needed for removing a very large goiter. Thyroid disease is not contagious. It often runs in families, and there is no way a person can prevent it. People who live in parts of the world where seafood is scarce and table salt is not iodized, however, need to make sure they take in sufficient amounts of iodine to avoid hypothyroidism and goiter.

▶ See also **Dietary Deficiencies • Growth and Growth Disorders • Metabolic Disease**

Resources

Books and Articles

- Burch, Warner M. *100 Q&A about Thyroid Disorders*. Sudbury, MA: Jones and Bartlett, 2008.
- Vanderpump, Mark P. J., and W. Michael G. Tunbridge. *Thyroid Disease: The Facts*, 4th ed. New York: Oxford University Press, 2008.
- Wood, Lawrence C., David S. Cooper, and E. Chester Ridgway. *Your Thyroid: A Home Reference*, 4th ed. New York: Ballantine Books, 2006.

Organizations

- American Thyroid Association.** 6066 Leesburg Pike, Suite 550, Falls Church, VA, 22041. Telephone: 703-998-8890. Web site: <http://www.thyroid.org>.
- National Graves' Disease Foundation.** P.O. Box 1969, Brevard, NC, 28712. Telephone: 828-877-5251. Web site: <http://www.ngdf.org>.
- New York Thyroid Center, Herbert Irving Pavilion.** 161 Fort Washington Avenue, 8th Floor, New York, NY, 10032. Telephone: 212-305-0442. Web site: <http://cpmcnet.columbia.edu/dept/thyroid/index.html>.

George and Barbara Bush

When George H. W. Bush was president of the United States (1989–1993), he and his wife, Barbara, both were diagnosed with Graves' disease, a type of hyperthyroidism (overactive thyroid).

Because only one or two of every 100 women, and even fewer men, get Graves' disease, the likelihood of a husband and wife having the disorder at the same time is extremely rare. Because one person cannot catch Graves' disease from another, this was an amazing medical coincidence.

* **neurological** (nur-a-LAH-je-kal) refers to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.

* **motor** relates to body movement.

TIA (Transient Ischemic Attack) *See Stroke.*

Tic Disorders

Tic disorders are neurological conditions characterized by sudden, rapid movements (for example, neck jerking) or sounds (words or other types of sounds, such as grunting or sniffing) that are repeated in a consistent way many times per day.*

What Are Tics?

Tics have been described as brain-activated “involuntary” movements or sounds, meaning that the person does not produce them intentionally. People with tics often can suppress them, sometimes for up to hours at a time, just as one might suppress a cough or a sneeze for a period of time. A parallel can be drawn between suppressing a tic and trying to suppress a cough in the middle of a concert. To avoid interrupting the musicians, people might try very hard not to cough until the intermission. When they finally cough, however, they might cough several times instead of just once or twice. The experience of trying to suppress a tic is similar. After a tic is suppressed, it may erupt with even greater force or frequency.

Tics tend to get worse when people feel anxious or tired and get better when they are calm and focused on an activity. One interesting aspect of the condition is that tics usually lessen around strangers and are expressed more freely among family members and other trusted people. This does not mean that a person is producing the tics purposely around family members. It probably reflects the fact that individuals work harder to suppress them in less comfortable situations, whereas they are naturally relax their suppression when they are in more familiar surroundings. It is not uncommon for a child to be taken to a doctor to diagnose the problem, only to have the child be unable to produce tics “on command.” Just as tics are experienced as uncontrollable, they cannot be voluntarily brought on. While tics may appear in individuals as early as two years of age, the average age at onset is about seven.

What Are the Symptoms of Tics?

Simple tics Simple tics involve a single movement, such as eye blinking or repeatedly sticking out the tongue. Tics also may be vocal, made up of a single sound, such as throat clearing or snorting, stuttering, or sniffing. The most common type of tics, and often the first to appear, are simple facial tics. Over time, more complex motor* tics may appear.

Complex tics Complex motor tics involve several coordinated muscle movements, such as touching or smelling an object, jumping or twirling, or making deep knee bends while walking. These tics may include neck stretching, foot stamping, body twisting and bending, or mimicking the gestures of other people. Complex vocal tics can range from combining “simple” throat clearing or grunting with other vocal behaviors, to repeating a long but meaningless string of words at regular intervals.

With complex tics, the repeated phrase or gesture at first may seem meaningful, even when it is not. For example, the person with a complex motor tic may feel a need to do and then redo or undo the same action several times (for example, stretching out one arm ten times before writing or retracing the same letter or repeating the same word) before proceeding to another activity. Such forms of behavior can interfere with a person’s ability to accomplish school- or work-related tasks.

Researchers have identified more than 80 tics, which are a mix of simple and complex motor and vocal tics. Recognizable tic patterns include:

- Echopraxia (EK-o-PRAX-ee-a): imitating other people’s movements or gestures
- Copropraxia (KO-pro-PRAX-ee-a): making obscene, rude, or socially unacceptable gestures
- Palilalia (PA-li-LAY-lee-a): repeating a person’s own words
- Echolalia (EK-o-LAY-lee-a): repeating someone else’s words
- Coprolalia (KO-pro-LAY-lee-a): shouting obscenities or impolite and offensive language
- Repetition: repeating words or phrases out of context (for example, “Look before you leap”).

What Are Tic Disorders?

Doctors usually classify tic disorders into four categories: Tourette’s syndrome, chronic motor or vocal tic disorder, transient (TRAN-shent) tic disorder, and tic disorder (not otherwise specified).

Tourette’s syndrome Tourette’s syndrome is the best known of the tic disorders, and it is characterized by a frequent and long-lasting pattern of both vocal and motor tics.

Chronic motor or vocal tic disorder In contrast to Tourette’s syndrome, chronic* motor or vocal tic disorder involves only one of these two basic types of tics (either motor or vocal). In other respects, chronic tic disorder has many of the same symptoms as Tourette’s syndrome:

- The tics occur many times per day, nearly every day, and the condition lasts for more than a year.
- The tics may disappear for a time, but that period never exceeds more than three months in a row.
- The tics first appear in individuals before the age of 18.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **genetically** (je-NE-ti-klee) means stemming from genes, the material in the body that helps determine a person's characteristics, such as hair or eye color.

- The tics are not the result of a medication or another medical condition.
- The tics cause significant impairment at school or work.

Transient tic disorder In contrast to chronic motor or vocal tic disorder, transient tic disorder refers to a briefer problem with tics. Transient tics may be motor or vocal or both. For a condition to be considered transient tic disorder, the tics must begin before a person reaches the age of 18; occur several times per day; occur nearly every day for at least four weeks; but for no longer than 12 months in a row. As with the other tic disorders, transient tics are not the result of another medical condition or a medication.

Tic disorder (not otherwise specified) This category for tic disorders is used when the disorders do not fit into any of the other three groups, usually because the tics last less than four weeks or because they begin when a person is older than 18.

How Are Tic Disorders Diagnosed?

While there are clear differences between tic disorders, a doctor may find it difficult to make a diagnosis because tics often change in type or frequency over time. Transient tics, for example, are short-lived tics that last for less than a year. But a child may experience a series of transient tics over several years. Neck jerking may last for several months and then be replaced by finger snapping or stamping in place. Chronic tics, by contrast, last longer than a year and tend to remain stable and constant over time.

Transient tics that change over time are believed to affect as many as one-fourth of all school-aged children. While they last, these tics may be quite odd. They might range from sticking out the tongue again and again to repeating a word or phrase a set number of times to poking or pinching various parts of the body. These strange kinds of behavior are more common than was once believed, but often they disappear as a child matures.

Distinguishing transient tics from chronic tics often requires careful evaluation by a physician over a period of years. In addition, it is important for a doctor to gather information about other members of the family (including parents, grandparents, and siblings) who also may have tics or related conditions. It is now known that the tendency for tics to develop is passed on genetically* (inherited) from generation to generation. Because a person may inherit the genetic tendency to tics without ever experiencing tics, it is possible for the disorder to skip several generations in one family. Researchers have attempted to identify the specific gene (or genes) for tic disorders and to understand other factors that may influence whether a person at risk actually will experience tics.

Related Conditions

For most people who have tics, the real threat may not be the tics themselves but the sense of shame and social isolation that can result from this odd behavior. A child may have great difficulty dealing with these

embarrassing, unwanted behaviors. It also may be hard for teachers, fellow students, and family members to understand that a person with tic disorder is not making these strange gestures and sounds intentionally, to gain attention or to avoid working. Other people can easily get that impression if the pattern of tics changes from day to day, as it often does. It can make matters even more difficult when tic disorders in children are associated with attention disorders, hyperactivity, impulsive behavior, obsessive-compulsive disorder*, irritability, or aggressiveness.

It is estimated that as many as half of the children with Tourette's syndrome also have the attention and impulse-control problems that are seen in attention deficit hyperactivity disorder. Children with Tourette's syndrome also have higher than average rates of learning disabilities that cause reading or language problems.

How Are Tics Treated?

There are several therapies to help children with tics cope with the frightening feelings of being out of control and with the specific types of behavior related to their condition. These include relaxation and stress-reduction techniques and biofeedback. Often medication is an important part of the treatment plan. Because of associated stress, anxiety, and self-esteem and relationship issues, working with a mental health professional when concerns begin to interfere with the quality of life is particularly important. A combination of treatment approaches is often required when tics and associated mental health problems are serious.

▶ See also **Attention Deficit Hyperactivity Disorder (ADHD) • Learning Disabilities • Obsessive-Compulsive Disorder • Tourette Syndrome**

Resources

Books and Articles

Chowdhury, Uttom. *Tics and Tourette Syndrome: A Handbook for Parents and Professionals*. New York: Jessica Kingsley, 2004.

Moe, Barbara. *Coping with Tourette Syndrome and Tic Disorders*, rev. ed. New York: Rosen, 2004.

Organizations

American Academy of Child and Adolescent Psychiatry. 3615 Wisconsin Avenue, NW, Washington, DC, 20016-3007. Telephone: 202-966-7300. Web site: http://www.aacap.org/cs/root/facts_for_families/tic_disorders.

American Academy of Pediatrics. 141 Northwest Point Boulevard, Elk Grove Village, IL, 60007-1098. Telephone: 847-434-4000. Web site: http://www.aap.org/publiced/BK5_Tics.htm.

* **obsessive-compulsive disorder** is a condition that causes people to become trapped in a pattern of repeated, unwanted thoughts, called obsessions (ob-SESH-unz), and a pattern of repetitive behaviors, called compulsions (kom-PUL-shunz).

How to Remove a Tick

Using thin-tipped tweezers, grasp the tick as close to the person's skin as possible.

Pull straight upward firmly and steadily until the tick lets go (do not squeeze or twist the tick body).

Clean the skin with soap and warm water, alcohol, or other antiseptic.

Save the tick for identification.

Petroleum jelly, lit matches, nail polish or other products do not help in tick removal and should not be used.

* **host** is an organism that provides another organism (such as a parasite or virus) with a place to live and grow.

Tick-borne Illnesses

A tick-borne illness is an infection that is transmitted through the bite of a tick.

What Are Tick-borne Infections?

Ticks can spread bacteria or parasites through their bites. A tick becomes infected when it bites an infected animal, and then the tick can pass the infection to humans when it bites them. Tick-borne infections cannot pass from human to human; they need time in the host* animal to develop.

Ticks can spread a number of different diseases, including Rocky Mountain spotted fever, ehrlichiosis (air-lik-e-O-sis), Lyme (LIME) disease, and babesiosis (bah-bih-sye-OH-sis).

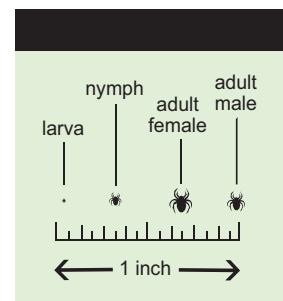
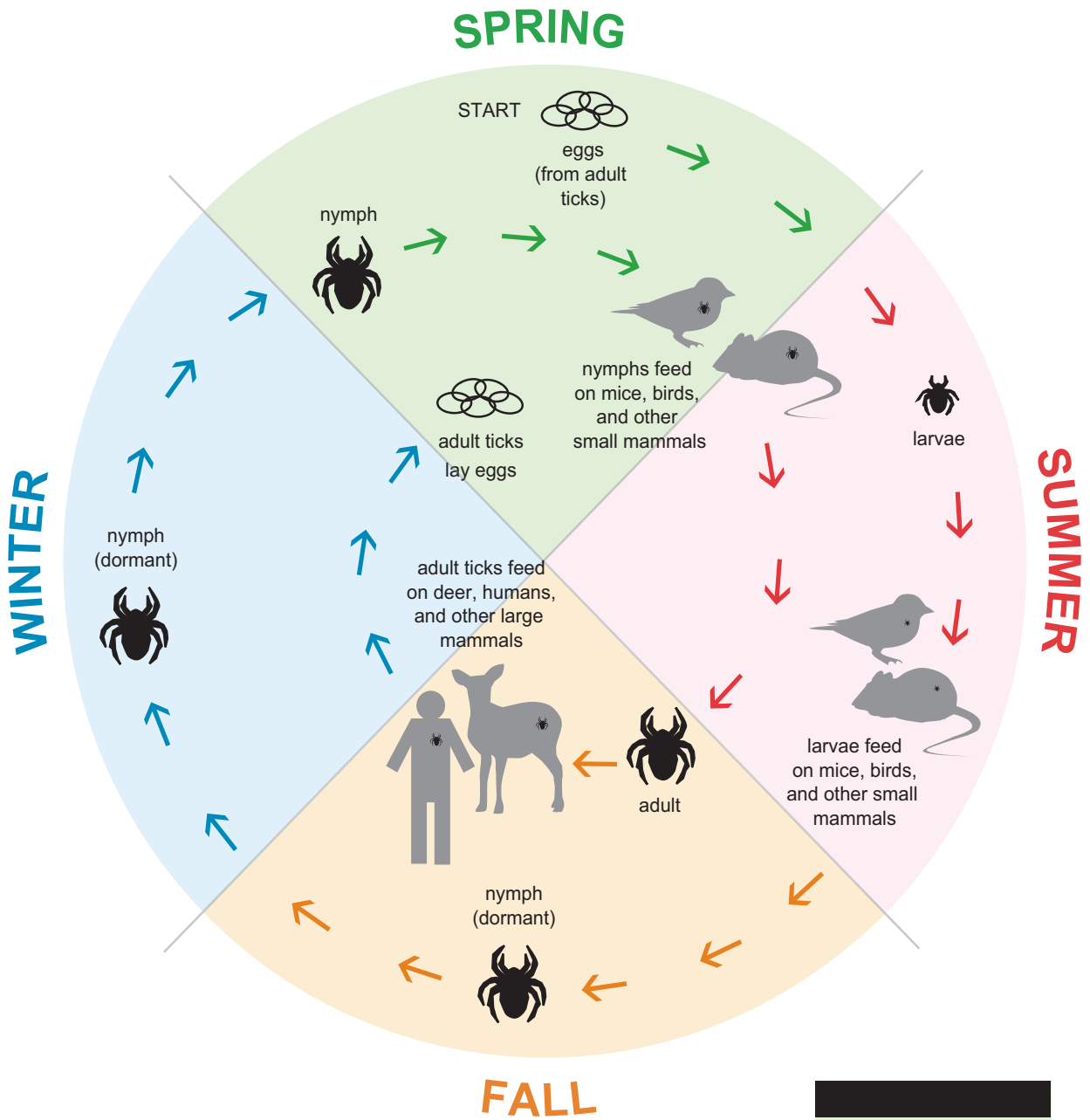
Rocky Mountain spotted fever Despite its name, most cases of Rocky Mountain spotted fever (RMSF) are not found in the Rocky Mountains but in the southeastern states. Cases also appear throughout the continental United States and in Canada, Mexico, and Central and South America. RMSF is one of the most dangerous tick-borne infections because it can be difficult to diagnose and has severe complications. Caused by the *Rickettsia rickettsii* (rih-KET-see-uh rih-KET-see-eye) bacterium, the disease spreads to humans through bites from the wood tick, dog tick, and Lone Star tick.

Symptoms of RMSF include high fever, headache, aching in the muscles, nausea (NAW-zee-uh), vomiting, and diarrhea (dye-uh-REE-uh). A rash may appear first at the wrists, ankles, palms, and soles and then on the forearms, neck, face, and trunk. RMSF is fatal in about 5 percent of cases, probably because of delays in diagnosing and treating the disease.

Ehrlichiosis Several types of bacteria in the genus *Ehrlichia* (air-LIH-kee-uh) cause ehrlichiosis. In the United States, the Lone Star tick, the blacklegged tick, and the western blacklegged tick spread the illness. People have long known that ehrlichiosis causes disease in animals, but the first case in humans in the United States was not identified until the 1980s. Ehrlichiosis is found in most parts of the country.

Symptoms of ehrlichiosis resemble those of the flu: fever, chills, extreme tiredness, headache, muscle and joint pain, nausea, and vomiting. There is usually no rash in adults, but many children develop a rash. Some people have no symptoms or only mild symptoms. Complications, although rare, can occur in the elderly and people with weakened immune systems.

Lyme disease Lyme disease gets its name from the town in Connecticut where doctors discovered the disease in 1975. It is the most common tick-borne illness in the United States. The majority of cases appear in the northeastern, north central, and northwestern states.



The life cycle of a tick takes 2 years to complete. In the spring, eggs hatch into larvae, which feed on mice, birds, and small mammals until the fall, when they become dormant. The following spring they molt into nymphs, which feed through the summer and then become adults in the fall. At any of these stages of growth, ticks may become infected with Lyme disease bacteria by feeding on infected animals; as adults they may feed on humans and transmit the bacteria that cause the disease. *Illustration by Molly A. Moore Blessington. Reproduced by permission of Gale, a part of Cengage Learning.*

- * **disseminated** describes a disease that has spread widely in the body.
- * **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.
- * **radiculitis** (ruh-dih-kyoo-LYE-tis) is numbness, tingling, or burning sensation along the course of a nerve due to irritation or inflammation of the nerve.
- * **Bell's palsy** (PAWL-zee) is a condition in which there is weakness or loss of function of muscles on one side of the face.
- * **malaria** (mah-LAIR-e-uh) is a disease spread to humans by the bite of an infected mosquito.
- * **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

The bacterium *Borrelia burgdorferi* (buh-REEL-e-uh burg-DOR-fee-ree), transmitted through deer ticks, causes Lyme disease. In most cases, the first sign of infection is the erythema migrans (air-uh-THEE-muh MY-granz) rash. It usually appears at the site of the tick bite, although it can develop anywhere on the body. The rash can be round, oval, or shaped like a bull's-eye with a red center surrounded by a clear area and then by a ring of red. Other early signs of the disease, such as extreme tiredness, headache, muscle aches, and fever, are similar to those of many infections, making diagnosis difficult. Not everyone who has Lyme disease develops the rash, and some people never show any symptoms.

The early disseminated* stage of the disease typically comes weeks to months later in people who have not received treatment. Symptoms at this stage include multiple rashes, meningitis*, radiculitis*, Bell's palsy*, and in some cases abnormalities of the heart rhythm. Lyme disease is not usually fatal, but if the illness remains untreated it can cause symptoms even years later. They can include arthritis, confusion, lack of coordination, difficulty in sleeping, and mood changes.

Babesiosis Babesiosis is a rare disease that appears mainly in the northeastern United States. It spreads through the bite of a deer tick that has been infected with a *Babesia* (buh-BE-she-uh) parasite, which attacks red blood cells. Because the deer tick also can spread Lyme disease, some people become infected with both diseases at the same time.

In healthy people, babesiosis infection may cause no symptoms. In others, early symptoms are extreme tiredness, lack of appetite, and a general feeling of being sick. Later symptoms include high fever, sweating, muscle aches, headache, and dark urine. The symptoms of babesiosis are similar to those of malaria*. Infected people also may have anemia* because of the parasite's attack on their red blood cells. The disease is not often fatal, but it can cause complications in the elderly, pregnant women, people with weakened immune systems, and people who have had their spleen removed.

How Common Are Tick-borne Infections?

Close to 20,000 cases of Lyme disease occur in the United States each year. RMSF is the second most common type of tick-borne illness, with the Centers for Disease Control and Prevention receiving as many as 1,200 reports of RMSF cases each year.

In contrast to these diseases, both ehrlichiosis and babesiosis are rare, with about 1,200 reports of ehrlichiosis over an 11-year period and several hundred cases of babesiosis since it was first reported in 1966.

How Are Tick-borne Infections Diagnosed and Treated?

Diagnosing a tick-borne illness can be difficult because the symptoms of many of the illnesses resemble those of the flu or other infections. One of the best clues is a recent tick bite, but many people do not remember being bitten.

Doctors often diagnose these diseases based on the patient's history of symptoms and activities, where the patient lives or became sick, and a physical examination that includes looking for rashes. A doctor may order a blood test to check for antibodies* to the organism causing the infection, but these tests usually are not helpful in the early stages of the illness. Skin biopsy* from a rash area may confirm a diagnosis.

Antibiotics are effective against the bacterial infections. Anti-parasitic medicines work well for babesiosis. In most cases, patients recover at home. Sometimes, however, especially in cases of RMSF, patients may need hospitalization for more intensive antibiotic therapy and supportive care.

What Should People Expect if They Have a Tick-borne Infection?

In almost all cases of tick-borne illnesses, quick treatment brings a complete cure, although it may take several months before all symptoms disappear. Untreated cases of Lyme disease can cause problems years after the tick bite.

Complications, while rare, can occur. Examples of complications are as follows:

- RMSF can cause paralysis*, hearing loss, and nerve damage.
- Ehrlichiosis can cause kidney* failure, respiratory problems, seizures*, and coma*.
- Long-term complications from Lyme disease include chronic* arthritis and nervous system problems.
- Babesiosis can cause respiratory problems, seizures, kidney failure, and other organ failure.

Can People Prevent Tick-borne Infections?

Avoiding areas where ticks are found is the best way to prevent the diseases they carry. If people venture into areas where ticks are likely to live, experts suggest that they wear long pants and long-sleeved shirts in light colors (to make it easier to find ticks) when going outside and that they tuck their pant legs into their socks. Applying insect repellents containing DEET* can also be helpful. Checking for ticks after being outside is wise. Studies show that ticks may not infect people until they have been attached for two days, so quickly removing ticks can help prevent illness. When ticks are found, they should be removed with tweezers and the area of the bite should be washed carefully with soap and water and alcohol, and people should watch for signs of infection, such as rash or fever.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **biopsy** (Bl-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **DEET** (abbreviation for N,N-Diethyl-meta-toluamide) is the active ingredient in many insect repellants.

▶ See also **Babesiosis • Ehrlichiosis • Lyme Disease • Rickettsial Infections • Rocky Mountain Spotted Fever**

Resources

Books and Articles

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Vanderhoof-Forschner, Karen. *Everything You Need to Know about Lyme Disease and Other Tick-Borne Disorders*, 2nd ed. Hoboken, NJ: Wiley, 2003.

Organizations

American Lyme Disease Foundation. P.O. Box 466, Lyme, CT, 06371, Web site: <http://www.aldf.com/majorTick.shtml>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/niosh/topics/tick-borne>.

Lyme Disease Foundation. P.O. Box 332, Tolland, CT, 06084-0332. Telephone: 860-870-0070. Web site: <http://www.lyme.org>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/tickborne>.

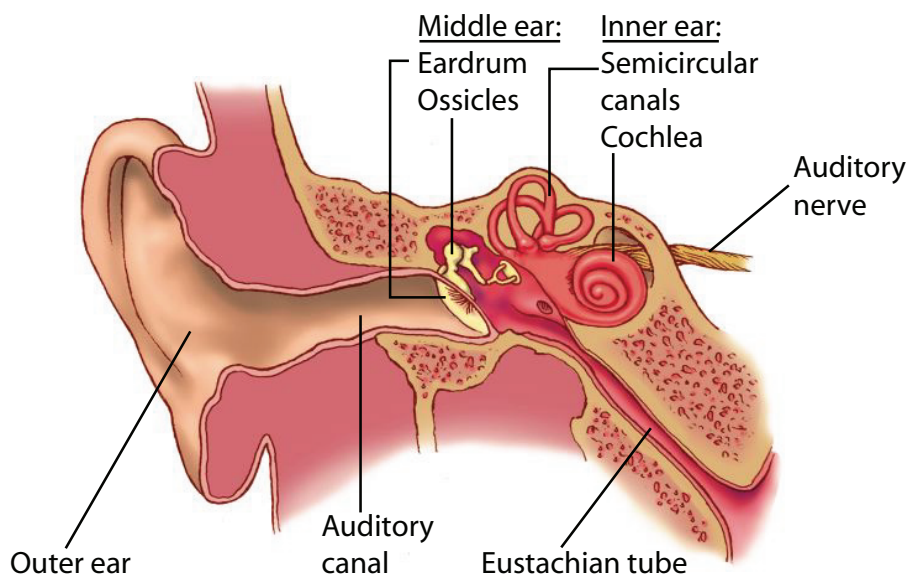
Tics See *Tic Disorders; Tourette Syndrome*.

Tinnitus

Tinnitus (ti-NY-tus) is the sense of ringing, whistling, or similar noise in the ear when no external sound is present.

What Is Tinnitus?

Tinnitus is a mysterious disorder that affects as many as 50 million Americans. People with tinnitus often describe the sound they hear as a ringing, but they sometimes say it resembles whistles, sizzles, clicks, roars, or other sounds too complex to explain easily. Some people experience the noise only at certain times or notice it only when it is quiet, such as at bedtime. Others, however, live with a constant unpleasant sound.



Anatomy of the ear. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

The noise can be high-pitched like a baby's whine or low like a rumbling train. It might sound like a continuous tone or cycle in a rhythm, often in time with the heartbeat.

What Causes Tinnitus?

Tinnitus is sometimes a symptom of other problems, such as too much earwax* or an ear or nasal infection. Other causes include cardiovascular disease, tumors, jaw misalignment, anemia, and neck and head injuries. Certain medicines, such as aspirin and some antibiotics, as well as carbon monoxide and alcohol, can also cause tinnitus. Long-term exposure to loud sounds such as a jet plane or loud music can also lead to tinnitus.

In some cases, a person may have problems with a part of the hearing pathway, such as the cochlea, which is a bony, coil-shaped part of the inner ear. Some evidence suggests another portion of the hearing pathway may be involved in many cases of tinnitus, the dorsal cochlear nucleus, which is basically a relay point between the nerves in the ear and the brain. Researchers have studied the dorsal cochlear nucleus in the hopes of one day developing a treatment for tinnitus.

What Can a Doctor Do?

First, a doctor looks for the cause. If a doctor can find the cause and determine that it can be corrected through a straightforward measure, such as removing earwax or treating an infection, the tinnitus usually goes away.

Sometimes a doctor cannot easily correct tinnitus, and people must find ways to live with it. Hearing aids are a common way to help, if the cause is related to hearing loss. Sometimes the person uses a device such as a hearing aid that covers the tinnitus with another sound that is less noticeable or less disturbing.

* **ear wax** also known as cerumen (se-ROO-men), is the wax-like substance in the ear that traps dust and other particles to prevent them from damaging the inner ear.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

▶ See also **Deafness and Hearing Loss • Otitis (Ear Infections) • Vertigo**

Resources

Books and Articles

Bauman, Neil G. *When Your Ears Ring! Cope with Your Tinnitus—Here's How*, 4th ed. Stewartstown, PA: GuidePost, 2005.

Tyler, Richard S., ed. *The Consumer Handbook on Tinnitus*. Sedona, AZ: Auricle Ink, 2008.

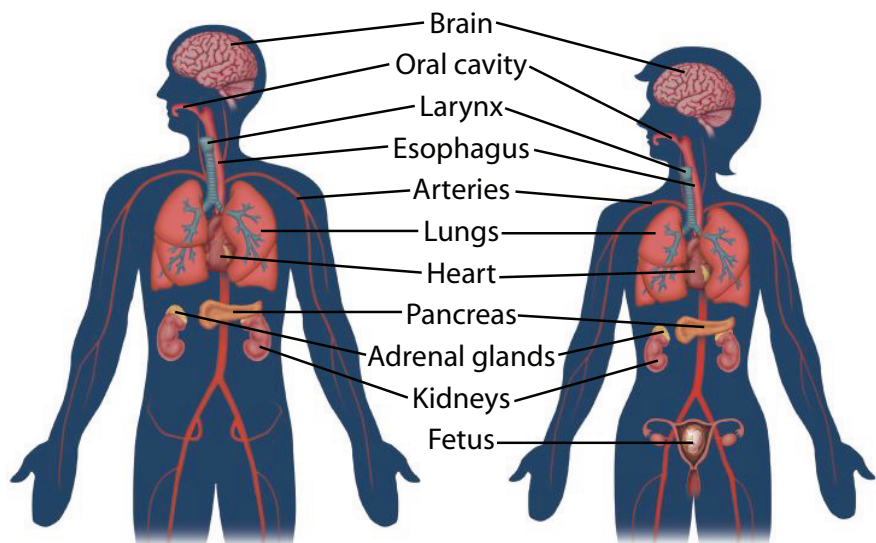
Organization

American Tinnitus Association. P.O. Box 5, Portland, OR, 97207-0005. Toll free: 800-634-8978. Web site: <http://www.ata.org>.

TJM See *Temporomandibular Joint (TMJ) Syndrome*.

Tobacco-Related Diseases

Tobacco-related diseases, including lung disease, heart disease, stroke, and cancer*, are illnesses caused by tobacco use, the leading preventable cause of death in the United States.*



▶
Parts of the body affected by tobacco in men and women. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

What Are Tobacco-Related Diseases?

Where there is smoke, there is disease. Hundreds of studies have found that cigarette smoking can cause lung disease, heart disease, stroke, cancer and many other diseases. Smoking as few as one to four cigarettes per day is enough to cause serious health problems. About 6 percent of all the money spent on health care each year in the United States is spent to treat tobacco-related diseases and health problems.

Tobacco use eventually leads to death or disability for half of all regular users. In fact, it is the leading cause of preventable death in the United States. Tobacco use is responsible for more than 430,000 deaths each year, or one in every five deaths. It kills more people than AIDS* (acquired immune deficiency syndrome), alcohol, drug abuse, car crashes, murders, suicides, and fires combined. The following are some of the disease and health conditions that are linked to tobacco use.

Chronic bronchitis Bronchitis (brong-KY-tis) refers to inflammation* of the bronchial (BRONG-kee-al) tubes, the airways that connect the windpipe to the lungs. This condition leads to a cough that brings up lots of thick, sticky mucus*. About 9 million Americans have chronic* bronchitis, and smoking is by far the most common cause.

Emphysema Emphysema (em-fe-ZEE-ma) is a chronic lung disease in which the air sacs of the lungs are overly large. This condition makes the lungs work less efficiently and leads to shortness of breath. About 3.6 million Americans have emphysema, and most of these cases are caused by smoking.

Heart disease A heart attack occurs when the blood supply to part of the heart muscle is decreased or stopped. This situation happens when one of the large blood vessels that bring blood to the heart is blocked, usually by a buildup of fatty deposits inside the vessel. More than 325,000 Americans die each year from a heart attack. Smokers are twice as likely as nonsmokers to have a heart attack, and two to four times as likely to die suddenly of heart problems.

Stroke A stroke occurs when a blood vessel to the brain is blocked or bursts, which can damage the brain. Strokes are the leading cause of serious, long-term disability in the United States. Strokes also kill more than 150,000 people per year. Smoking raises the risk of having a stroke.

Lung cancer Lung cancer kills more people than any other kind of cancer. Each year, more than 174,000 people are diagnosed with lung cancer in the United States, and about 162,000 people die from it. Smoking is the direct cause of almost 90 percent of all lung cancers.

Other cancers Cigarette smoke contains more than 4,000 different chemicals, and more than 60 of these have been shown to cause cancer in humans and animals. Smokers are more likely to get several kinds of cancer, including that of the mouth, larynx*, esophagus*, bladder*, cervix*, pancreas*, and kidney*.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **larynx** (LAIR-inks) is the voice box (which contains the vocal cords) and is located between the base of the tongue and the top of the windpipe.

* **esophagus** (eh-SAH-fuh-gus) is the soft tube that, with swallowing, carries food from the throat to the stomach.

* **bladder** (BLAD-er) is the sac that stores urine produced by the kidneys prior to discharge from the body.

* **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.

* **pancreas** (PAN-kree-us) is a large gland located behind the stomach that secretes various hormones and enzymes necessary for digestion and metabolism (me-TAB-o-liz-um), notably insulin.

* **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

Healthy lung of a nonsmoker (left);
damaged lung of a smoker (right).
*St. Bartholomew's Hospital/Photo
Researchers, Inc.*



* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

* **stillbirth** is the birth of a dead fetus.

* **premature birth** (pre-ma-CHUR) means born too early. In humans, it means being born after a pregnancy term lasting less than 37 weeks.

Pregnancy problems Smoking by pregnant women is linked to miscarriage*, stillbirth*, premature birth*, low birth weight*, and infant death. Women who smoke are also more likely to have trouble getting pregnant.

Dental problems Use of smokeless tobacco can lead to gum problems and tooth loss.

Smoking has also been linked to a variety of other health problems, including asthma*, high blood pressure, gum disease*, cataracts*, bone

thinning, pneumonia*, peripheral artery disease (disease of the blood vessels outside the heart, such as those of the legs, hips and kidneys), and peptic ulcers*.

What Are Other Risks of Tobacco Use?

Smoking causes shortness of breath and reduces the amount of oxygen that is available for the muscles and other body tissues to use. These changes can limit people's ability to engage in various activities. In young people, sports performance can suffer as a result. For example, many smokers cannot run as far or as fast as nonsmokers. Tobacco use also makes people less attractive. It stains teeth and causes bad breath, yellowed fingers, and smelly clothes. Research has found that two-thirds of teenagers say that seeing someone smoke turns them off, and more than four-fifths say they would rather date nonsmokers. Over the years, smoking causes skin to wrinkle more than normal aging does among nonsmokers.

Are All Forms of Tobacco Harmful?

No form of tobacco use is safe. In addition to smoking cigarettes, using smokeless tobacco (also called oral, spitting, or chewing tobacco, and snuff), can have deadly results. It can cause bleeding gums, tooth loss, and sores of the mouth that never heal. Eventually, smokeless tobacco can cause cancer of the mouth, larynx, and esophagus. Young people who use smokeless tobacco are also more likely to start using cigarettes.

Pipe and cigar smokers, like cigarette smokers, have higher death rates from heart disease than nonsmokers. They are more likely to get cancer of the mouth, larynx, and esophagus, too. The use of any tobacco product, even ones that are labeled "low tar," "naturally grown," or "additive free," as well as hand-rolled cigarettes and smoking using a hookah (water pipe), can cause addiction and health problems.

What about Secondhand Smoke?

In addition to harming the health of the smoker, smoking harms nonsmokers. Each year in the United States, about 3,400 nonsmokers die from lung cancer and more than 22,000 nonsmokers die from heart disease caused by exposure to secondhand smoke*. Secondhand smoke also causes infections of the lower airways and lungs in up to 300,000 children and makes asthma worse in as many as 1 million children with asthma each year.

Why Does Tobacco Harm the Body?

Cigarette smoke is a mixture of several thousand chemicals; some are present naturally in the tobacco, and some are added by cigarette manufacturers to enhance the flavor and make smoking more pleasant. Tar, ammonia, carbon monoxide, and nicotine (NIK-o-teen) are some of these chemical compounds. The carbon monoxide in smoke attaches to

* **low birth weight** means born weighing less than normal. In humans, it refers to a full-term (pregnancy lasting 37 weeks or longer) baby weighing less than 5.

* **asthma** (AZ-mah) is a condition in which the airways of the lungs repeatedly become narrowed and inflamed, causing breathing difficulty.

* **gum disease** is an infection caused by bacteria that affect the tissues surrounding and supporting the teeth.

* **cataracts** (KAH-tuh-rakts) are areas of cloudiness of the lens of the eye that can interfere with vision.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **ulcer** is an open sore on the skin or the lining of a hollow body organ, such as the stomach or intestine. It may or may not be painful.

* **secondhand smoke**, also called environmental tobacco smoke or passive smoke, is smoke that is inhaled passively or involuntarily by someone who is not smoking. It is a mixture of gases and particles from a burning cigarette, cigar, or pipe and the smoke exhaled by smokers.

Butting Out

The following tips can help smokers to quit the habit:

- Pick a quit date. Write it down. Make a commitment to yourself and stick to your quit date.
- Tell your friends and family members that you plan to quit. Ask them not to smoke around you or leave cigarettes around.
- Stop smoking completely on the quit date. Do not just cut back on smoking. People who try to smoke fewer cigarettes usually wind up smoking the same amount again soon.
- Think about past attempts to quit. Try to figure out what worked and what did not.
- Do something other than smoking to reduce stress. Exercise, take a hot bath, or listen to soothing music.
- Try to distract yourself from the urge to smoke. Call a friend, go for a walk, or take up a new hobby.
- Be ready for short-term symptoms. Quitting smoking can lead to a dry mouth, cough, scratchy throat, and feelings of edginess.
- Get professional help, if needed. A doctor, dentist, therapist, or school nurse may be a good source of advice and support.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **addiction** (a-DIK-shun) is a strong physical or psychological dependence on a physical substance.

compounds in the blood that normally carry oxygen. As a result, less oxygen is able to reach body tissues. Smoke contains at least 60 chemicals that harm the genetic material inside cells, triggering changes that lead to cancer. Other chemicals in smoke cause inflammation in body tissues, damage the lining of the airways, or harm the body's immune system*. Nicotine damages blood vessels, causing changes that can eventually lead to heart disease and stroke. Cigarettes and tobacco products contain compounds that damage the body in many other ways.

How Do Tobacco Users Become Addicted?

The nicotine in tobacco is the chemical that causes people who smoke to become addicted (hooked). Nicotine is absorbed easily from tobacco smoke in the lungs. Within seconds, nicotine travels through the bloodstream to the brain. There, it signals the brain to release chemicals that make people want to smoke more. The effect is very powerful. Smokers can become addicted to nicotine, which means they can become dependent on it physically and suffer unpleasant symptoms when it is taken away. The ability of nicotine to cause addiction* is as strong as that of heroin or cocaine. Users of smokeless tobacco can also become addicted because nicotine is absorbed through the inner lining of the mouth.

One hallmark of any addiction is tolerance (TAH-le-rans), which means that over time people start to need more and more of a substance to feel its effects. When people first start smoking, one cigarette may make them queasy and dizzy; some first-time smokers even vomit with their first inhalation. Soon these individuals can smoke several cigarettes without any symptoms, however, and most smokers are up to a pack or more each day by age 25.

Another sign of addiction is withdrawal symptoms, which means that people have physical symptoms and feel sick if they stop using the substance to which they are addicted. When people are forced to stop smoking even for a short time, they may have unpleasant symptoms. Many rush to light up as soon as they leave a place where smoking is not allowed.

Who Uses Tobacco?

About 45 million adults in the United States smoke cigarettes, including people of all ethnic groups. Among adults in 2005, the highest rates of smoking were among Native American and Native Alaskans (32%), non-Hispanic whites (22%), and African Americans (22%). Hispanics and Asian Americans are less likely to smoke. Although fewer women than men smoke, the gap has been steadily decreasing; in the early 2000s, nearly as many women as men smoke.

Tobacco use during the teenage years is of special concern because nicotine is highly addictive at this age. Four out of five adults who smoke began smoking by age 18. Young people who stay smoke-free through high school have a good chance of never lighting up. The 2004

National Youth Tobacco Survey reported that about 8 percent of middle school students and 22 percent of high school students smoked cigarettes. About 3 percent of middle school students and 6 percent of high school students used smokeless tobacco. Sizeable numbers of students also smoked cigars, kreteks (clove cigarettes), or bidis (small, flavored cigarettes from India). Although the rate of smoking among African-American students nearly doubled in the 1990s, it decreased in the early 2000s, and as of 2008 they were far less likely to smoke than white or Hispanic students.

Young people who start smoking are more likely to get low grades in school than nonsmokers. These students often have low self-esteem, and they may turn to smoking because they think it will make them more attractive or popular. Because such teenagers lack self-confidence, they may have trouble saying no to tobacco.

How Can Tobacco-Related Problems Be Prevented?

The best way to prevent tobacco-related diseases is never to start smoking. For people who already are smokers, there is good news, though. Those who quit, no matter how old they are, live longer than those who keep smoking. Quitting is hard. It usually takes people two or more tries to succeed. However, studies have shown that each time a person tries to quit, he or she learns more about what works and what does not. Eventually, all people can succeed if they really want to stop smoking. Half of all people who have ever smoked have quit.

Quitting the Habit Most smokers say they do not plan to be smoking in five years. But in fact, more than 70 percent of smokers continue to smoke. The main reason it is so tough for them to quit is the discomfort of withdrawal. When smokers suddenly stop or sharply cut back on their tobacco use, a host of distressing symptoms quickly set in. People are tempted to start smoking again to relieve the distress. Common symptoms of tobacco withdrawal include the following:

- Bad mood
- Depression
- Trouble sleeping
- Irritability
- Anger
- Anxiety
- Short attention span
- Increased appetite
- Weight gain

Three strategies have been shown to best help people quit smoking: using medications, getting support and encouragement, and learning to handle the urge to smoke.

Teen Smoking

- Each day, more than 4,000 teenagers try their first cigarette and 2,000 start smoking regularly.
- However, most young people, 88 percent to be exact, do not use tobacco.
- More than four in five teenagers say that they would rather date a nonsmoker.
- About two-thirds of teenagers say that seeing someone smoke turns them off.
- Some problems, such as coughing, shortness of breath, nausea, and dizziness, begin with a person's first cigarette.
- Problems such as coughing and wheezing have been found in young people who smoke as little as one cigarette a week.
- About two in five young people who smoke say they have tried to quit but failed.

* **antidepressant medications** are used for the treatment and prevention of depression.

Using medications Research shows that almost all smokers can benefit from temporarily wearing a small nicotine patch or chewing gum that contains nicotine. The nicotine passes through the skin and reduces the craving for this substance. Nicotine patches, gum, and lozenges are available without a prescription, but people should talk to their doctor before using them. A prescription nicotine inhaler and nasal spray are also approved for use in the United States. Bupropion and varenicline are other prescription drugs approved for use in smoking cessation. Antidepressant medications*, such as nortriptyline, have also been shown to help smokers quit. Using any of these products doubles a person's chances of success.

Getting support and encouragement Personal counseling or a quit-smoking program can help someone learn how to live life as a nonsmoker. Studies have shown that the more counseling people have, the greater their chances of success. A quit-smoking program that offers at least four to seven sessions over a period of at least two weeks and devotes a satisfactory amount of time and attention to the problem. Friends and family members can also give support. In addition, self-help books and telephone hotlines may be helpful.

Learning to handle the urge to smoke People benefit from becoming aware of the situations or problems that make them want to smoke. For example, many people like to smoke when they are around other smokers or are feeling sad or frustrated. It is a good idea to avoid these situations as much as possible when trying to quit. Engaging in physical enjoyable and healthy activities, such as going for a walk or bike ride, can reduce stress. People who want to quit need to keep their minds busy, too, to help control thoughts of smoking.

Avoiding Passive Smoke Choosing not to smoke goes a long way toward preventing tobacco-related diseases, but it is not enough. Studies have shown that smoke from the cigarettes of others contains carcinogens (car-SIN-o-jenz), cancer-causing chemicals that can affect people who are around smoke often. The secondhand smoke from cigarettes contains more tars and other chemicals than does the smoke exhaled by the smoker. Most cigarettes are filtered and remove at least some of the harmful chemicals. Protecting oneself and others requires taking the following steps:

- Avoiding places where people are smoking whenever possible
- Encouraging smokers to quit for their health and the health of others
- Preventing children from regularly being exposed to smoke
- Encouraging restaurants, stores, and other social settings to provide no-smoking areas or to change their policy so the building is smoke free.

▶ *See also* **Addiction • Asthma • Bronchiolitis and Infectious Bronchitis • Cancer: Overview • Environmental Diseases • Halitosis • Heart Disease • Hypertension • Kidney Cancer • Lung Cancer • Oral Cancer • Pancreatic Cancer • Pregnancy • Substance Abuse • Sudden Infant Death Syndrome • Uterine Cancer**

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Cowan, David, and Susanna Palomares. *Don't Get Hooked: Tobacco Awareness and Prevention Activities*. Austin, TX: PRO-ED, 2005.

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org>.

American Cancer Society. 250 Williams Street NW, Atlanta, GA, 30303. Toll free: 800-ACS-2345. Web site: <http://www.cancer.org>.

American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org>.

American Lung Association. 1301 Pennsylvania Ave. NW, Suite 800, Washington, DC, 20004. Toll free: 800-LUNG-USA. Web site: <http://www.lungusa.org>.

Campaign for Tobacco-Free Kids. 1400 Eye Street NW, Suite 1200, Washington, DC, 20005. Telephone: 202-296-5469. Web site: <http://www.tobaccofreekids.org>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/tobacco>.

Office of the Surgeon General. 5600 Fishers Lane, Room 18-66, Rockville, MD, 20857. Telephone: 301-443-4000. Web site: <http://www.surgeongeneral.gov/tobacco>.

QuitNet. Web site: <http://www.quitnet.org>.

Smoke-Free.gov. Web site: <http://www.smokefree.gov>.

Tonail, Ingrown *See Ingrown Toenail.*



▲ A case of tonsillitis caused by a streptococcal infection. The bacterium is spread by respiratory droplets and the illness primarily affects children between five and fifteen years of age. *Dr. P. Marazzi/Photo Researchers, Inc.*

* **lymphatic tissue** is tissue where white blood cells fight invading germs.

* **pharyngitis** (far-in-JI-tis) is inflammation of the pharynx, part of the throat.

* **respiratory** (RES-pi-ra-to-ree) refers to the breathing passages and lungs.

Tonsillitis

Tonsillitis is an infection of the tonsils, which are two lumps of tissue located at the back of the mouth on either side of and near the opening of the throat.

Tonsillectomy's Cool Cure

Until the last part of the 20th century, the removal of tonsils (tonsillectomy) was very common in childhood. Many adults in the early 2000s recall the unlimited ice cream they were given as children to soothe throat pain after surgery. In the early 2000s, however, it is uncommon to remove the tonsils unless they become infected repeatedly or are large enough to obstruct breathing.

What Is Tonsillitis?

The tonsils are collections of lymphatic tissue* involved in helping the body to prevent and fight infection. Sometimes, however, the tonsils themselves become infected with viruses or bacteria. The tonsils swell and sometimes become coated with whitish spots or pus. This condition commonly occurs with pharyngitis*, influenza, or other respiratory* infections.

The first symptom of tonsillitis is usually a sore throat. Fever and chills may follow, and the lymph nodes (glands) under the jaw and in the neck may become swollen and sore. Tiredness and loss of appetite are common. Swallowing may become difficult. Sometimes there is also a middle ear infection because the eustachian (yoo-STAY-ke-an) tube, which connects the throat and middle ear, becomes blocked by the swelling of the tonsils.

Who Gets Tonsillitis?

Tonsillitis can happen to anyone, but it is more common in children. A doctor will try to determine whether a virus or a bacterium is causing the tonsillitis. A cotton swab is touched to the tonsillar area and used to test for the presence of streptococci bacteria, which cause strep throat and can be killed with antibiotics. If, however, a virus is causing the tonsillitis, then antibiotics will not work. The body's own defenses must fight the virus.

A non-aspirin pain reliever can lessen soreness in the throat. Soft food, soups, milkshakes, and ice pops also help. Getting adequate rest is important, as is drinking enough liquid. Most people start to feel better within five days after the sore throat starts. It might take longer if the tonsillitis is the result of a viral infection.

Can Tonsillitis Be Prevented?

The best way to avoid a bout of tonsillitis is to avoid close contact with people who have respiratory infections. This is especially important for people who have had tonsillitis before. It is important not to share cups or utensils with people who have sore throats or who are coughing and

sneezing. It is always important to wash the hands frequently to help prevent the spread of this and other infections.

Will the Doctor Cut Out the Problem?

Recurrent bouts of tonsillitis may cause a doctor to recommend tonsillectomy (ton-si-LEK-to-mee), which means surgery to remove the tonsils. Often, the surgeon removes the adenoids* (also lymphatic tissue near the tonsils) at the same time. Surgery may be considered when a child has had many infections. This surgery was common for many years, although in the early 2000s it is done less frequently. In some cases, the tonsils are removed to help people with sleep apnea, which is a disorder that causes breathing to stop for brief periods during sleep.

▶ See also **Otitis (Ear Infections)** • **Sleep Apnea**

Resources

Books and Articles

Zelinger, Laurie. *The “O, My” in Tonsillectomy & Adenoidectomy: How to Prepare Your Child for Surgery, a Parent’s Manual*. Ann Arbor, MI: Loving Healing Press, 2009.

Organization

University of Virginia Health System. P.O. Box 800224, Charlottesville, VA, 22908. Telephone: 434-924-3627. Web site: https://www.med.virginia.edu/uvahealth/adult_ent/tonsillitis.cfm; http://www.healthsystem.virginia.edu/UVAHealth/adult_respire/pharyn.cfm.

Tooth Decay See *Cavities*.

Tourette Syndrome

Gilles de la Tourette (ZHEEL de la too-RETT) syndrome is a neurological disorder that causes a person to make sudden movements or sounds, which are called tics. Many scientists think Tourette syndrome is caused by a chemical imbalance in the brain.

Daniel’s Story

When Daniel yelped out loud like a dog, and his classmates erupted with laughter, Ms. Jones sent him to the school office. The teacher knew Daniel was being treated for hyperactivity, but recently he had been

* **adenoids** (AH-din-oyds) are the fleshy lumps of tissue behind the nose that contain collections of infection-fighting cells of the immune system.

blinking his eyes, twitching his nose, and shuffling his feet. Ms. Jones decided she could no longer tolerate his interruptions. She also was concerned about Daniel. Was he just showing off, or could he have a more serious condition? She had read about Tourette syndrome, which causes strange movements and sounds. Was that Daniel's problem?

What Is Tourette Syndrome?

Gilles de la Tourette syndrome is named after the French physician Georges G. A. B. Gilles de la Tourette (1857–1904), who first described the disorder in 1885. It is commonly referred to as Tourette syndrome (TS). The symptoms are tics: abrupt, rapid, and repeated movements or vocal sounds. Researchers have identified more than 80 tics associated with this syndrome, including grunts, barks, babbling, eye movements, head or neck motions, throat clearing, grimaces, shrugging, sniffing, leg and mouth motions, and motions of the torso.

Tics are categorized as either simple or complex. Simple motor tics include twitching of an eye or a jerking movement of the arm. Simple vocal tics include grunts, barks, or other noises. Complex tics involve several coordinated muscle movements, including twirling or doing deep knee bends when walking. Complex vocal tics include stuttering, babbling, uttering profanities, or echoing sounds. The more common tics in Tourette syndrome are:

- Echolalia (eh-koh-LAY-lee-uh): echoing other people's words
- Palilalia (pal-ee-LAY-lee-uh): repeating one's own last words, sounds, or sentences
- Coprolalia (ko-pro-LAY-ee-uh): literally "babbling about feces," but also includes use of explicit and obscene language or sounds
- Echopraxia (eh-koh-PRAK-see-uh): imitating other people's movements
- Copropraxia (ko-pro-PRAK-see-uh): making obscene and socially unacceptable gestures

People with more severe tics may mutilate themselves by biting their lips or banging their heads. Others may exhibit obsessive-compulsive behavior such as excessive hand washing. In addition to tics, a person with Tourette syndrome may show signs of hyperactivity, poor coordination, or attention deficit hyperactivity disorder (ADHD).

People with TS can sometimes control their tics for minutes, but like a suppressed sneeze, the tic returns inevitably. Tics get worse when a person is tired or anxious; they get better when a person is focused and concentrating on something. Severe tics can be more pronounced around family and close friends and less pronounced in the presence of strangers. Tics are less pronounced in the morning, worse at night, and, generally, not evident when a person is sleeping.

The disorder usually begins in childhood. Symptoms appear around age seven, and 90 percent of cases develop before age 10. Boys are four

LITERARY GIANT: SAMUEL JOHNSON

Samuel Johnson (1709–1784) is a towering figure in English literature. He wrote essays, poetry, and in 1755 the monumental *Dictionary of the English Language*. Johnson's friends recognized that he was a brilliant writer. They also thought he was quite eccentric.

Johnson was always in motion, rocking or swerving. He twitched and grunted and blew out his breath like a whale. His friends noticed he had obsessive-compulsive behaviors. For example, when he walked outside, he maneuvered so that he never walked on cracks in the paving stones, and he touched every post he passed. If he missed a post, he would go back to touch it. He also would scrape his fingernails and joints with a knife until they were raw.

When Samuel Johnson died in 1784, a physician examined his brain, looking for evidence of disease. He found none. Based on the observations and letters of his friends, most modern scholars believe Johnson had Tourette syndrome.

times more likely to develop TS than girls. About one person in 2,000 has Tourette syndrome.

At least 25 percent of all children display a simple tic. However, these tics go away within a year and are not a sign of TS. A person with Tourette syndrome may have tics for a lifetime, although the frequency and type of tic may change. About 35 percent of people with TS experience an easing of symptoms in adolescence; most others find that, even if they do not disappear, tics become less frequent and less severe in adulthood. The reverse can also be true: Some people with mild symptoms develop severe tics in their twenties or early thirties.

People with Tourette syndrome may suffer social embarrassment or emotional stress due to their tics. The disorder does not affect their intelligence or ability to lead a full life.

What Causes Tourette Syndrome?

In the Middle Ages, people who displayed movement and vocal tics were thought to be possessed by demons. Gilles de la Tourette, the French physician who studied the disorder in the 1800s, thought TS had a physiological basis, which means that its cause was physical, not mental. Modern scientists think Gilles de la Tourette was right.

Scientists believe TS is caused by an abnormality in the brain's neurotransmitters, which are chemicals that carry signals from one nerve cell to another. The affected neurotransmitter is dopamine, a chemical that controls movement. Research indicates that some forms of TS are inherited, which means they are passed down from parent to child.



▲ Jim Eisenreich, Major League Baseball player from 1982 to 1984 and 1987 to 1998, has Tourette Syndrome. Eisenreich was the Florida Marlins designated hitter when they won the World Series in 1997. *AP Images.*

HOME RUN HITTER: JIM EISENREICH

Jim Eisenreich (b. 1959) was different from other children. His body was constantly in motion, but not in the same way as other active children. His head twitched from side to side, and his shoulders jerked and shrugged. He often grunted, suddenly, for no apparent reason. His classmates laughed at his odd behavior. Doctors said Eisenreich was hyperactive and nervous and would outgrow the behavior. He did not.

Because he was embarrassed by his behavior, Eisenreich kept to himself and concentrated on baseball. He was a terrific baseball player, and in 1982, he won a spot on the Minnesota Twins.

Baseball in the big leagues was competitive and stressful. Much to his embarrassment, Eisenreich began to experience tics on the field in front of thousands of fans. His neck and shoulders twitched. His face twitched. One day, deeply embarrassed, Eisenreich walked off the field.

Eisenreich retired from baseball for four years. During those years, he sought medical help and discovered the reason for the tics: He had Tourette syndrome. Medication helped ease the tics and counseling helped Eisenreich accept himself.

Eisenreich returned to baseball and became a star hitter and outfielder for the Philadelphia Phillies. In the second game of the 1993 World Series, he smacked a three-run home run that helped Philadelphia beat the Toronto Blue Jays. Eisenreich had returned to baseball with a new outlook on life and on a condition known as TS.

How Do Doctors Treat Tourette Syndrome?

An accurate and prompt diagnosis is important to a person with Tourette syndrome, especially if the symptoms surface during childhood. People with TS often are misunderstood or ridiculed, and children may be punished for behavior that is out of their control.

Most people with Tourette syndrome do not need medication. Medication is reserved for people with severe or disruptive cases of TS. For those with severe tics, medication can reduce the frequency and severity of their symptoms so they can function at school, at work, and in social settings.

▶ See also **Tic Disorders**

Resources

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Marsh, Tracy. *Children with Tourette Syndrome: A Parents' Guide*, 2nd ed. Bethesda, MD: Woodbine House, 2007.

Woods, Douglas. *Managing Tourette Syndrome: A Behavioral Intervention for Children and Adults*. New York: Oxford University Press, 2008.

Organizations

American Academy of Child and Adolescent Psychiatry. 3615 Wisconsin Avenue NW, Washington, DC, 20016-3007. Telephone: 202-966-7300. Web site: http://www.aacap.org/cs/root/resources_for_families/glossary_of_symptoms_and_illnesses/tourettes_syndrome.

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org>.

American Academy of Neurology. 1080 Montreal Avenue, St. Paul, MN, 55116. Telephone: 651-695-1940. Web site: <http://www.aan.org>.

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905. Web site: <http://www.mayoclinic.com/health/tourette-syndrome/DS00541>.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD, 20824. Web site: <http://www.ninds.gov/patients/Disorder/tourette/tourette.htm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/tourettesyndrome.html>.

Tourette Syndrome Association. 42-40 Bell Boulevard, Suite 205, Bayside, NY, 11361. Toll free: 800-237-0717. Web site: <http://www.tsa-usa.org>.

Toxemia of Pregnancy *See Pregnancy.*

Toxic Inhalation Injuries

Toxic inhalation injuries occur when individuals are harmed by breathing toxic materials, which may include gas, dust, mist, fumes, smoke, or aerosols.



▲ Firefighters and other first responders like these at the site of the collapsed World Trade Center on September 11, 2001, are at risk for toxic inhalation disorders. *AP Images.*

What Are Toxic Inhalation Injuries?

A toxic inhalation injury is damage that results from breathing in toxic materials. Toxic inhalations can be acute. Acute inhalations happen when a person has symptoms soon after breathing in toxic materials, such as gas, dust, mist, fumes, smoke, or aerosols. Chronic inhalations are longer-term exposures to a toxin and may not result in symptoms until many months or even years later. Toxic inhalation injuries may be accidental or intentional. Accidental injuries occur when individuals have inhaled a toxin by mistake or have knowingly inhaled a toxin but did not intend to do any harm to themselves. Individuals who work on cars, for instance, may know that the spray from a certain can of cleaning product is dangerous, but they may ignore warnings on the can that recommend the use of a breathing mask. Intentional injuries occur when individuals inhale a toxin with the intent to harm themselves. For instance, individuals may purposely breathe toxic chemicals in an attempt to commit suicide.

Generally, toxic inhalations cause injury in several different ways:

- Irritant gases may dissolve in water present on the mucous membrane of the trachea (windpipe) or other parts of the respiratory tract and cause inflammation of respiratory tract due to their acidity or alkalinity
- Toxic materials can damage cells of multiple organ systems
- Toxins can cause asphyxiation, which is a dangerous drop in oxygen available to the body

What Are the Symptoms of Toxic Inhalation Injuries?

The symptoms of toxic inhalation injuries vary depending on the inhaled toxin and the duration of exposure. In general, these injuries have the following symptoms: coughing, shortness of breath, wheezing, a burning sensation, and increased phlegm or other respiratory secretions. Some examples of common inhaled toxins include the following:

- Carbon monoxide
- Chlorine gas
- Vinyl chloride
- Asbestos
- Cyanide
- Hydrocarbons

Carbon monoxide One of the most common and dangerous of toxic materials carbon monoxide is a chemical compound made of one carbon atom bonded to one oxygen atom. When individuals breathe in carbon monoxide with regular air, the carbon monoxide removes oxygen from the air so that the body takes in less oxygen with every breath. As a

result, even though they continue to breathe in and out, they are becoming asphyxiated because less oxygen is available.

Carbon monoxide poisoning can be acute or chronic. Symptoms of acute carbon monoxide poisoning include: flu-like symptoms, such as headache, dizziness, nausea, and/or vomiting; shortness of breath during activity; problems walking; memory loss, which may be mild or severe; confusion and sometimes hallucinations; chest pain; anxiety; depression; abdominal pain; fainting; a fast heartbeat; an increase in blood pressure; seizure; and unconsciousness. Occasionally, a patient may have noticeable reddening of the cheeks, but this so-called cherry-red appearance often does not occur. A particular danger with carbon monoxide poisoning is that people may at first have only the flu-like symptoms and, therefore, mistake their symptoms for the flu. Because carbon monoxide gas is colorless, odorless, and tasteless, they may be unaware they are breathing it in. If they then go to sleep in the place where the gas is located, their symptoms may get worse while they are asleep, and they may die. Occasionally, entire families die overnight because of exposure in their home to carbon monoxide poisoning. Such poisoning in homes is often the result of faulty appliances, such as furnaces, or the improper use of appliances, such as operating a space heater without proper ventilation. Fortunately, inexpensive home detectors are available to alert family members to the presence of carbon monoxide before it becomes a problem.

Carbon monoxide poisoning is quite common. The Centers for Disease Control and Prevention reports that more than 20,000 people visit the emergency room each year due to carbon monoxide poisoning. Of those 20,000, more than 4,000 are hospitalized and more than 400 Americans die from accidental CO poisoning. The CDC also notes that fetuses, infants, and people 65 years old and older, as well as people with chronic heart disease, anemia, or respiratory problems, are especially susceptible to the effects of carbon monoxide poisoning.

Individuals who may experience chronic carbon monoxide poisoning include firefighters, because carbon monoxide is present in smoke; certain automotive workers because carbon monoxide is present in car exhaust; warehouse or factory employees who work in buildings where propane-powered fork lifts or other equipment is used; and welders, who are exposed to shielding gas, which breaks down into carbon monoxide. Symptoms of chronic carbon monoxide poisoning include repeated and lasting headaches; lightheadedness; nausea and sometimes vomiting; depression; and confusion.

In addition, carbon monoxide is one of the compounds found in cigarette smoke. Both habitual cigarette smokers and those exposed to second-hand smoke can be affected by chronic carbon monoxide poisoning.

Chlorine Gas When a person mixes the commonly used cleaning products ammonia and chlorine bleach (or bleach-containing products), dangerous chlorine gas can result. Inhalation of this gas can cause choking and severe breathing problems. It can also be fatal.

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

Vinyl Chloride Vinyl chloride is a colorless, somewhat sweet-smelling gas that is used in building and construction products, such as electrical wiring and polyvinyl chloride (PVC) plastic; for the automotive and other industries; for various industrial and household equipment; and in medical supplies. Vinyl chloride is also known by such names as chlorethene, chlorethylene, and monovinyl chloride (or MVC). The Environmental Protection Agency lists vinyl chloride as a dangerous carcinogen (kar-SIN-o-jen), which means that has been linked to cancer. Symptoms of acute exposure to high levels of vinyl chloride in the air include dizziness, drowsiness, and headaches. Repeated exposure over a long period of time can result in liver damage and also increases the risk of liver angiosarcoma (an-gee-o-sar-CO-muh), which is a type of liver cancer. Regulations are in place in the United States to help protect workers who are employed in at-risk jobs from exposure to vinyl chloride.

Asbestos Asbestos, which was once used in many building products, is one of several types of minerals that contain microscopic fibers. When asbestos is disturbed, such as during building renovations, these tiny fibers become airborne and are easily inhaled. Once breathed into the lungs, they can become lodged in the respiratory tract and produce health problems many years after the initial exposure. These health problems include lung cancer; mesothelioma (me-zoe-thee-lee-O-muh), which is a type of cancer of the lung and the lining surrounding the lungs; and asbestosis (az-bess-TOE-sis), which is breathing disorder.

Cyanide Cyanide is present in smoke from the burning of plastics, rubber, and other common household products. It is also present in certain plastic-manufacturing, metal-processing, and other industries. Workers in these industry factories are most at risk for cyanide poisoning. Symptoms from acute exposure include one or more of the following: headache, weakness and/or fatigue, confusion, vertigo (an unsettling dizzy feeling), anxiety, shortness of breath, nausea sometimes with vomiting, bluish skin, convulsions*, unconsciousness, and sometimes death. Symptoms from chronic exposure are similar to those for acute exposure, but also may include thyroid problems and itchy, irritated skin.

Hydrocarbons Medical professionals have become alarmed by the practice—often among teenagers—of purposely breathing in toxins to become high. This practice is known as huffing, sniffing, or bagging, and involves a variety of dangerous substances, especially those containing hydrocarbons. These substances include petroleum products, numerous cleaning products, and many glues. Typical symptoms of acute poisoning include: drowsiness, lightheadedness, dizziness, hallucinations, and impaired judgment. Chronic hydrocarbon abusers can suffer depression, weight loss, a decrease in motor skills, weakness, and changes in mood, often including irritability. In both acute and chronic poisoning, however, some individuals experience permanent damage to the brain, heart, or other organs, and some of them die. In some cases, teens who inhale hydrocarbons die after trying it only once.

How Are Toxic Inhalation Injuries Treated?

Treatment of acute exposures depends on the specific toxin but always includes removing of the victim from the area of exposure, giving the victim oxygen, and decontaminating the area as needed. Victims often spend time in a hospital or other clinical setting where they are monitored 24 hours to keep watch for the development of a severe lung condition, called acute respiratory distress syndrome (ARDS), that can be fatal without immediate treatment.

Diagnosing chronic exposures to toxins is often much more difficult. In many cases, medical professionals are able to treat the symptoms but cannot determine the exact cause of the patient's health problems.

Major Disasters and Their Prevention

Accidental exposures sometimes happen in industrial settings, and such accidents may be devastating. An example is the release of the deadly gas methyl isocyanate from a chemical plant in Bhopal, India, in 1984. More than 500,000 people were exposed to the gas, and at least 3,000 of them died shortly thereafter.

In the United States, strict rules are in place to protect workers and the general public from exposure to airborne and other toxic chemicals. Two groups that create the rules and monitor workplace safety are the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health.

Weapons of Mass Destruction

Several toxic gases have been developed as weapons of mass destruction. In World War I, for instance, soldiers on all sides used different toxins, including a yellow substance known as mustard gas. Shortly after exposure to mustard gas, victims experienced intense blistering and itching of the skin, and those who inhaled a substantial amount of the gas had severe breathing problems. In addition, exposed individuals who survived exposure faced an increased the risk of cancer later in life.

Whereas most developed nations have signed the Geneva Protocol that bans the use of chemical weapons, many countries have developed and stockpiled chemical weapons and chemical responses to the possible use of those weapons.

▶ See also **Carbon Monoxide Poisoning • Liver and Biliary Tract Cancers • Lung Cancer • Mesothelioma**

Resources

Organizations

Agency for Toxic Substances and Disease Registry. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: <http://www.atsdr.cdc.gov>.

ATTENTION: TAMPONS ARE ASSOCIATED WITH TOXIC SHOCK SYNDROME (TSS). TSS IS A RARE BUT SERIOUS DISEASE THAT MAY CAUSE DEATH. READ AND SAVE THE ENCLOSED INFORMATION.
MISE EN GARDE : LES TAMPONS HYGIÉNIQUES SONT ASSOCIÉS AU SYNDROME DE CHOC TOXIQUE (SCT). LE SCT SE MANIFESTE RAREMENT, MAIS IL N'EN CONSTITUE PAS MOINS UNE MALADIE GRAVE QUI PEUT ÊTRE MORTELLE. VEUILLEZ LIRE ET CONSERVER LES RENSEIGNEMENTS CI-JOINTS.

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The outer packaging of a tampon box shows a warning about Toxic Shock Syndrome. *Leonard Lessin/Peter Arnold, Inc.*

* **tampon** is a plug of cotton or other material placed in the vagina during menstruation to absorb menstrual blood and other fluids.

* **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-227-2345. Web site: <http://www.cancer.org>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA 30333. Toll free: 800-232-4636. Web site: <http://www.cdc.gov>.

National Institute for Occupational Safety and Health. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site: <http://www.cdc.gov/NIOSH>.

Occupational Safety and Health Administration. 200 Constitution Avenue NW, Washington, DC, 20210. Web site: <http://www.osha.gov>.

Toxic Shock Syndrome (TSS)

Toxic shock syndrome (TSS) is a sometimes life-threatening form of bacterial poisoning usually associated with Staphylococcus or Streptococcus bacteria. Very few people get TSS. On average, it affects approximately three of every 100,000 men, women, and children in the United States, and most of them recover without any lingering problems.

What Is Going On?

Between October 1979 and May 1980, doctors all over the United States began reporting a new illness to the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia. Fifty-five women between the ages of 13 and 52 had shown up in doctors' offices and in hospitals with symptoms of serious infections. The cooperation of doctors, health officials, epidemiologists, and laboratory scientists in the months that followed revealed a surprising coincidence: All the women were menstruating and used tampons*. This discovery led to recommendations that reduced the risk for the illness.

What Is Toxic Shock?

Bacteria are microscopic, one-celled organisms found all over the Earth. Many bacteria play a beneficial role in producing antibiotics and nutrients such as vitamins for use by humans, plants, and animals. Bacteria are also essential ingredients in foods such as yogurt and sauerkraut. In addition, however, bacteria can cause disease. *Staphylococcus aureus* (staf-i-lo-KOK-us AW-ree-us) is a bacterium that normally lives harmlessly on the skin and in the nose, armpit, groin, or vagina*, but can cause disease under certain circumstances.

For reasons scientists continued to try to understand, certain forms of bacteria sometimes produce, or secrete, poisonous substances called toxins. People whose bodies are not equipped to fight these toxins may develop a severe reaction to them called toxic shock syndrome. In humans, the toxin does not poison the cells directly. Instead, it stimulates the immune cells (the body's defenders against disease) to secrete huge amounts of cytokines (SI-to-kines), which are proteins that act on other cells. The action of these cytokines produces the symptoms of TSS.

In 1987 experts recognized a second kind of TSS, which is caused by *Streptococcus* (strep-to-KOK-us) bacteria and called STSS. This illness behaves similarly to TSS, but it is much rarer and is related to injured skin and wounds. It is not associated with tampon use.

How Does a Person Get Toxic Shock?

Anyone can get TSS. TSS is not contagious like the cold or flu, but a person who has the bacteria on his or her hands can infect areas of broken skin or wounds anywhere on the body. Half of TSS cases occur in women who use tampons during menstruation* or who have had injuries to the vagina from other causes, and half are related to infections arising from burns, insect bites, chickenpox blisters, or wounds resulting from surgery.

Signs and Symptoms

Symptoms for TSS are vomiting, a high fever, diarrhea, and muscle aches. A sunburn-like rash develops over the body during the first two days of illness. Curiously, the place on the body where the bacteria are multiplying and producing toxin may appear perfectly normal. The early signs and symptoms of TSS go away within a few days. As the rash heals, the skin on the torso, face, hands, and feet begins to peel. Later symptoms may include low blood pressure and heart and kidney failure.

Most people with TSS recover in 7 to 10 days, but 3 percent of people who get TSS die from it, mainly because they do not get treatment for it. People are more likely to die from TSS that is unrelated to menstruation.

Diagnosis

The early symptoms of TSS may resemble those of severe allergic drug reactions or other illnesses. Lacking any other explanation, a doctor will suspect TSS in certain patients, such as women who use vaginal methods of birth control (for example, a diaphragm) or anyone who has recently had an operation. A blood test can confirm the diagnosis.

How Is TSS Treated?

Hospitalization is usually recommended for TSS. Doctors treat TSS with antibiotics and anti-inflammatory drugs, and they disinfect the place on the body where the toxin is being produced. During the worst part of the illness, treatment typically includes fluids to maintain normal blood

Introducing *Staphylococcus aureus*

The staphylococci were among the first human disease-causing organisms to be discovered. They grow in various shapes, including irregular bulky clusters from which they get their name (the Greek word *staphulé* means “grapelike”). Staphylococci are the most common causes of the infections that people get in hospitals. In fact, they are at the root of about 2 million hospital infections each year. Various kinds of staphylococci exist. Some are particularly dangerous to people whose systems are already weak from other diseases.

Staphylococcus aureus, a bacterium that causes toxic shock syndrome, is a major public health worry because it is very destructive, and the infections it causes can be hard to treat.

* **menstruation** (men-stroo-AY-shun) is the discharge of the blood-enriched lining of the uterus. Menstruation normally occurs in females who are physically mature enough to bear children. Most girls have their first period between the age of 9 and 16. Menstruation ceases during pregnancy and with the onset of menopause. Because it usually occurs at about four-week intervals, it is often called the monthly period.

Naming Bacteria

Bacteria, like all other organisms, have a two-word scientific name. The scientific name is a pair of Latin words that identify the species in the same way that a person's name identifies the person. The first word is the genus name and the second word is the species name. One genus can have many species in it. For example, some members of the genus *Staphylococcus* are named *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Staphylococcus saprophyticus* to distinguish them from one another. Like members of a family, they are all related, but each acts in a different way.

* **dialysis** (dye-AL-uh-sis) is a process that removes waste, toxins (poisons), and extra fluid from the blood. Usually dialysis is done when a person's kidneys are unable to perform these functions normally.

* **cutaneous** (kyoo-TAY-nee-us) related to or affecting the skin.

pressure. A patient may also need a breathing machine (ventilator), and if the kidneys fail, may require dialysis* to remove waste products from the blood.

Can Toxic Shock Syndrome Be Prevented?

On average, toxic shock syndrome affects approximately three of every 100,000 men, women, and children in the United States. No sure way exists to prevent TSS, but women can take precautions against it. Menstruating women should avoid using superabsorbant tampons; they should change tampons frequently and never leave a tampon inserted overnight. They also should wash their hands before and after inserting tampons. Girls and women who have had TSS should check with their doctor before using tampons again.

▶ See also **Bacterial Infections • Shock**

Resources

Books and Articles

Sheen, Barbara. *Toxic Shock Syndrome*. San Diego, CA: Lucent Books, 2006.

Sommers, Michael. *Yeast Infections, Trichomoniasis, and Toxic Shock Syndrome*. New York: Rosen Central, 2008.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/dbmd/diseaseinfo/toxicshock_t.htm.

TSS Information Service. P.O. Box 450, Godalming, Surrey, GU7 1GR, UK, Web site: <http://www.toxicshock.com>.

Toxocariasis

Toxocariasis (TOK-so-ka-RY-a-sis) is an infection that occurs in people, and most commonly affects young children who come in contact with contaminated dirt. It is caused by parasitic roundworms found in the intestines of cats and dogs.

What Is Toxocariasis?

Toxocariasis comes in two forms: visceral larva migrans (VIS-er-ul LAR-vuh MY-granz) and cutaneous* larva migrans. Visceral larva migrans is a syndrome that usually results from infection with certain worms. Many

cats and dogs, especially kittens and puppies, have intestinal worms called *Toxocara canis* (in dogs) or *Toxocara cati* (in cats). The culprit in visceral larva migrans is usually *Toxocara canis* and sometimes *Toxocara cati*. In rare instances, a pig roundworm called *Ascaris suum* or a raccoon roundworm called *Baylisascaris procyonis* may cause visceral larva migrans. This syndrome occurs when eggs from one of these worms pass with the stools from infected cats and dogs and then contaminate the soil. When children play in these contaminated areas, the eggs can stick to their hands or toys, and the children may then put their hands or the toys in their mouths and swallow the eggs. Those children who eat dirt are especially at risk. Adults may become infected, too, especially if they eat unwashed, contaminated vegetables.

When the eggs enter the digestive system, they hatch. The larvae* burrow through the intestinal wall and move to the liver, lung, and sometimes to other sites, including the central nervous system*, heart, kidney, and eye. (When it affects the eye, the syndrome is sometimes called ocular [OK-yoo-lur] larva migrans.) The larvae may stay alive for many months and cause damage to tissues or organs. Because the larvae are cat or dog parasites, they do not complete their life cycle in humans, so the larvae do not grow into egg-producing adults in humans.

Cutaneous larva migrans, which sometimes goes by the name of ground itch or creeping eruption, results from infection with various roundworm species, especially *Ancylostoma braziliense*, which occurs in dogs and cats in North America (usually from the central United States and South) and South America; *Ancylostoma caninum*, which affects dogs in Australia; and *Uncinaria stenocephala*, which affects dogs in Europe. In addition, people occasionally, although rarely, get cutaneous larva migrans from roundworms that occur in other animals, such as cows, horses, sheep, and goats. People can become infected when the larvae of these worms burrow into the skin. For instance, the larvae may infect the buttocks of a child who is sitting in contaminated dirt, or they may infect the bare feet of a beachgoer who is walking upon contaminated sand. A few days to a few months after they have burrowed into the skin, the larvae start to move beneath the skin, traveling an inch or more per day. Their movements are evident in red lines that appear on the skin. The larvae eventually reach and enter the bloodstream. From there, they typically travel to the lungs.

What Are the Symptoms of Toxocariasis?

Most people with visceral larva migrans have no symptoms. Those that do have symptoms may experience one or more of the following: fever, cough or wheezing, abdominal pain, enlarged liver or spleen, loss of appetite and weight loss, rash, and enlarged lymph nodes*. Some patients may experience seizures* or behavioral disorders, and in rare instances, an individual may die from heart, lung, or nerve problems associated with the syndrome. When an infection affects the eye, it can cause decreased vision, swelling around the eyes, and a cross-eyed appearance.

- * **larvae** (LAR-vee) are the immature forms of an insect or worm that hatches from an egg.
- * **central nervous system** (SEN-trul NER-vus SIS-tem) is the part of the nervous system that includes the brain and spinal cord.
- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

- * **pneumonia** (nu-MO-nyah) is inflammation of the lungs.
- * **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.
- * **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- * **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

Some patients with cutaneous larva migrans have no symptoms. Others, however, will notice a puffy, red area at the site where the larvae have burrowed into the skin. This symptom appears within hours of the penetration. When the larvae start to move beneath the skin, red lines appear. The lines become extremely itchy, and sometimes blisters appear. After the larvae have entered the bloodstream and reached the lungs, they can cause additional symptoms, including pneumonia*, coughing, and anemia*.

How Is Toxocariasis Diagnosed and Treated?

To diagnose visceral larva migrans, a doctor will typically order a blood test to determine whether the patient has a higher than normal number of certain white blood cells, called eosinophils (e-o-SIN-o-filz), which is a sign of this syndrome. In some cases, the doctor may also request that the blood be examined with a test called ELISA, which stands for enzyme-linked immunosorbent assay. ELISA is a very sensitive technique that can scan for signs of the body's own, very specific immune response (its defense system) to the larvae. In addition, the doctor will look for or ask the patient about other symptoms, including lung or eye problems. Visceral larva migrans often goes away on its own. When doctors feel treatment is necessary, they frequently prescribe the drug albendazole, which kills the larvae. If a patient is having severe, infection-related heart, nervous-system, or lung problems, the doctor may prescribe hormones* known as glucocorticoids that reduce inflammation* in these organs.

To diagnose cutaneous larva migrans, a doctor will look for the characteristic red lines, which the patient will typically report as extremely itchy. Doctors can also take a very close look at the red lines with a microscope using a technique called epiluminescence (eh-pih-loom-in-ES-sens) to verify that the lines were made by the larvae. Cutaneous larva migrans usually goes away on its own without treatment. Sometimes, however, doctors will prescribe albendazole or ivermectin to help eliminate the larvae.

How Can Toxocariasis Be Prevented?

As with other infections, good hygiene and frequent hand-washing are essential. Important safety measures include the following:

- Keeping children from playing in areas that may be contaminated by cat or dog feces, such as the damp area under a porch
- Teaching children not to put their hands and toys in their mouths after playing with cats and dogs
- Keeping pets away from sandboxes, which should be covered when not in use
- Prohibiting pets from public areas, such as beaches and parks, where people are likely to come into contact with sand or dirt
- Having a veterinarian periodically check pets for parasites, and if parasites are present, treat the pets

- Keeping an especially close watch on children who are known to eat dirt
- Teaching children to wash their hands thoroughly after playing outside, after playing with pets, and before eating
- Washing raw vegetables before eating them

▶ See also **Parasitic Diseases: Overview** • **Worms: Overview** • **Zoonoses**

Resources

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/parasites/toxocara/default.htm>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894. Web site: <http://www.nlm.nih.gov/medlineplus/ency/article/000633.htm>.

Toxoplasmosis

Toxoplasmosis (tok-so-plaz-MO-sis), often called toxo, is an infection caused by the Toxoplasma gondii parasite that animals can transmit to people. It usually causes no symptoms in healthy people, but it can be serious in people with weak immune systems and in unborn babies.

What Is Toxoplasmosis?

Toxoplasmosis is a disease caused by the microscopic parasite* *Toxoplasma gondii*. This parasite lives in the soil and can infect humans and many species of animals. It is particularly common in cats, and the parasite's eggs pass from their bodies in their feces (FEE-seez, or bowel movements). Touching dirty litter from a cat's litter box is one common way that people contract the parasite. The eggs can stick to a person's hands and may eventually end up in the mouth, where the person can inadvertently swallow them. People also become infected by accidentally eating contaminated soil or by eating raw or undercooked meat, especially pork, lamb, and venison, containing the parasite's cysts*. Thorough cooking kills the parasite.

In addition, pregnant women can pass the disease to their unborn babies, leading to congenital* toxoplasmosis, a condition that can range from mild to severe, and may involve developmental problems and mental retardation, seizures*, and vision problems.

In rare cases, blood transfusions*, organ transplants, and laboratory accidents also can cause toxoplasmosis.

* **parasite** (PAIR-uh-site) is an organism such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

* **cysts** (SISTS) are shell-like enclosures that contain small organisms in a resting stage.

* **congenital** (kon-JEH-nih-tul) means present at birth.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **blood transfusions** (trans-FYOO-zhunz) are procedures in which blood or certain parts of blood (such as specific cells) are given to a person who needs them due to illness or blood loss.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

* **stillbirth** is the birth of a dead fetus.

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

Toxoplasmosis is a life-long infection, although usually it is latent (inactive). Most people with toxoplasmosis have no symptoms or symptoms that are very mild. The disease can be life-threatening, however, for people with weakened immune systems* and for babies born with the disease. Toxoplasmosis also may cause miscarriage* or stillbirth*.

How Common Is Toxoplasmosis?

The Centers for Disease Control estimates that *T. gondii* infects more than 60 million Americans, but cases of actual disease are much less common. Most people who carry the parasite have no symptoms of illness.

What Are the Symptoms of Toxoplasmosis?

Most people with toxoplasmosis, including pregnant women, have no symptoms. When symptoms do appear, they usually appear within 10 days of exposure, and they vary with the person's age and the response of his or her immune system. Children with toxoplasmosis fall into three groups:

- Babies born with toxoplasmosis: Congenital infection occurs when babies get toxoplasmosis before birth from their mothers. Most of these babies (85 percent) appear normal at birth but later have learning disabilities, movement disorders, mental retardation, and loss of vision.
- Healthy children who become infected: These children may have no symptoms, or they may have swollen glands, fever, general tiredness, and weakness.
- Children with immune disorders such as AIDS* or cancer: These children may have severe infections, which attack the central nervous system, brain, lungs, and heart. Symptoms may include fever, seizures, headache, psychosis (severe mental disturbance), and problems in vision, speech, movement, or thinking.

For most people who get toxoplasmosis after birth, symptoms may include:

- fever
- night sweats
- weight loss
- general tiredness
- sore throat
- muscle pain
- swollen lymph nodes*
- calcium deposits in the brain

For people with weakened immune systems (especially those with AIDS), toxoplasmosis can cause major infections of the brain or, less commonly, the lungs or heart. Severe disease can be fatal.

How Is Toxoplasmosis Diagnosed?

If toxoplasmosis is suspected, the doctor draws a blood sample and tests it for evidence of the parasite. For people who have weakened immune systems and are therefore more likely to develop a severe infection, a doctor may order a magnetic resonance imaging* (MRI), a computerized tomography* (CT) scan of the head, or rarely, a brain biopsy (removing a small sample of brain tissue to examine) to look for signs of damage caused by the parasite.

The doctor may also suggest a visit to an ophthalmologist for an eye exam, which may include the use of a special lamp called a slit lamp to check for signs of the disease in the eyes. These signs may include reduced, hazy, or blurred vision; pain when looking into bright light; eye redness; tearing; inflammation in the back of the eye; swelling in part of the retina*; and lesions (injuries) in the retina and/or an adjacent membrane called the choroid. Ophthalmologists sometimes prescribe medicine to treat an active disease. Occasionally, an eye doctor may find signs of a prior infection with the *Toxoplasma gondii* parasite during a routine eye exam, even though the patient never experienced or noticed any symptoms. This is not a cause for alarm, but pregnant women and those with weakened immune systems should discuss the findings with their regular doctor to determine whether they should take any additional precautions to prevent repeat infection.

What is the Treatment for Toxoplasmosis?

People who have symptoms from toxoplasmosis but are otherwise healthy do not need any treatment, and their symptoms will likely only last a few days. Doctors treat with medication pregnant women, newborns with the congenital infection, and people with weak immune systems. Patients with AIDS often continue taking the medicine even after the infection clears up to keep it from returning. In newborns and patients with unhealthy immune systems, the illness can last for weeks or months, and it can cause permanent disability.

How Is Toxoplasmosis Prevented?

Toxoplasmosis can be prevented by careful attention to hygiene and sanitation. Preventive steps include:

- Thoroughly cooking meat, which means heating it to an internal temperature of 160 degrees Fahrenheit, and until it is no longer pink in the center or until the juices run clear.
- Washing hands, utensils, and food preparation surfaces after handling meats.
- Washing fruits and vegetables before eating them
- Keeping flies and cockroaches away from food
- Washing hands after petting cats and changing litter boxes
- Wearing gloves when working in the garden or cleaning sandboxes.
- Keeping outdoor sandboxes covered when not in use so that they will not be used as litter boxes by cats who roam outdoors

* **magnetic resonance imaging** or MRI, uses magnetic waves, instead of X-rays, to scan the body and produce detailed pictures of the body's structures.

* **computerized tomography** (kom-PYOO-ter-ized toe-MAH-gruh-fee) or CT, also called computerized axial tomography (CAT), is a technique in which a machine takes many X rays of the body to create a three-dimensional picture.

* **retina** (RET-i-na) is the tissue that forms the inner surface of the back of the eyeballs; it receives the light that enters the eye and transmits it through the optic nerves to the brain to produce visual images.

In addition, pregnant women and people whose immune systems are weak can take additional precautionary measures, including being tested for the parasite. This allows the doctor to discover the infection and begin treatment even if the individual does not have any symptoms. Even if people in these groups do not have an infection, they should be especially careful to avoid contact with soil, uncooked meat, and strange or stray cats. In addition, they should keep their own cats indoors and on a diet of canned or dried cat food because cats can pick up the parasite from eating raw meat.

▶ See also **AIDS and HIV Infection • Cancer: Overview • Parasitic Diseases: Overview • Pregnancy • Zoonoses**

Resources

Books and Articles

Subauste, Carlos S. *Toxoplasmosis and HIV*. HIV InSite Knowledge Base Chapter available at <http://hivinsite.ucsf.edu/InSite?page=kb-05-04-03>.

Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://familydoctor.org/online/famdocen/home/women/pregnancy/illness/180.html>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/toxoplasmosis>.

Medical College of Wisconsin. 8701 Watertown Plank Road, Milwaukee, WI, 53226, Web site: <http://healthlink.mcw.edu/article/955156433.html>.

Trachoma See *Chlamydial Infections*.

Transgender Health See *Gay, Lesbian, Bisexual, and Transgender Health*.

Transient Ischemic Attack (TIA) See *Stroke*.

Trauma

Trauma occurs when a person experiences a sudden or violent injury. Safety should be foremost in people's minds because preventing a trauma is easier than treating it.

Seat Belts Saved Marcus

Marcus was 16 years old and in a car with four other teenagers. The driver was going too fast, missed a curve, and smashed into a tree. The compact car flipped over, tossing out the teens who were not wearing seat belts. Marcus was not one of them. Paramedics found him conscious and still belted in the back seat with only a broken arm and leg. The four other passengers died. "Without them," Marcus said of seat belts, "I'd be dead."

What Is Trauma?

Physical trauma is an injury or wound caused by external force or violence: motor vehicle accidents, falls, burns, drowning, electric shock, stabbings, gunshots, and other physical assaults. Physical trauma may cause permanent disability. It is the leading cause of death for people below age 45 in the United States and is responsible for 73 percent of deaths in those persons aged between 15 and 24 years of age. In all, more than 100,000 Americans die every year as a result of trauma.

The majority of deaths occur in the first several hours after trauma. Trauma also may cause psychological shock that produces confusion, disoriented feelings and behaviors, and long-term aftereffects.

Trauma Emergencies

Traumatic injuries may include broken bones, severe sprains, head injuries, burns, and internal or external bleeding. They may occur at any time, and they are medical emergencies, meaning they require immediate treatment.

Doctors often try to evaluate the severity of a patient's injuries using numerical scales. These scales help the patient and/or the patient's family understand just how damaging the injuries are and assist in making difficult decisions about options for a patient who will likely not survive regardless of treatment. In addition, medical professionals use these scales to help them quickly evaluate the injuries of multiple patients during a disaster, such as a bus accident or factory explosion, so they can do the most good in a hectic situation. Some of the commonly used scales include the Abbreviated Injury Scale (AIS), the Injury Severity Score (ISS), the Acute Physiology and Chronic Health Evaluation (APACHE), and the Simplified Acute Physiology Score (SAPS).

Burns A burn is tissue damage that results from scalds, fires, flammable liquids, gases, chemicals, heat, electricity, sunlight, or radiation. In the

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **epilepsy** (EP-i-lep-see) is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

United States each year, more than 1 million people receive burns severe enough that they need medical attention, and 45,000 of them require hospitalization. In addition to the 4,500 Americans who die each year from the burns themselves, as many as 10,000 more die from burn-related infections, particularly pneumonia.

The symptoms of burns vary. Burns may cause one or more of the following: swelling, blistering, dehydration*, infection, and destruction of skin and other body organs. Depending on the severity of the burn, its treatment may require antibiotics, transfusions, and/or surgery.

Traumatic brain injury Traumatic brain injury is the form of trauma most likely to result in permanent disability or death. According to the National Center for Injury Prevention and Control, about 1.4 million Americans sustain traumatic brain injuries (TBIs), and most of the injuries result from falls (28%) and motor-vehicle accidents (20%). For active duty military personnel in war zones, blasts are a leading cause of TBI. Adolescents and young adults between the ages of age 15 and 24 have the highest incidence of these injuries out of any age group, and males incur nearly twice as many TBIs as females do. About 50,000 Americans die from these injuries each year, and according to the Centers for Disease Control and Prevention, another 5 million Americans have long-term consequences, including a need for assistance in performing normal daily activities.

Traumatic brain injuries affect many different parts of the body, and they may impair vision, memory, mood, concentration, strength, coordination, and balance. These injuries sometimes cause epilepsy* and coma*, and they may increase the risk for other diseases, such as Parkinson's or Alzheimer's.

Shock In some cases, a trauma patient may go into shock, a condition in which the body's circulatory system shuts down. Shock may result from internal or external bleeding, dehydration, vomiting, other loss of body fluids, burns, drug overdoses, severe allergic reactions, bacteria in the bloodstream (septic shock), and severe emotional upset. The symptoms of shock include cold and sweaty skin, weak and rapid pulse, dilated pupils, and irregular breathing.

Doctors who treat trauma patients often take action to avert shock even before they treat the injury itself. One way they do so is by ordering a transfusion of salt solution to maintain fluid levels and blood pressure.

Preventing Trauma

Trauma is one of the most preventable causes of death. Reducing traumatic injury requires individual, group, and government attention to public health and safety. Some important preventive measures for individuals are as follows:

- Using vehicle seatbelts, restraints, and airbags
- Installing child-safety seats in cars and using them correctly

- Wearing bicycle helmets
- Installing home smoke detectors and keeping them stocked with fresh batteries

The Trauma May Last

Survivors of traumatic events are at risk for psychological problems. These include post-traumatic stress disorder, which can interfere with activities of daily living long after physical wounds have healed. Emotional support and counseling can provide assistance. Signs and symptoms of ongoing psychological trauma include the following:

- Dreams, flashbacks, or intrusive thoughts during which people re-experience the traumatic event
- The avoidance of places and people the victim associates with the trauma
- Insomnia* or difficulty concentrating
- Anxiety or depression
- Physical problems that did not exist before the trauma

▶ See also **Broken Bones (Fractures) • Burns • Concussion • Post-Traumatic Stress Disorder • Seizures • Shock • Strains and Sprains**

Resources

Organizations

American Trauma Society. 7611 South Osborne Road, Suite 202, Upper Marlboro, MD, 20772. Toll free: 800-556-7890. Web site: <http://www.amtrauma.org>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

National Institute of General Medical Sciences. 45 Center Drive, MSC 6200, Bethesda, MD, 20892-6200. Telephone: 301-496-7301. Web site: http://www.nigms.nih.gov/Publications/trauma_burn_facts.htm.

* **insomnia** abnormal inability to get adequate sleep.

Travel-related Infections

When people travel to other countries, they are at increased risk for travel-related infections.

* **parasite** (PAIR-uh-sites) is an organism such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

* **anemia** (uh-NEE-me-uh) is a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **endemic** (en-DEH-mik) describes a disease or condition that is present in a population or geographic area at all times.

What Are Travel-related Infections?

When Americans travel to other countries, they may be exposed to many bacterial, viral, parasitic, and fungal infections that they would not come into contact with in the United States. With different climates, sanitation, and hygiene practices (such as bathing and defecating in the same water source), some diseases that are rarely or never seen in the United States are common in other parts of the world. The risk of infectious disease is greatest in tropical and subtropical countries because warm, moist climates offer an ideal environment for the survival and growth of certain organisms. Visiting developing regions of the world, particularly Africa (especially sub-Saharan Africa), Southeast Asia, and Central and South America, also puts people from northern developed countries such as those in Europe and North America at higher risk for travel-related infections. One of the most common ailments is “traveler’s diarrhea” (dye-uh-REE-uh), which can be caused by a variety of bacterial, parasitic, and viral infections. According to the Centers for Disease Control and Prevention (CDC), between 20 and 50 percent of these travelers experience diarrhea.

How Are Travel-related Infections Spread?

Some travel-related infections are spread through the bites of insects, such as mosquitoes, which carry malaria and yellow fever, or flies, for example, the tsetse (SET-see) fly, which can carry trypanosomiasis (trih-pan-o-so-MY-uh-sis). Other diseases, including schistosomiasis (shis-tuh-so-MY-uh-sis), can be contracted from swimming, wading, or bathing in contaminated water. Eating or drinking contaminated food or water is another common way of contracting disease, especially traveler’s diarrhea.

What Are Some Common Travel-related Infections?

Malaria Malaria is a disease that is transmitted through a mosquito bite. It is a public health problem throughout many countries and affects 300 to 500 million people each year, according to the World Health Organization (WHO). When an infected mosquito bites a human, the *Plasmodium* (plaz-MO-dee-um) parasite* causes fever and symptoms similar to those of the flu, such as extreme tiredness, muscle aches, nausea (NAW-zee-uh), and chills. The *Plasmodium* parasite typically invades red blood cells. Many symptoms of the disease are related to the destruction of infected red blood cells and resulting anemia*. If left untreated, malaria can cause seizures*, kidney* failure, and death. Medications can treat malaria and prevent this disease in travelers. Malarial prophylaxis (medicine that prevents malaria) is strongly recommended for individuals traveling to endemic* areas. The specific medications to be used vary regionally, depending on resistance patterns of the parasite. For those residing in malaria hot spots, extensive trials of a potentially effective anti-malarial vaccine was initiated in 2008.

Cholera Cholera (KAH-luh-ruh) is a gastrointestinal* disease that causes watery diarrhea, vomiting, and other symptoms. Without treatment, it can lead to dehydration* and even death. People develop cholera by eating food or drinking water that has been contaminated with the cholera bacterium, *Vibrio cholerae* (VIH-bree-o KAH-luh-ray). Eating contaminated shellfish or coming into contact with the feces* of an infected person also can infect someone. A person with cholera is treated to replace fluids lost through vomiting or diarrhea; some antibiotics may reduce the severity and length of the illness.

Dengue fever Dengue (DENG-gay) fever is caused by a virus from the *Flavivirus* (FLAY-vih-vy-rus) group transmitted to humans via the bite of an infected mosquito. According to the CDC, up to 100 million people worldwide develop symptoms of dengue fever each year, such as fever, severe headaches, joint pain, and rashes. Dengue hemorrhagic (heh-muh-RAH-jik) fever is a severe form of dengue that is associated with bruising easily, bleeding from the nose or gums, and bleeding internally, in addition to the other symptoms of dengue fever. No medication can treat either form of the illness. Doctors recommend that people who have dengue fever drink plenty of fluids to avoid dehydration and take acetaminophen* for pain relief.

Filariasis A bite from an infected mosquito can transmit filariasis (fih-luh-RYE-uh-sis), a parasitic disease that affects the lymphatic system*. When the infected mosquito feeds, tiny worms pass from it to the person, where they travel to and grow in the lymph vessels. Someone with this disease may not have noticeable symptoms, but filariasis can lead to permanent damage to the kidneys and lymphatic system. It can also progress to a condition called elephantiasis (eh-luh-fan-TIE-uh-sis), in which fluid builds up in parts of the body and causes swelling and disfigurement. The condition can be treated with medication.

Viral hepatitis Viral hepatitis (heh-puh-TIE-tis) is a viral infection of the liver* that leads to inflammation of the organ. Infections caused by the hepatitis B and C viruses are contracted sexually or through contact with contaminated blood or other body fluids, but hepatitis A virus is more contagious and is the hepatitis virus that more commonly infects travelers. It can spread through person-to-person contact or through contaminated water and food, especially shellfish and raw vegetables and fruits. A person with hepatitis may have symptoms similar to those of the flu, such as fever, chills, and weakness. People with hepatitis A may need extra fluids and rest, but most recover without medication.

Leishmaniasis Travelers who are bitten by an infected sand fly can develop leishmaniasis (leesh-muh-NYE-uh-sis), a disease caused by *Leishmania* (leesh-MAH-nee-uh) parasites that can affect the skin or the internal organs. People with the skin disease often have skin sores that may spread to cause facial disfigurement. Those with the internal form of

* **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **lymphatic system** (lim-FAH-tik) is a system that contains lymph nodes and a network of channels that carry fluid and cells of the immune system through the body.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **spleen** is an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **urinary tract** (YOOR-ih-nair-e TRAKT) is the system of organs and channels that makes urine and removes it from the body. It consists of the urethra, bladder, ureters, and kidneys.

* **systemic** (sis-TEM-ik) a problem affecting the whole system or whole body, as opposed to a localized problem that affects only one place on the body.

the disease experience fever and an enlarged spleen* or liver and may need to be hospitalized.

Plague Fleas that bite rodents infected with the bacterium *Yersinia pestis* (yer-SIN-e-uh PES-tis) can transmit plague (PLAYG) to humans. Two to six days after becoming infected with plague, a person may have swollen and tender lymph nodes*, fever, cough, chills, and belly pain. The plague can lead to severe respiratory illness, shock*, and death if a person is not treated with antibiotics.

Rabies Although rabies (RAY-beez) in humans is rare in the United States, people who travel to certain other countries may be at higher risk for infection. The virus that causes rabies, from the Rhabdoviridae (rab-doh-VEER-ih-day) family, is transmitted to humans through a bite from an infected animal, and without treatment rabies can cause paralysis*, seizures, coma*, and death. A person who has been bitten by an animal suspected of having rabies has to receive injections of the rabies vaccine to prevent the infection from developing.

Schistosomiasis Schistosomiasis is a disease caused by parasitic *Schistosoma* (shis-tuh-SO-mah) worms that infect humans when they come into contact with contaminated water. The worms must spend part of their life cycle growing in freshwater snails before they enter and infest humans. Common symptoms include rash, fever, muscle aches, and chills. Years later, if left untreated, schistosomiasis can lead to permanent liver damage or damage to the urinary tract*. In certain areas of the world, the free swimming larvae of *Schistosoma* that primarily infect aquatic birds may penetrate the skin of humans and lead to an itchy rash, called swimmer's itch. This symptom resolves over a short period of time and does not lead to systemic* infection.

Typhoid fever According to the CDC, typhoid (TIE-foyd) fever affects up to 16 million people worldwide each year, although only about 400 cases occur in the United States (and the majority of those are among individuals who contracted it while traveling abroad). A person who has contact with water or food contaminated with *Salmonella typhi* (sal-muh-NEH-luh TIE-fee) bacteria may develop symptoms such as fever, weakness, rash, stomach pain, or headache. Typhoid fever is treatable with antibiotics.

Typhus Typhus (TY-fis) is transmitted by the bites of fleas or lice infected with Rickettsiae (rih-KET-see-eye) bacteria. Symptoms of typhus include an extremely high fever, rash, nausea, joint pain, and headache. Patients often become very sick, and without treatment the disease can be life threatening. However, it is treatable with antibiotics.

Viral hemorrhagic fevers Viral hemorrhagic (heh-muh-RAH-jik) fevers (VHF) are a group of rare but potentially life-threatening viral

illnesses that cause symptoms ranging from fever, extreme tiredness, and dizziness to bleeding from the eyes and ears, kidney failure, and seizures. Humans contract VHF after exposure to people or animals that have been infected with one of a variety of viruses. Examples of VHF include Ebola virus infection and Lassa fever.

Yellow fever The yellow fever virus (from the flavivirus group) is transmitted to humans by a mosquito bite. Within a week of being infected, a person may experience fever, muscle aches, nausea, or vomiting. Most people recover within three to four days, but according to WHO about 15 percent of people with yellow fever develop a more serious form of the disease that can cause bleeding, kidney failure, and death. An effective vaccine is available for yellow fever and is often recommended for travelers who will be visiting areas where the disease is found.

Trypanosomiasis African trypanosomiasis is a parasitic illness commonly known as sleeping sickness. The *Trypanosoma* (trih-pan-o-SO-mah) parasite is transmitted to humans through a bite from the tsetse fly, after which a person may develop a skin sore, high fever, extreme tiredness, swollen lymph nodes, and swelling around the eyes. The disease is called sleeping sickness because people who have an advanced form of it can have an uncontrollable urge to sleep. If untreated, trypanosomiasis can cause the brain and membranes around the brain to swell and become inflamed. The disease can be treated with hospitalization and medication.

American trypanosomiasis is found in the western hemisphere. It is also known as Chagas' disease. It is transmitted to humans by the bite of the Reduviid (kissing bug). The disease is caused by the protozoan parasite, *Trypanosoma cruzi*. WHO estimates that 16 to 18 million persons are infected with *Trypanosoma cruzi* every year. Acute infections are usually mild but repeated infections can lead to damage to the digestive tract or heart.

Tuberculosis Tuberculosis (TB) reemerged as a major public health problem in the early 2000s. Experts estimate that up to one-third of the world population has been infected by a TB bacterium at some point. The reemergence of this disease is becoming even more troubling because multiple-drug resistant strains of TB were also emerging. Therefore, travelers who develop any symptoms suspicious of TB (low-grade fevers, weakness, night sweats, cough, and weight loss) should see a doctor as soon as the symptoms are observed.

Avian influenza Avian influenza is largely confined to birds such as chickens, ducks and geese. However, people experiencing prolonged close contact with infected birds have developed the disease. As of early 2009, sustained human-to-human transmission had not occurred.

Although primarily affecting birds, a relatively small number of human cases have been reported. The mortality (death) rate among humans as of

* **pandemic** (pan-DEH-mik) is a worldwide outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual.

* **prophylaxis** (pro-fih-LAK-sis) means taking specific measures, such as using medication or a device (such as a condom), to help prevent infection, illness, or pregnancy.

* **vaccinations** (vak-sih-NAY-shunz), also called immunizations, are the giving of doses of vaccines, which are preparations of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself.

late 2008 was approximately 60 percent. Many experts predicted that avian influenza would mimic the influenza pandemic* of 1918 and 1919. Global travel is seen as a major potential factor in the possible spread of this virus, especially with marked increase in travel to the Far East, Indonesia, and the Indian subcontinent.

How Can Travelers Protect Themselves from Illness?

Travelers can take precautions to reduce their risk of contracting a disease while abroad. Experts offer the following tips for staying healthy:

- Do not swim, wade, or bathe in freshwater sources, the ocean near beaches that are contaminated with human feces, or pools that are not chlorinated.
- Use only bottled water or water that has been boiled for drinking and brushing teeth.
- Avoid drinks containing ice, as the ice may be from unsafe water. Canned or bottled beverages are the safest drinks. Carefully wiping the top of the can or bottle before drinking from it may help remove disease-causing agents.
- Do not eat raw foods, particularly meat and salad. Avoid raw fruits and vegetables unless you peel them yourself.
- Avoid shellfish and other fish, which can be toxic at certain times of the year even if they have been cooked.
- Do not eat foods that are bought from street vendors.
- Avoid unpasteurized milk (milk that has not been processed with heat to kill parasites and bacteria) and dairy products.
- Prevent insect bites by wearing long sleeves and long pants in light colors so the insects can be seen easily.
- Use repellent and sleep under mosquito netting.
- Stay inside at times when biting insects are most active, mostly dawn and dusk.

Vaccination Prophylaxis* is especially important for preventing certain illness, such as malaria. Individuals traveling to areas of the world that are considered to be high-risk for contracting malaria, typically take prophylactic medication to prevent malaria. Special travel medicine clinics provide advice on specific disease patterns depending on the destination and offer appropriate vaccinations* and prophylaxis.

Depending on the destination and the length of the planned trip, travelers may receive immunizations for hepatitis, meningococcal infection, typhoid fever, or yellow fever, as well as any vaccinations in the regular immunization schedule that the person may have missed or may need to renew, such as those for diphtheria and tetanus. If someone plans to travel abroad, it is important to discuss travel plans with a doctor so that any necessary vaccinations can be given.

▶ See also **Cholera • Dengue Fever • Ebola Hemorrhagic Fever • Filariasis • Hepatitis • Lassa Fever • Leishmaniasis • Malaria • Plague • Rabies • Schistosomiasis • Severe Acute Respiratory Syndrome (SARS) • Trypanosomiasis • Typhoid Fever • Typhus • Vaccination • Yellow Fever**

Resources

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Organizations

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org/afp/980800ap/dick.html>.

American College of Occupational and Environmental Medicine. 55 West Seegers Road, Arlington Heights, IL, 60005. Telephone: 708-228-6850. Web site: <http://www.acoem.org>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/travel>.

International Society of Travel Medicine. 2386 Clower Street, Suite A-102, Snellville, GA, 30078. Telephone: 770-736-7060. Web site: <http://www.istm.org>.

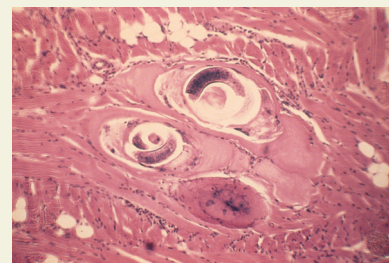
Pan American Health Organization. 525 Twenty-third Street NW, Washington, DC, 20037. Telephone: 202-974-3000. Web site: <http://www.paho.org>.

Trichinosis

Trichinosis (trih-kih-NO-sis) is a parasitic infection that comes from eating raw or undercooked meat. It is caused by species of the roundworm Trichinella (trih-kih-NEH-luh).

What Is Trichinosis?

Also called trichinellosis (trih-kih-neh-LO-sis), trichinosis can occur when people eat meat that is infected with the larvae* of *Trichinella* roundworms (also called nematodes, NEE-muh-todes); *Trichinella spiralis* (spy-RAL-is)



▲ The larvae of the *Trichinella* worm after they have become embedded in muscle causing trichinosis as seen under the microscope. *Custom Stock Medical Photos, Inc. Reproduced by permission.*

* **larvae** (LAR-vee) are the immature forms of an insect or worm that hatches from an egg.

- * **cysts** (SISTS) are shell-like enclosures that contain small organisms in a resting stage.
- * **small intestine** is the part of the intestines—the system of muscular tubes that food passes through during digestion—that directly receives the food when it passes through the stomach.
- * **biopsy** (Bl-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

is the most common species that causes trichinosis. People can become infected only by eating infected meat; the disease is not spread through human contact. The parasite also can spread when animals eat the infected flesh of other animals. Most often, meat infected with the parasite comes from pigs or wild game, such as bear, horse, wolf, and fox.

Trichinella larvae form cysts* in meat. When an animal eats this meat, the animal's stomach acid dissolves the cysts, and the worms are released into the body. They travel to the small intestine*, where they grow into adult worms and mate. After about a week, the mature female worm releases larvae, which travel through the bloodstream to the muscles. There they form the hard cysts that began the cycle. The cysts remain in the muscles, and people become infected when they eat these cysts in animal meat.

How Common Is Trichinosis?

According to the Centers for Disease Control and Prevention, approximately 12 cases of trichinosis per year have been reported to them since the late 1990s. The cases are so few because people became more aware of the dangers of eating raw or undercooked meat; better storage and freezing methods of meat were being used; and laws prohibiting the feeding of raw meat to pigs were passed. Most trichinosis cases in the early 2000s were associated with eating wild game.

How Do People Know They Have Trichinosis?

The length of the period between eating the infected meat and the first symptoms of illness depends on the number of parasites in the meat and how much a person ate. The time before symptoms occur can range from 1 to 45 days, but symptoms often surface in 10 to 14 days. Symptoms can be mild and even go unnoticed, but they usually start with fever, diarrhea (dye-uh-REE-uh), stomach pain, nausea (NAW-zee-uh), vomiting, and extreme tiredness. Other symptoms may follow, such as headache, cough, chills, muscle and joint pain, eye swelling, and constipation. If the infection is severe, a person may have trouble with coordination as well as heart and breathing problems.

How Do Doctors Diagnose and Treat Trichinosis?

A blood test or muscle biopsy* can be done to determine whether a person has trichinosis. The blood test can detect antibodies* working to destroy the parasite, and the biopsy shows the presence of cysts in the muscles. Asking if a person has recently eaten game or traveled outside the United States may provide information useful in making the diagnosis.

The infection can be treated with various medications to kill the worms in the intestine, but the medication does not get rid of the larvae that have produced cysts in the muscles. These larvae remain in a dormant (inactive) state in the muscle tissue. If the infection is mild, symptoms usually go away after a few months. Muscle aches and weakness may last longer. Some people require only bed rest; others need to be

hospitalized and receive oxygen and intravenous (in-tra-VEE-nus) fluids (fluids injected directly into a vein). Severe complications of trichinosis include inflammation of the heart muscle, heart failure, lung problems, delirium*, and coma*. The disease can be fatal if it is not treated.

How Can Trichinosis Be Prevented?

The best way to prevent infection is to eat only thoroughly cooked meat. Curing, drying, salting, and microwaving meat may not kill *Trichinella* larvae. Meat is thoroughly cooked when the juices are clear (not bloody), and the meat has reached an internal temperature of 170 degrees Fahrenheit. Freezing meat at subzero temperatures for several weeks also should kill any larvae in cysts. Raw meat can contaminate work surfaces, so it must not touch surfaces used to prepare food, and grinders and other utensils used with raw meat must be cleaned thoroughly and not used to prepare cooked meat.

▶ See also **Intestinal Parasites • Zoonoses**

Resources

Books and Articles

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Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/dpd/parasites/trichinosis/factsht_trichinosis.htm.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC, 6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107. Web site: <http://www3.niaid.nih.gov/topics/trichinosis/default.htm>.

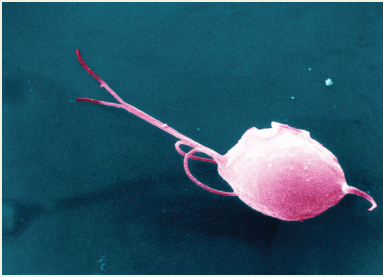
Trichomoniasis

Trichomoniasis (trih-ko-mo-NYE-uh-sis) is a common sexually transmitted disease (STD) that occurs in women and men.

What Is Trichomoniasis?

Trichomoniasis (also known as “trich”) is an infection caused by the parasite* *Trichomonas vaginalis* (trih-koh-MO-nas vah-jih-NAL-is). It usually affects the urethra* in men and the vagina* or urethra in women.

- * **delirium** (dih-LEER-e-um) is a condition in which a person is confused, is unable to think clearly, and has a reduced level of consciousness.
- * **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.
- * **parasite** (PAIR-uh-sites) is an organism such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.
- * **urethra** (yoo-REE-thra) is the tube through which urine passes from the bladder to the outside of the body.
- * **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.



▲ Scanning electron micrograph of *trichomonas vaginalis*, the parasite that causes the sexually transmitted disease trichomoniasis. *BSIP/Photo Researchers, Inc.*

- * **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.
- * **ejaculation** (e-jah-kyoo-LAY-shun) is the discharge of semen, a whitish fluid containing sperm, from the penis.
- * **pelvic exam** is an internal examination of a woman's reproductive organs.
- * **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.
- * **Pap smear** is a common diagnostic test used to look for cancerous cells in the tissue of the cervix.
- * **cultured** (KUL-churd) means subjected to a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.
- * **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

The disease spreads from person to person through sexual contact and infects primarily women between the ages of 16 and 35. It is one of the most common STDs in young sexually active women, and the Centers for Disease Control and Prevention estimates that 7.4 million new cases occur each year among women and men in the United States. As with all STDs, people who have had many sexual partners are more likely to contract trichomoniasis.

What Are the Signs and Symptoms of Trichomoniasis?

Women who contract trichomoniasis are more likely to have symptoms than men who become infected, although many people who have trichomoniasis experience no symptoms at all. If a person has symptoms, they usually appear within six months of becoming infected. Women often have a strong-smelling yellow-green or gray foamy vaginal discharge and itching in or around the vagina. They may feel pain or burning during sex or urination and, rarely, lower abdominal* pain. Men typically have no symptoms. When they do, they may feel irritation inside the penis and burning after urination or ejaculation*. They may have a discharge from the penis as well.

How Do Doctors Diagnose Trichomoniasis?

If a woman has symptoms of the disease, the doctor will perform a pelvic exam* to look for the telltale signs of inflammation on the cervix* and inner walls of the vagina. The doctor will take a sample of fluid from the vagina to look at under the microscope for evidence of the parasite. In some instances, *Trichomonas* infection may be found during a routine Pap smear* or when vaginal fluid is cultured* to diagnose infection caused by other organisms. Most cases of trichomoniasis that cause symptoms can be diagnosed in the doctor's office by examining the vaginal fluid under a microscope.

When trichomoniasis is suspected in a man, the doctor may take a sample of fluid from the man's urethra to confirm the diagnosis. If the doctor diagnoses trichomoniasis in any patient, tests for other STDs will likely be done as well, because it is common for a person to have more than one STD at the same time.

What Is the Treatment for Trichomoniasis?

Most cases of trichomoniasis are treated with a single-dose of the oral antibiotic* metronidazole. Doctors recommend that people who are infected not have sex until they have completed treatment, to limit the risk of spreading the infection. Treating all sexual partners of someone who has trichomoniasis, even if they have no symptoms, also is suggested as a way to prevent a new round of infection or the spread of the disease.

Does the Disease Have Complications?

In a pregnant woman, the infection can bring about early rupture of the amniotic sac* and premature delivery*. Trichomoniasis may also increase

the risk of becoming infected with human immunodeficiency (ih-myoo-no-dih-FIH-shen-see) virus (HIV), the virus that causes acquired immunodeficiency syndrome (AIDS), which severely weakens the immune system.

Can Trichomoniasis Be Prevented?

The risk of trichomoniasis can be lowered or prevented by taking the following precautions:

- Practicing abstinence (not having sex)
- Practicing safe sex by using a male latex condom
- Reducing the number of sexual partners

▶ See also **AIDS and HIV Infection • Chlamydial Infections • Gonorrhea • Sexually Transmitted Diseases (STDs)**

Resources

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American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://www.aafp.org>.

American College of Obstetricians and Gynecologists. 409 12th Street SW, P.O. Box 96920, Washington, DC, 20090-6920. Telephone: 202-638-5577. Web site: <http://www.acog.org>.

American College of Physicians. 190 N. Independence Mall West, Philadelphia, PA, 19106. Toll free: 800-523-1546. Web site: <http://www.acponline.org>.

American Social Health Association. P.O. Box 13827, Research Triangle Park, NC, 27709. Telephone: 919-361-8400. Web site: http://www.ashastd.org/learn/learn_vag_trich_tri.cfm.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Telephone: Hotline 800-227-8922. Web site: <http://www.cdc.gov/std/Trichomonas/STDFact-Trichomoniasis.htm>.

* **amniotic sac** (am-nee-AH-tik SAK) is the sac formed by the amnion, the thin but tough membrane that lines the outside of the embryo in the uterus and is filled with fluid to cushion and protect the embryo as it grows.

* **premature delivery** is when a baby is born before it has reached full term.



▲
About 75 percent of people with trichotillomania pull hair from the scalp. In some cases trichotillomania is a response to stress at home or school, while in others it results from a hair-pulling habit developed during childhood. *Custom Medical Stock Photos, Inc. Reproduced by permission.*

Trichotillomania

Trichotillomania (trik-o-til-o-MAY-nee-a) is a condition that involves compulsive (kom-PUL-siv) hair pulling, usually the hair on the scalp or the eyebrows or eyelashes.

Penny's Story

Penny put on her favorite baseball cap and headed out the door for school. The cap hid the bald spot on the side of her head pretty well. She envied the girls who could wear barrettes and ponytails to school, and she remembered the days when she had worn them, too. Over the previous two years, Penny had started to pull out her hair and her eyebrows. It began gradually at first, but pretty soon her eyebrows were gone, and she had bald patches on her head. She did not want to pull the hair, but she felt a powerful urge to do it. She just could not stop. No one understood why she was doing it, not even Penny. The boys in her class teased her. She pretended not to listen to them, but their unkind comments made her cry when she was alone. Even the nice kids asked her why she did not have any eyebrows. Until recently, Penny did not really know what to say. Then Penny began to see a therapist, who helped her understand that she had trichotillomania.

What Is Trichotillomania?

Trichotillomania is a condition that involves strong urges to pull hair. People with this condition pluck or pull the hair on their heads, their eyelashes, their eyebrows, or hair on other body parts. For people with trichotillomania, the hair pulling is more than a habit. It is a compulsive behavior, which means the behavior is irrational and very hard to stop. A person with trichotillomania feels a strong urge to pull hair, an impulse that is so powerful that it seems impossible to resist.

Pulling the hair often provides a brief feeling of relief, like the feeling of finally scratching an itch but much more intense. But after the feeling of relief, which lasts only a moment, the person usually feels distressed and unhappy about having pulled the hair. Soon the urge to pull hair returns. People with trichotillomania wish they could stop, and they may feel ashamed or embarrassed. Many people who have this condition try to keep it secret.

What Causes Trichotillomania?

The condition trichotillomania was first described in 1889 by the French physician François Hallopeau (1842–1919). The term “trichotillomania” comes from the Greek words “thrix,” meaning “hair,” and “tillein,” meaning “to pull.” “Mania,” the Greek word for “madness” or “frenzy,” was used in the 19th century for any condition that affected human behavior. Hallopeau wrote that his patients with hair-pulling compulsions were, in fact, quite emotionally healthy.

Although the exact cause of trichotillomania is unknown, in the early 2000s there was growing evidence that suggested it is a biological disorder of neurotransmitter* function in the brain. Trichotillomania has some similarities to obsessive-compulsive disorder* (OCD), but in trichotillomania there are no obsessions*, and hair pulling is the only compulsion. Both trichotillomania and OCD fall into the larger category of anxiety disorders*. Some people with trichotillomania have other forms of anxiety as well. Trichotillomania can affect children, adolescents, and adults. Both males and females can have trichotillomania, but it seems to be more common among females.

How Is Trichotillomania Diagnosed?

When individuals lose their hair or eyebrows, doctors may first check for other conditions that might cause a person's hair to fall out, such as ringworm*, alopecia areata*, or other skin diseases. But if the person tells the doctor about the hair pulling, it is probably trichotillomania. Penny's doctor sent her to see a therapist, a mental health specialist who listens to people talk about their experiences and feelings and who can help people work out ways to deal with behavior problems. The therapist explained Penny's condition to her and told her about the urges, habits, and anxiety that are part of the problem. She helped Penny understand that the hair pulling was not her fault. Penny felt relieved to know that she was not the only person with this problem and that she could do something about it.

How Is Trichotillomania Treated?

One common treatment for trichotillomania is a behavior therapy* technique called habit reversal. In habit reversal, the person first learns to notice the urge before the compulsion to pull hair becomes too strong to resist. Then the person learns to do something else instead of hair pulling until the urge grows weaker and passes. This shift in behavior can be more difficult than it sounds, because the person may feel increasing, uncomfortable tension and anxiety while trying to resist the urge to pull hair. With time and practice, the brain can begin to react differently to the urges, and the person can start to control the compulsive behavior. Some people may also take medication that helps with the compulsions and decreases the strength of the urges, making them easier to resist. After a few weeks of practice, coaching from her therapist, and support from her parents, Penny began to get better at resisting the urges she felt. Penny started to see results; her hair began to grow back in.

What Is It Like to Live with Trichotillomania?

Now that Penny's hair and eyelashes are growing in, she feels better about herself and more hopeful about coping with trichotillomania. Now and then, Penny may continue to feel urges to pull her hair and eyebrows, but she knows what to do to resist them. She knows that these impulses can be stronger in times of stress, but they can also arise on their own during

* **neurotransmitter** (NUR-o-tranz-mit-er) is a brain chemical that lets brain cells communicate with each other and therefore allows the brain to function properly. In other words, a neurotransmitter transmits (carries) a chemical message from neuron to neuron.

* **obsessive-compulsive disorder** is a condition that causes people to become trapped in a pattern of repeated, unwanted thoughts, called obsessions (ob-SESH-unz), and a pattern of repetitive behaviors, called compulsions (kom-PUL-shunz).

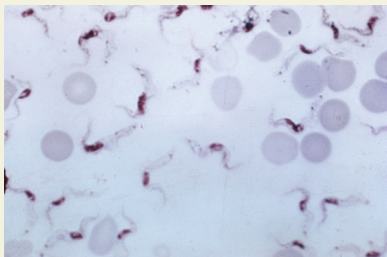
* **obsessions** (ob-SESH-unz) are repeated disturbing thoughts or urges that a person cannot ignore and that will not go away.

* **anxiety disorders** (ang-ZY-e-tee dis-OR-derz) are a group of conditions that cause people to feel extreme fear or worry that sometimes is accompanied by symptoms such as dizziness, chest pain, or difficulty sleeping or concentrating.

* **ringworm** is a fungal infection of the skin or scalp that appears as a round, red rash.

* **alopecia areata** (al-o-PEA-shah a-ree-AH-ta) is a condition that leads to sudden hair loss, often in small, round patches on the scalp. The cause is not known.

* **behavior therapy** is a type of counseling that works to help people change their actions.



▲ Blood infected with the protozoa that cause trypanosomiasis seen under a microscope. The disease is known as sleeping sickness in Africa and Chagas' disease in Latin America. *Custom Stock Medical Photos, Inc. Reproduced by permission.*

* **parasite** (PAIR-uh-sites) is an organism such as a protozoan (one-celled animals), worm, or insect that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. A parasite lives at the expense of the host and may cause illness.

* **protozoa** (pro-tuh-ZOH-uh) are single-celled microorganisms (tiny organisms), some of which are capable of causing disease in humans.

times when Penny is bored or just relaxed. Her therapist helped Penny learn and practice ways to cope with normal stresses, to stop the urges before they get too strong, and to control her compulsive pulling.

▶ See also **Anxiety and Anxiety Disorders** • **Obsessive-Compulsive Disorder**

Resources

Books and Articles

Golomb, Ruth Goldfinger, and Sherrie Mansfield Vavrichek. *The Hair Pulling "Habit" and You: How to Solve the Trichotillomania Puzzle*. Silver Spring, MD: Writers' Cooperative of Greater Washington, 2000.

Penzel, Fred. *The Hair-Pulling Problem: A Complete Guide to Trichotillomania*. New York: Oxford University Press, 2003.

Organizations

Mental Health America. 2000 N. Beauregard Street, 6th Floor, Alexandria, VA, 22311. Toll free: 800-969-6642. Web site: <http://www.mentalhealthamerica.net>.

Trichotillomania Learning Center. 207 McPherson Street, Suite H, Santa Cruz, CA, 95060-5863. Telephone: 831-457-1004. Web site: <http://www.trich.org>.

Truancy See *School Avoidance*.

Trypanosomiasis

Trypanosomiasis (trih-pan-o-so-MY-uh-sis) is a disease found in Africa and the American continents that is caused by infection with a parasite. Forms of the disease may persist for many years and have several phases, with symptoms that can vary from one stage to the next.*

What Is Trypanosomiasis?

Trypanosomiasis is the name for three types of infections caused by protozoa* and spread to humans through insect bites. There are two kinds of African trypanosomiasis, East African and West African. Both of these varieties also are known as sleeping sickness. The disease can affect people

living on the African continent south of the Sahara Desert. American trypanosomiasis is also called Chagas' (SHAH-gus) disease. It occurs only on the American continents, from Mexico to Argentina.

What Causes Trypanosomiasis?

The bite of an infected tsetse (SET-see) fly usually transmits the organisms that cause the African forms of trypanosomiasis. These flies live in the countryside in Africa, especially in bushes and thick vegetation near rivers and lakes. Tsetse flies infected with the protozoan *Trypanosoma brucei rhodesiense* (trih-pan-o-SO-mah BRU-see-eye ro-dee-see-EN-see) spread East African trypanosomiasis, the most severe form of the disease, to humans. The West African variety comes from a fly infected with *Trypanosoma brucei gambiense* (trih-pan-o-SO-mah BRU-see-eye gam-be-EN-see).

Reduviid (rih-DO-vee-id) bugs (also called assassin, cone-nose, or kissing bugs) carry the *Trypanosoma cruzi* (trih-pan-o-SO-mah KROO-zee) protozoa that cause the American variety of trypanosomiasis, or Chagas' disease, named for the Brazilian physician Carlos Chagas (1879–1934) who discovered it in 1909. These bugs hide during the day in the cracks in mud and adobe homes. At night they crawl across sleeping people and bite them, usually on the face but sometimes on the arms, legs, or trunk. They also leave behind their feces*, which contain the protozoa. Without knowing it, people can rub the infected feces into the bite, a cut, or open sore, or even into their noses, mouths, or eyes.

How Common Is Trypanosomiasis?

Trypanosomiasis can infect people of every age and race, although it is uncommon in the United States. Since the late 1960s, fewer than 30 cases have been reported among U.S. citizens traveling to areas where the infection is found. In other parts of the world, however, the disease affects thousands of people. The World Health Organization estimates that as many as 500,000 people could have African trypanosomiasis, but because of poor monitoring most of these cases are not reported. Between 16 million and 18 million people in the Americas in the early 2000s had Chagas' disease. Approximately 50,000 may die from the disease each year.

Is Trypanosomiasis Contagious?

People cannot catch any form of trypanosomiasis in the same way that they catch a cold or the flu from other people. Only the tsetse fly spreads the African varieties, and the reduviid bug spreads Chagas' disease. Rarely, a mother infected with the West African variety of trypanosomiasis or with Chagas' disease can pass the illness to her unborn child. People who receive a transfusion* of blood or an organ transplant from an infected person also may contract the disease; this form of transmission tends to happen more often with Chagas' disease than with the African types.



▲ The tsetse fly is responsible for transmitting trypanosomiasis in Africa.

©Ray Wilson/Alamy.

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

* **transfusion** (trans-FYOO-zhun) is a procedure in which blood or certain parts of blood, such as specific cells, is given to a person who needs it due to illness or blood loss.

Global Warming

The bite of an insect can transmit bacteria, protozoa, or even worms into a person's bloodstream, leading to a variety of illnesses. Trypanosomiasis is just one example of a tropical insect-borne disease. A few others, along with the insects that spread them, are:

- Malaria (mah-LAIR-e-uh) mosquitoes
- Yellow fever mosquitoes
- Elephantiasis (eh-luh-fan-TIE-uh-sis) mosquitoes
- Leishmaniasis (leesh-muh-NYE-uh-sis) sandflies
- Onchocerciasis, (on-koh-sir-KYE-us-sis) or river blindness black flies

These diseases are common to the tropics because the hot and often rainy climate makes the tropics an ideal breeding ground for insects. Greenpeace, among other organizations dedicated to protecting the environment, has warned that global warming could create new breeding grounds for insects throughout the world. At the same time, rising temperatures could raise insect reproductive rates, increasing their numbers. As the climate in the United States and Europe becomes more "tropical," diseases such as yellow fever and malaria may become more common, bringing the tropics into the backyards of people living in northern areas.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

What Are the Symptoms of the Disease?

African trypanosomiasis People who contract the African varieties of trypanosomiasis may start sleeping more, although this usually does not happen until the later stages of the disease. Sleeping sickness may start with the appearance of a sore called a chancre (SHANG-ker) at the spot where the person received the tsetse fly bite. Later symptoms include fever, extreme tiredness, severe headaches, rashes, itching, joint pain, and swelling of the hands and feet. The lymph nodes* on the back of the neck may become swollen as well. These signs typically appear two to four weeks after infection with East African trypanosomiasis.

Other symptoms can follow quickly, as the protozoa cross the blood-brain barrier* and start affecting a patient's mental functions. The later stages of sleeping sickness may bring mental confusion, changes in personality, problems with walking and talking, weight loss, and seizures*. The spleen and liver may become enlarged. Sleeping sickness gets its name from the later part of the disease, when the sick person has nighttime insomnia* but sleeps for long periods during the day. If the person does not receive treatment, the heart muscles may become inflamed or weakened, causing death from heart failure.

The early symptoms in West African trypanosomiasis are similar but may take longer to appear. Months or years may pass before an infected person becomes sick, and the disease develops more slowly, although it can still cause death if it is left untreated. The gap between infection and the start of symptoms can make this form of sleeping sickness difficult to diagnose.

Chagas' disease The first sign of Chagas' disease may show up a few hours after infection, when a raised red spot called a chagoma (chuh-GO-mah) appears at the site of the insect bite. Most people have no other symptoms during the early, or acute, phase of the disease, which begins a few weeks later. People who experience symptoms may have fevers, rashes, extreme tiredness, vomiting, loss of appetite, or swollen lymph nodes. The side of the face where the infected feces were rubbed into an eye or a bug bite may swell. In most people these symptoms usually disappear within four to eight weeks without causing problems, but infants can die in this early stage from brain swelling. About 10 to 20 years after this first phase, approximately one-third of infected people can show symptoms of the chronic* phase of Chagas' disease. They may become constipated and experience trouble swallowing. The heart may become enlarged, and patients may have altered heart rhythms or heart failure leading to death.

How Do Doctors Diagnose Trypanosomiasis?

Because all types of trypanosomiasis are rare in the United States, it is important for people who have any symptoms of the disease to let their doctor know right away if they have been traveling in areas where the

disease is common. To diagnose sleeping sickness or Chagas' disease, a doctor orders blood tests to look for protozoa or antibodies* to the organism. In cases in which the doctor suspects sleeping sickness, a sample drawn from fluid surrounding the brain and spinal cord or tissue from swollen lymph nodes may be examined for evidence of the disease. If a patient has a suspicious-looking skin lesion*, a biopsy* is performed to test for *Trypanosoma cruzi* protozoa.

Can Trypanosomiasis Be Treated Successfully?

There are medications available to treat all types of the disease. Doctors recommend that people with trypanosomiasis receive treatment as soon as possible. Treatment is given in a hospital. After leaving the hospital, patients typically are watched closely by a doctor for at least two years to see whether they show any signs that they still have the infection.

What Happens to People with Trypanosomiasis?

East African sleeping sickness can move through the body quickly, progressing in just weeks or months to the most serious phase of illness. West African sleeping sickness takes longer to develop. People may not reach the critical phase for months or even years. People who do not receive treatment for African trypanosomiasis can die from heart failure, and those who wait to start treatment may have permanent brain damage. Long-term complications of Chagas' disease, which may not appear for 20 or more years after infection, include damage to the digestive and nervous systems, heart problems, and sudden death.

Can Trypanosomiasis Be Prevented?

There is no vaccine or medication that can prevent any form of the disease, so it is wise for people who travel in areas where the disease is common to take precautions. In Africa precautions include wearing clothes of thick material, with long sleeves and long pants. Neutral colors, such as tan, are best because tsetse flies are attracted to dark and bright colors. Doctors recommend that travelers to Africa sleep under netting and avoid riding in the backs of open trucks because dust from moving vehicles attracts the flies. It is also advisable not to walk through brush. In areas where Chagas' disease is found, it is a good idea for people to avoid sleeping in mud, adobe, or thatch houses; to sleep under netting; and to use insect repellent.

▶ See also **Chagas' Disease** • **Leishmaniasis** • **Travel-related Infections**

Resources

Books and Articles

Kruel, Donald. *Trypanosomiasis*. New York: Chelsea House, 2007.

* **blood-brain barrier** is a biological shield in the body that helps prevent germs or other potentially harmful materials in the blood from entering the brain and spinal cord.

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

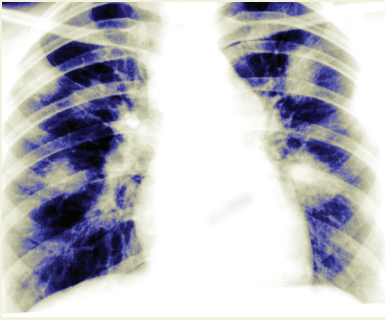
* **insomnia** abnormal inability to get adequate sleep.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **lesion** (LEE-zhun) is a general term referring to a sore or a damaged or irregular area of tissue.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.



▲
X-ray of lungs infected with *Mycobacterium tuberculosis*, the bacterium that causes tuberculosis. This disease has infected humans for thousands of years. *Custom Medical Stock Photo, Inc. Reproduced by permission.*

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dpd/parasites/trypanosomiasis/default.htm>; <http://www.cdc.gov/chagas>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: http://www.who.int/topics/trypanosomiasis_african/en; <http://www.who.int/tdr/diseases/chagas/default.htm>.

Tuberculosis

Tuberculosis (too-ber-ku-LO-sis) is a bacterial infection that spreads through the air and usually affects the lungs. Worldwide, it kills more people than any other infectious disease.

An Ancient Disease

Hippocrates (c.460–c.377 B.C.E.), a Greek physician who in modern times is called “the father of medicine,” accurately described tuberculosis (TB) about 2,400 years ago when he coined the term “phthisis,” which means to melt and to waste away. In later years, tuberculosis was called consumption because people with TB tended to waste away as if they were being slowly consumed.

What Is Tuberculosis?

Tuberculosis is a potentially serious infection caused by *Mycobacterium tuberculosis* bacteria. The bacteria are spread mainly through the air from an infected person to others nearby. TB usually infects the lungs, but it can also cause symptoms that affect the whole body.

Not everyone who is infected with tuberculosis bacteria (called primary infection) gets sick or infects other people. About 10 million people in the United States are infected with tuberculosis, but only 1 out of every 10 of these people develops active TB (called secondary infection). Of the 10 percent of infected people who ultimately develop active disease, about one-third to one-half manifest illness in the first two months to two years after they are initially infected; the remainder develop active TB later in life.

People with primary TB infection are protected from developing active TB by their body’s immune system*, but they still carry the bacteria in their bodies. As long as the infection is inactive, they cannot spread TB. They can, however, develop active (secondary) TB years later if their immune systems are weakened by other diseases such as HIV/AIDS or diabetes, or by alcohol or drug abuse. Most people with active TB who are treated can be cured. If left untreated, however, TB is fatal 40 to 60 percent of the time. Importantly, individuals discovered to have TB

infection can be given preventive therapy, which can reduce the lifetime risk of developing active disease by at least 70 percent.

How Is Tuberculosis Spread?

When people with active tuberculosis of the lungs or throat cough or sneeze, they spread bacteria through the air. Other people who breathe

THE UNITED STATES AND THE WORLD

- In the United States, tuberculosis is a serious disease, but it is not a leading cause of death or illness. In 2004, for instance, there were about 14,500 new cases of TB and about 662 deaths. It is estimated that 10 million people in the United States have primary (in other words, nonactive) TB infection. Of these about 1 in 10 eventually become ill with the disease.
 - In the United States, TB is most common among people with HIV, people in homeless shelters and prisons, other poor people who live in big cities, and elderly people. Rates are higher for men than for women and far higher for people of African ancestry than for people of European ancestry, which may be because a higher proportion of African Americans are poor. Another factor may be that, over the centuries, TB was largely a European disease and Europeans who survived it may have developed resistance to it.
 - In the United States, tuberculosis was on the decline until the mid-1980s, when it began to make a comeback. A main reason was the rise of HIV, the AIDS virus, which weakens the immune system. HIV-infected people are more likely to get new TB infections and to have old, inactive infections become active and cause illness. Health officials responded to the upsurge with better TB control programs, and rates of TB went down again. By the late 1990s, the number of new U.S. illnesses was the lowest ever and was dropping each year.
 - Worldwide, TB causes more deaths than any other infectious disease. In 2004, it was estimated to cause about 9 million new cases of illness and 1.7 million deaths, on top of nearly 15 million existing cases of illness.
- It is estimated that one-third of the world's people have primary (inactive) TB infection. That means more than 2 billion people are infected.
- Worldwide, most tuberculosis cases occur in Asia. About 4.5 million of the 9 million new cases each year occur in India, China, Bangladesh, Pakistan, Indonesia, and the Philippines. But the rates—the number of cases that occur for each 100,000 people—tend to be highest in some African countries. That is because HIV is particularly common there and HIV-infected people are more likely to get sick with TB. Many cases of tuberculosis also occur in the Middle East and South America. In the developing world, TB is most common among young men and women of reproductive age.
 - Worldwide as well, the spread of TB has been fueled by the rise of HIV, and it has not been brought under control. The World Health Organization has been trying to get countries to use the kind of TB control measures that worked in the United States in the 1990s. But the control measures are expensive and difficult to do on the large scale that is needed, and the countries that need them most are not as wealthy as the United States.
 - The measures advocated by the World Health Organization are called DOTS, for “directly observed treatment—short course.” Under this system, health workers watch patients take their medicines each day for six months to a year, either at a clinic or on visits to the patient's home. This ensures that the patients complete their treatment, rather than stopping whenever they feel better. That cuts down on the spread of the illness and on the emergence of drug-resistant strains.

HIV and TB: A Lethal Combination

Because HIV/AIDS weakens the immune system, patients who have HIV/AIDS are at high risk for contracting TB.

Approximately 13 million people around the globe are infected with both HIV and TB. TB is more likely to spread to other areas of the body in people with HIV, and multidrug-resistant (MDR) TB is much more dangerous in these patients. TB infection in patients who have HIV/AIDS can be cured if found and treated early.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **peritoneum** is the membrane that lines the abdominal cavity.

* **sputum** (SPYOO-tum) is a substance that contains mucus and other matter coughed out from the lungs, bronchi, and trachea.

the same air may become infected with the bacteria, which can lodge in the lungs and begin to grow. From there, the bacteria can move through the blood and settle in almost any other part of the body, including the urinary tract, brain, kidneys, lymph nodes*, bones, joints, peritoneum*, and heart.

Spending lots of time in close quarters with a person who has untreated active TB is the most common way to becoming infected. Even with close contact, however, only one-third of people who are exposed to TB infection become infected. Within a few weeks of the start of effective treatment, patients are no longer contagious. TB in parts of the body other than the lungs and throat usually is not contagious. People who have primary tuberculosis cannot spread it to others.

Who Gets Tuberculosis?

Tuberculosis can strike anyone, but some people are more likely to get it than others:

- Babies and young children who have weak immune systems
- People with medical problems, such as HIV (the virus that causes AIDS) infection, alcohol or drug abuse, poor nutrition, diabetes, certain types of cancer, or severe kidney diseases that weaken their immune systems
- People who take certain medications, such as corticosteroid drugs that weaken their immune systems
- People who have had organ transplants and take drugs to suppress their immune systems
- People who do not get good medical care due to poverty or homelessness.

What Are the Symptoms of Tuberculosis?

Primary tuberculosis does not cause any symptoms. The symptoms of secondary (active) tuberculosis depend on where in the body the tuberculosis bacteria are growing.

Tuberculosis of the lungs may cause a cough that does not go away, pain in the chest, and coughing up blood or sputum*. Other common symptoms include feeling tired all the time, weight loss, lack of appetite, fever, chills, and sweating at night. People with secondary TB may feel sick quickly or develop symptoms gradually over weeks or months, and they may be highly contagious until treated. However, some people with active TB feel well and only cough occasionally.

Tuberculosis bacteria typically infect the lungs, but they can infect almost any part of the body:

- Urinary tract. Symptoms may include repeated urinary tract infections, repeated fevers, or pus or blood in the urine for which there is no other explanation.

TUBERCULOSIS TIMELINE

Archeologists have found evidence of tuberculosis in skeletons from Peru that are 1,300 years old and in Egyptian skeletons dating back 3,400 years. But TB apparently did not emerge as a major killer until the 1600s in Europe.

By the 1800s the Industrial Revolution had created ideal conditions for TB to spread—overworked, underfed people crowded together in tenements and factories with poor ventilation. TB became the leading killer in many European and U.S. cities. It even took on an aura of romance, as it sapped the life from many literary figures, both real (British poet John Keats, 1795–1821) and fictional (Mimi, the heroine of the opera *La Boheme*).

It was unclear whether TB was inherited or infectious until the 1880s, when the German physician Robert Koch (1843–1910) identified the TB bacterium. Treatment consisted of rest, rich food, and fresh air, often provided in special TB hospitals called sanatoriums that were built in mountain areas.

Streptomycin, an antibiotic that kills TB bacteria, was introduced in the 1940s. Isoniazid, another effective antibiotic, came into use in the 1950s. These drugs dramatically lowered the number of TB cases over the next few decades. Both remained in use in the early 2000s, along with other drugs. As drug-resistant strains of TB continued to emerge, research toward better treatment continued.

- **Brain.** Tuberculosis bacteria can infect the membranes surrounding the brain and spinal cord (the meninges), especially in babies and young children. Symptoms of tuberculosis meningitis may include headaches, seizures, or abnormal behavior.
- **Lymph nodes.** Tuberculosis bacteria can infect the small organs commonly known as lymph nodes. Symptoms may include inflammation and swelling of the nodes anywhere in the body, including in the neck.
- **Bones and joints.** Tuberculosis bacteria can infect the skeleton, especially in the elderly. Symptoms may include fever; pain; and stiff, swollen joints. The lower spine and weight-bearing joints are most often affected.
- **Peritoneum.** Tuberculosis bacteria can infect the inner lining of the abdomen. Symptoms may include a fever and buildup of fluid inside the abdomen, which often goes along with a buildup of fluid around the lungs.
- **Heart.** Tuberculosis bacteria can infect the sac enclosing the heart. Although this is extremely rare, the death rate is high when it does occur. Symptoms may include shortness of breath, chest pain, and fever.



▲
The red spot on the arm indicates a positive skin test for TB.

©PHOTOTAKE Inc./Alamy.

Germ that Resists Arrest

Multi-drug resistant (MDR) tuberculosis, caused by bacteria that cannot be killed by regular tuberculosis drugs, is very dangerous. Even with treatment, 40 to 60 percent of people with MDR tuberculosis die. People with MDR tuberculosis must take special medications that do not work as well as the usual tuberculosis drugs and that have more side effects.

MDR tuberculosis occurs when TB patients stop taking their prescribed medications or do not take them as directed. Patients often stop taking the drugs when they begin to feel better. However, TB bacteria can survive inside the body for several months during treatment and are ready to spring back into activity when the medication disappears.

One way to fight this problem is through directly observed therapy (DOT). In DOT, patients must take their medications regularly in the presence of a health professional. Home visits by health professionals to supervise the taking of medications or free transportation and meals often are provided to encourage patients to take part in this type of program.

MDR tuberculosis is common in some parts of the world, including Southeast Asia, Latin America, Haiti, and the Philippines.

How Is Tuberculosis Diagnosed?

A skin test known as the Mantoux or PPD (purified protein derivative) test is used to diagnose primary tuberculosis. For this test, a small amount of testing fluid is injected with a fine needle just beneath the skin on the lower part of the arm. Two to three days later, a healthcare professional checks the arm to see if a bump has formed at the site of the injection. If a bump wider than a certain size is present (for most people, 10 to 15 millimeters or a half inch), the patient most likely has been infected by TB bacteria; this is known as a positive test. Doctors may order more tests, such as a chest x-ray and a test of sputum that is coughed up, to see if secondary (active) tuberculosis is present.

How Is Tuberculosis Treated?

Primary tuberculosis People with primary tuberculosis who are in high-risk groups for developing active TB may be given medication to help ward off the illness. This treatment is called preventive therapy. People under age 35 with primary tuberculosis who are not in high-risk groups also may benefit from preventive therapy. The goal is to kill the bacteria that are not doing any harm now but that could cause active TB in the future. The medication usually given for this purpose is called isoniazid (INH). To kill these bacteria, however, INH must be taken every day for 6 to 12 months.

Secondary (active) tuberculosis Secondary (active) tuberculosis can often be cured with medication. People with secondary TB usually take several different drugs because doing so is more effective at killing all the bacteria and preventing the formation of resistant bacteria that cannot be killed by drugs.

Although they usually feel better after a few weeks of treatment, people with active TB must continue to take their medication correctly for the full length of the treatment or they can become sick again. Because people with tuberculosis of the lungs or throat can spread the infection to others, they need to stay home from school or work until they are no longer infectious to others, which usually takes several weeks.

People with tuberculosis who are sick enough to go to the hospital may be put in a special room with an air vent system that keeps the bacteria from spreading. Doctors, nurses, and others who work in such rooms must wear special facemasks to protect themselves from breathing the bacteria.

How Can the Spread of Infection Be Stopped?

The Centers for Disease Control and Prevention recommends that certain people at risk for getting tuberculosis get the skin test yearly so that treatment can begin immediately if they are found to have TB. These include:

- People who have spent a lot of time with other people who are infected with TB
- People who think they may have caught the disease for other reasons

- People who have HIV infection or other medical problems that put them at high risk for getting tuberculosis
- People who inject street drugs
- People who come to the United States from countries where tuberculosis is more common (most countries in Latin America and the Caribbean, Africa, and all of Asia except for Japan)
- People who live in the United States in environments in which tuberculosis is common (homeless shelters, migrant farm camps, prisons, and some nursing homes)

People who have tuberculosis can keep from spreading the infection by taking all their medication exactly as prescribed; visiting their doctors regularly; staying away from people until they are no longer infectious to others; covering their mouths with a tissue when they cough, sneeze, or laugh; and airing out the room often.

Tuberculosis bacteria can only be spread through the air. Other people cannot be infected by shaking hands, sitting on toilet seats, or sharing dishes or personal items with people who have tuberculosis. If close contact with someone who has TB is necessary, a special type of facemask (called a respirator) should be worn.

Bacillus Calmette-Guerin (BCG) is a vaccine* that can help protect people against tuberculosis infection. It does not always work and may cause a positive reaction to the tuberculosis skin test, making it harder to tell if people become infected despite the vaccine. BCG is not widely used in the United States, but it often is given to babies and young children in countries where tuberculosis is common.

▶ See also **AIDS and HIV Infection • Bacterial Infections • Pneumonia**

Resources

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Organizations

American Lung Association. 1301 Pennsylvania Ave. NW, Suite 800, Washington, DC, 20004. Toll free: 800-LUNG-USA. Web site: <http://www.lungusa.org>.

Centers for Disease Control and Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/tb/default.htm>.

National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC

* **vaccine** (vak-SEEN) is a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.



▲
Hand with tularemia ulcer. *Photo Researchers, Inc.*

* **mucous membranes** are the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.

6612, Bethesda, MD, 20892-66123. Toll free: 866-284-4107.
Web site: <http://www3.niaid.nih.gov>.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/en>.

Tularemia

Tularemia (too-lah-REE-me-uh), sometimes called rabbit fever, is an infection caused by bacteria that can spread from wild animals to humans.

Do Rabbits Cause Rabbit Fever?

The bacterium *Francisella tularensis* (fran-sih-SEL-uh too-lah-REN-sis) causes tularemia. Most cases of tularemia in people in the United States result from contact with infected rabbits and deer, although the bacterium can also live in other small mammals and birds and in the soil.

Tularemia bacteria enter the body through the mucous membranes*, the skin, the lungs, or the digestive system. Seven different forms of the disease exist:

- **Ulceroglandular tularemia** comes from handling an infected animal or from the bite of an infected tick, fly, or mosquito. An ulcer (an open sore) forms on the skin. Some symptoms include headache, fever, chills, and lack of energy.
- **Glandular tularemia** causes symptoms similar to those of the ulceroglandular form but an ulcer does not form. The bacteria may enter the body through small cuts in the skin. Most cases of rabbit fever in the United States are glandular or ulceroglandular tularemia.
- **Oculoglandular tularemia** comes from touching the eye with infected fingers. The eye becomes red and painful and has a discharge.
- **Oropharyngeal tularemia** arises from eating the undercooked meat of an infected animal or from drinking water contaminated by the bacterium. It causes digestive system symptoms, such as vomiting or diarrhea.
- **Pneumonic tularemia** results from inhaling spores (an inactive form of the germ enclosed in a protective shell) in dust from a contaminated area into the lungs. Other types of tularemia may also spread to the lungs.

- **Typhoidal tularemia** affects many organs of the body. This rare form of the disease occurs without any previous signs of infection in any specific part of the body.
- **Septic tularemia** is a severe form of the disease that affects the whole body. Someone with this form may go into shock* and experience serious complications.

How Do People Contract Rabbit Fever?

People cannot catch tularemia from one another. Most cases in the United States occur when someone gets a bite from a tick, fly, or mosquito that has previously bitten an infected rabbit or deer. If a person is in contact with infected animals, the bacterium may be able to enter that person's body through small cuts on the skin. Hunters contract tularemia from handling carcasses or from eating undercooked, contaminated meat. In rare cases, people may breathe in bacterial spores that have been released into the air from the soil where the bacteria live. Drinking contaminated water is another rare but possible way to contract the disease.

Is Tularemia Common?

Tularemia occurs in the United States, Europe, and Asia, mainly in rural areas. Tularemia is highly infectious, but fewer than 200 cases in the United States are reported each year (mostly from Missouri, Arkansas, and Oklahoma). Some additional cases may occur but remain unrecognized or unreported.

Tularemia affects people of every age, sex, and race. In spring and summer months, it occurs most often in children who become infected when playing outside. In fall and winter, hunters are more likely to contract the infection.

What Are the Symptoms of Tularemia?

Symptoms of tularemia depend on the form of the disease. Most infected people have a red spot at the site of the insect bite or the cut where the bacterium entered the body. This spot may become an ulcer.

Other signs and symptoms appear within one to 14 days (most frequently in two to five days) and may come on suddenly. They can include extreme tiredness, muscle aches, fever, headache, sweating, chills, and weight loss. Lymph nodes* in the groin and armpits may become swollen.

People who contract tularemia from inhaled bacteria usually have pneumonia*-like symptoms, such as a dry cough, shortness of breath, or discomfort in the chest area. This form can progress to shock and respiratory failure*.

People who drink contaminated water or eat contaminated meat may experience nausea (NAW-zee-uh), vomiting, pain in the abdomen, diarrhea, sore throat, and sometimes gastrointestinal* bleeding.

Tularemia—the Next Anthrax?

As few as 10 spores of the *Francisella tularensis* bacterium are enough to infect someone and cause tularemia.

The bacterium is hard to destroy and the spores are easily released into the air, which also makes it a potent weapon.

The United States stockpiled the bacteria as a biological weapon during the 1960s but destroyed its stores in the 1970s at the order of the president. Russia, too, stockpiled and produced the bacteria through the mid-1990s. Experts on biological weapons have warned that other groups could possibly use the bacteria as a weapon, noting that an aerosol release of the bacteria in a city of five million would result in severe symptoms to 250,000 people.

No tularemia vaccine was available in the United States as of 2009, but other countermeasures were. In 2001 a group of 25 health experts, government agency representatives, and others issued a report with recommendations about how to react to an intentional release of the bacteria. If the release was discovered before people began to fall ill, the recommendations called for the swift and widespread use of the antibiotics doxycycline or ciprofloxacin to dampen the effects of the bacteria. If people were already developing symptoms, the recommendations emphasized the use of the antibiotics streptomycin and gentamicin.

* **shock** is a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **respiratory failure** is a condition in which breathing and oxygen delivery to the body are dangerously altered. This may result from infection, nerve or muscle damage, poisoning, or other causes.

* **gastrointestinal** (gas-tro-in-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.

* **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

How Is Tularemia Diagnosed?

Doctors use blood tests to check for tularemia. Some tests look for antibodies* to the *Francisella tularensis* bacterium. Doctors also may look for evidence of the bacterium in the blood, fluid from the nose and mouth, and lymph nodes. If the person has symptoms of pneumonia, the doctor will also order a chest x-ray.

How Is Tularemia Treated?

Tularemia responds well to antibiotics, and most people can receive treatment at home. Because tularemia is not contagious, people who have it do not have to be isolated.

In more severe cases, when the disease attacks the lungs or other organs, people may require hospitalization and closer monitoring.

Most people who receive treatment recover from tularemia, but the septic and pneumonic forms of the disease can be life-threatening. Symptoms of tularemia can last for several weeks. Most people do not experience any lasting damage from the disease and may develop some degree of immunity* to it.

Complications of tularemia can include pneumonia, meningitis*, osteomyelitis*, kidney problems, lung abscesses*, pericarditis (inflammation of the sac surrounding the heart), shock, and, rarely, death. Approximately 1.4 percent of all cases in the United States are fatal.

Can Tularemia Be Prevented?

In the past, laboratory workers at risk for contracting tularemia due to frequent contact with laboratory animals received vaccinations against the disease. That vaccine was unavailable for public use in the United States as of 2009. The Food and Drug Administration was, however, continuing its review of a potential vaccine for use by the general public.

The best way to avoid contracting tularemia is to prevent tick and insect bites by using repellent and by wearing light-colored clothing that covers the arms and legs. Another prevention measure is to avoid contact with certain wild animals, such as rabbits. Experts recommend that hunters wear rubber gloves when handling animals and that they cook all meat thoroughly. In addition, people should avoid swimming in or drinking water that might be contaminated.

▶ See also **Bioterrorism • Meningitis • Osteomyelitis • Pneumonia • Tick-borne Illnesses • Zoonoses**

Resources

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National Institute of Allergy and Infectious Diseases. Office of Communications and Public Liaison, 6610 Rockledge Drive, MSC 6612, Bethesda, MD, 20892-6612. Toll free: 866-284-4107. Web site: <http://www.niaid.nih.gov/factsheets/tularemia.htm>.

* **osteomyelitis** (ah-stee-o-my-uh-LYE-tis) is a bone infection that is usually caused by bacteria. It can involve any bone in the body, but it most commonly affects the long bones in the arms and legs.

* **abscesses** (AB-seh-sez) are localized or walled off accumulations of pus caused by infection that can occur anywhere within the body.

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

Tumor

A tumor (TOO-mor) is an abnormal growth of new tissue that can occur in any of the body's organs. Many people automatically associate tumors with the disease called cancer, but cancer is not always present when someone has a tumor.*

What Is a Tumor?

The human body is made up of many types of cells that are constantly dividing to produce new, younger cells that can “take over” for aging or damaged cells. Through this process, the body heals its injuries and keeps tissues healthy. Sometimes, this process gets out of control, and new cells continue to be produced even when they are not needed, forming a clump of extra tissue, a tumor.

There are two types of tumors:

- malignant (ma-LIG-nant), or cancerous, tumors are made up of abnormally shaped cells that grow quickly, invade nearby healthy tissues, and often make their way into the bloodstream. When these cells travel to other parts of the body, they form additional tumors in other locations.
- Benign (be-NINE) tumors are not cancerous. They grow slowly and are self-contained; that is, they do not invade and destroy the tissue around them, nor do they spread to other parts of the body. Their cells are usually normally shaped.

Who Gets Tumors?

People of all ages can develop tumors, but generally they are more common as people grow older. Researchers believe that malignant tumors result from a combination of causes, the most important being genetic

* **colon** (KO-lin), also called the large intestine, is a muscular tube through which food passes as it is digested, just before it moves into the rectum and out of the body through the anus.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

and environmental. People may inherit a tendency to develop certain kinds of tumors from their parents. Also, repeated exposure to harmful substances such as cigarette smoke, pollutants, and too much sunlight can damage cells and trigger the process of tumor formation.

When a tumor first starts to develop, it is so small that it does not cause symptoms. As it grows, it usually causes symptoms that vary according to its location. For instance, a tumor in the lung may cause a feeling of irritation or a nagging cough. People with brain tumors may experience headaches, dizziness, blurry vision, or loss of coordination. A person with a tumor in the colon* may notice that going to the bathroom is painful or produces blood.

How Are Tumors Diagnosed and Treated?

A doctor can usually diagnose a tumor with one of many tests that create images of the inside of the body, such as x-rays, ultrasound*, CT scans*, or MRIs*. The next step is to figure out whether the tumor is benign or malignant through a process called biopsy (BY-op-see). Surgeons remove part or all of the tumor and examine a sample under the microscope. The appearance of the cells indicates whether a tumor is cancerous.

Even though a benign tumor is not harmful, it may have to be removed if it causes pain, pressure, or other symptoms. In many cases of a malignancy, the tumor and any affected surrounding tissue will be removed. Sometimes, radiation therapy (directed high-energy x-rays) or chemotherapy (cancer-fighting drugs) may be used to shrink the tumor.

▶ See also **Cancer: Overview • Tobacco-Related Diseases**

Resources

Books and Articles

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Organizations

National Cancer Institute Public Inquiries Office. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/benigtumors.html>; <http://www.nlm.nih.gov/medlineplus/cancer.html>.

Turner's Syndrome

Turner's syndrome (also called Turner syndrome) is a genetic disorder caused by a missing or partially missing X chromosome. It affects only females and typically causes a variety of physical abnormalities. Girls and women with Turner's syndrome usually are short, their ovaries and breasts fail to develop normally, and they are almost always infertile.

What Is Turner's Syndrome?

Turner's syndrome is a genetic disorder that occurs when one of a girl's X chromosomes is partially or completely missing. Almost every cell in a person's body (except for eggs and sperm cells) has 23 pairs of chromosomes. One pair, the sex chromosomes, makes a person male or female: Boys have an X and a Y chromosome (XY), whereas girls have two X chromosomes (XX). The chromosomes contain all of the information the body needs to function and to develop properly. If part of a chromosome is missing, as in Turner's syndrome, the important information on that chromosome is also missing.

How a girl's body is affected physically by Turner's syndrome depends on how much of the chromosome is missing. Some girls have a mild form of the syndrome that is not detected until they are teenagers or adults. If untreated, nearly all girls with Turner's syndrome grow slowly and reach a short adult height, and their breasts do not enlarge, and they do not have menstrual periods as is normal for adolescent girls. Some may have additional problems, including the following:

- abnormalities in appearance
- hearing loss
- obesity
- heart disorders
- kidney disorders
- thyroid disorders

Most of the physical conditions are treatable, and with good consistent medical care, a person with Turner's syndrome can have a fully productive life and normal life span. Most people with Turner's syndrome have normal intelligence, but some may have specific learning problems, especially with math.

It is believed that approximately 98 percent of pregnancies in which the mother is carrying a fetus with the genetic defect that would become Turner's syndrome will spontaneously end in miscarriage*.

What Causes Turner's Syndrome?

About 1 in 2,500 female babies is born with Turner's syndrome, and doctors do not know why. Researchers have tried to find a link between Turner's syndrome and environment, race, geography, and socioeconomic status, but as of 2009 these factors had not been proven to play a role.

* **miscarriage** (MIS-kare-ij) is the end of a pregnancy through the death of the embryo or fetus before birth.

Living with Turner's Syndrome: Carol's Life

Because of physical abnormalities and feeling “different,” life might not be easy for a girl with Turner's syndrome. Carol was born with swollen hands and feet, extra skin at the back of her neck (a webbed neck), oddly shaped ears, and arms that tilted outward from the elbows. Based on her appearance, her doctor suspected that she had Turner's syndrome. A test in which Carol's chromosomes were studied confirmed that she was missing one of her X chromosomes.

Carol was teased about her appearance in elementary school, but she was most miserable during her teenage years. She was the shortest person in her class. When other girls started developing breasts and getting their period, Carol still looked and felt like a little girl. After Carol's doctor prescribed the hormone estrogen to promote sexual development, she finally got her period.

How Do Doctors Treat Turner's Syndrome?

Many of the problems associated with Turner's syndrome, such as the failure of the ovaries to develop normally, cannot be prevented, but there are a number of medical treatments that can be performed to improve an affected person's quality of life:

- Plastic surgery for the neck, face, or ears can improve appearance and self-esteem, if necessary.
- Growth rate and adult height may be increased by treatment with injections of growth hormone.
- Taking the female hormone estrogen promotes sexual development in girls with Turner's syndrome.
- Support groups can help girls with Turner's syndrome develop into confident, successful, and productive adults.
- In some cases, women with Turner's syndrome may be able to become pregnant if a fertilized donor egg is inserted into their uterus.

▶ See also **Genetic Diseases • Growth and Growth Disorders • Menstruation and Menstrual Disorders**

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Organizations

Eunice Kennedy Shriver National Institute of Child Health and Human Development. Turner Unit, 10 Center Drive, CRC 1-3330, Bethesda, MD, 20892-1103. Toll free: 800-370-2943. Web site: <http://turners.nichd.nih.gov/clinical.html#Anchor>.

Turner Syndrome Society of the United States. 10960 Millridge North Drive, No. 214A, Houston, TX 77070. Toll free: 800-365-9944. Web site: <http://www.turnersyndrome.org/index.php>.

Twins See *Conjoined Twins*.

Typhoid Fever

Typhoid fever is a bacterial infection that is common in many parts of the world. It is spread by contaminated water and food and primarily affects the digestive system.

What Is Typhoid?

In many developing countries, typhoid fever is a major problem. An estimated 16 million are infected and more than 500,000 die each year worldwide. The disease is especially common in parts of Asia, Africa, and South America where pure water is not readily available and sewage treatment is inadequate. In many countries, children are the most likely to get typhoid.

Typhoid used to be a serious problem in the United States as well. Early in the twentieth century, before clean water supplies and sewage systems to dispose of human waste were widely available, about 35,000 people contracted typhoid fever each year. Technological advancements in sewage and water treatment made typhoid fever rare in industrialized countries. Only about 400 cases are reported each year in the United States. In most of these cases, the individuals had acquired the disease while traveling abroad.

What Causes Typhoid Fever?

Typhoid fever is caused by a bacterium called *Salmonella typhi*. It is related to the salmonella bacteria that cause food poisoning, but they are not exactly the same.

Salmonella typhi bacteria are present in the solid wastes (stool) of infected people, including some “healthy carriers” who have no symptoms of illness. The bacteria can spread if human waste gets into water that is used for drinking, irrigating crops, or washing food. Typhoid is also occasionally transmitted through an infected person who is working in food preparation. Once swallowed, the bacteria move from the digestive tract into the bloodstream and then to the liver, spleen, gall bladder, and lymph nodes.

The United States and the World

About 21.5 million cases of typhoid fever occur each year worldwide, and more than 200,000 people die from this disease.

The disease is common in many underdeveloped nations, especially in parts of Asia and in South America, with unsanitary water and food preparation. The situation is made more difficult because the disease shows resistance to some of the traditional antibiotics used to treat those who are infected.

About 400 cases a year are reported in the United States, but about 70 percent of them involve people who have traveled internationally.

In 1998 and 1999, 13 people in Florida contracted typhoid fever when they drank shakes made with a frozen tropical fruit containing *Salmonella typhi*.

Typhoid fever is suspected in the deaths of such famous people as Alexander the Great, Wilbur Wright of the Wright Brothers, and poet Gerard Manley Hopkins.

* **constipation** is the sluggish movement of the bowels, usually resulting in infrequent, hard stools.

TYPHOID MARY

Some people, called carriers, can be infected with *Salmonella typhi* but not develop typhoid fever. If they prepare food for others, however, they may contaminate the food they handle and pass the bacteria on to other people who eat it and then may get sick.

The most famous typhoid carrier was Mary Mallon (1869–1938), also known as Typhoid Mary, who worked as a cook in homes in New York and New Jersey in the early 1900s. Fifty-one cases of typhoid fever resulting in three deaths were traced to her. Mallon never was sick herself, however, and she never accepted that she had infected anyone else.

Against her will, the authorities confined Mallon to a hospital on North Brother Island in New York's East River. Three years later, in 1910, they released her on condition that she never work as a cook again. But in 1915 typhoid struck a maternity hospital in Manhattan, and it turned out that Mallon had cooked there. She spent the rest of her life, 23 years, as a captive on North Brother Island.

What Happens When People Have Typhoid Fever?

Symptoms The symptoms of typhoid fever come on gradually. At first, people may get a headache, stomachache, and constipation*. The people develop a fever and lose their appetite. In some cases, they may get rose spots, a rash mostly on the chest and abdomen. As symptoms worsen, their fever may rise as high as 103 to 104 degrees Fahrenheit. People often develop bloody diarrhea, become dehydrated (lose fluids faster than they are replaced), and start acting confused or disoriented. In severe cases, people may go into a coma, a state of deep unconsciousness, and die.

Diagnosis and Treatment A blood or urine test usually can detect the presence of the bacterium that causes typhoid fever. Antibiotic drugs that fight the bacterial infection can make the illness shorter and milder and prevent complications. Fluids may be given as well to counter the effects of diarrhea. Severe infections can lead to a perforation (hole) in the intestine that requires surgery to repair.

How Is Typhoid Fever Prevented?

Clean water supplies and effective waste disposal systems are the best ways of preventing typhoid, but these are lacking in many countries. A vaccine is available in the early 2000s that is about 70-percent effective for several years.

Travelers to countries where typhoid fever is common should drink only boiled or bottled water. They should eat only food that has been properly cooked or fruit that they peel themselves and that has not been washed with tap water. The Centers for Disease Control and

Prevention sums up advice for travelers this way: “Boil it, cook it, peel it, or forget it.”

▶ See also **Bacterial Infections • Fever • Gastroenteritis • Salmonellosis**

Resources

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Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: http://www.cdc.gov/ncidod/dbmd/diseaseinfo/typhoidfever_g.htm.

World Health Organization. Avenue Appia 20, CH - 1211 Geneva 27, Switzerland. Telephone: +41 22 791 2111. Web site: <http://www.who.int/en>.

Typhus

Typhus (TI-fus) is the name for a group of infections caused by bacteria called rickettsiae that are spread by parasites such as lice that live on people or on other warm-blooded animals such as rats and mice.

War, Famine, and Typhus

Throughout history, war and famine have brought outbreaks of typhus, a group of infections spread by parasites that live on people or animals such as rats and mice. During World War II, typhus spread through Europe, North Africa, and the Pacific Islands, and it killed thousands of prisoners in German concentration camps. Epidemic typhus can still be a serious threat in parts of the world where a breakdown in society or a natural calamity such as an earthquake leads to unhealthy living conditions.

What Is Typhus?

Typhus is a group of infections caused by rickettsiae, a group of unusual bacteria. Rickettsiae are like other bacteria in that they can be killed by antibiotics. They are also like viruses, however, in that they must invade living cells in order to grow. There are three main types of typhus: epidemic, murine, and scrub.

- Epidemic typhus, caused by *Rickettsia prowazekii*, is a severe form of the disease spread by human body lice. In the United States,

TYPHUS EPIDEMICS

It is likely that typhus existed in ancient times, although the first specific historical description of typhus comes from the 11th century, when an outbreak took place in a monastery in Sicily. Typhus reached epidemic proportions in 1489, during a siege in Granada. Typhus then spread throughout Europe.

Typhus also was present in the Americas, although there is some controversy as to whether Spanish explorers brought the disease in the 16th century or whether the disease already was present in Aztec and other pre-Columbian societies.

In the early 19th century, typhus increased dramatically in Europe. In the 20th century, typhus spread through Europe, North Africa, and the Pacific Islands. During World War II, typhus killed thousands of prisoners in German concentration camps.

this type of typhus occasionally is also spread by lice and fleas on flying squirrels. Sometimes the symptoms of typhus become active again years after the individual suffered the original attack; this reoccurrence is called Brill's disease. Brill's disease is milder than epidemic typhus.

- Murine typhus, caused by *Rickettsia typhi*, is a milder form of the disease and is spread by fleas on rats, mice, and other rodents.
- Scrub typhus, caused by *Rickettsia tsutsugamushi*, is a form of the disease found in the Asian-Pacific area bounded by Japan, Australia, and the Indian subcontinent. It is spread by mites on rats, field mice, and other rodents.

Who Gets Typhus?

Both epidemic and murine typhus are found around the world. However, epidemic typhus is most common in situations where poor hygiene and crowded living conditions exist. Epidemic typhus is rare in the United States. Murine typhus is most common in rat-infested areas. It is the only type of typhus that occurs regularly in the United States, but fewer than 100 cases a year are reported, mainly in Texas and California.

What Happens When People Have Typhus?

Symptoms The symptoms of typhus include fever, headache, chills, and general aches that are followed by a rash. The rash spreads to most of the body but usually does not affect the face, palms of the hands, or soles of the feet. In murine typhus, the symptoms are similar but milder. In epidemic and scrub typhus, the fever may rise as high as 104 to 105 degrees Fahrenheit and stay high for about two weeks. The headache is intense.

In severe cases of typhus, blood pressure may drop dangerously. Severe illness also may lead to confusion, seizures, coma*, or even death. The disease's name comes from the Greek word "typhos," meaning smoke, a cloud, or a stupor arising from a fever.

Diagnosis and Treatment Blood tests are used to show if people are infected with typhus rickettsiae. People with typhus who are treated with antibiotics generally recover. If treatment is begun early, they usually get better quickly. If treatment is delayed, however, the improvement usually is slower, and the fever lasts longer. If left untreated, typhus can damage organs, lead to coma, and even to death.

Prevention Prevention of typhus is based on avoiding the unsanitary conditions in which it spreads. It is always wise to avoid contact with animals such as rats and mice that may carry disease. Travelers to areas where typhus is common should be especially cautious. To prevent the spread of typhus, body lice must be destroyed by removing them from people with the disease and by boiling or steaming the clothes of infected individuals.

▶ See also **Bacterial Infections • Lice • Rickettsial Infections • Rocky Mountain Spotted Fever**

Resources

Books and Articles

Zinsser, Hans. *Rats, Lice and History: A Study in Biography*. New Brunswick, NJ: AldineTransaction, 2007.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://wwwn.cdc.gov/travel/yellowBookCh4-Rickettsial.aspx>.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

U

Ulcer See *Bedsores (Pressure Sores)*; *Canker Sores (Aphthous Ulcers)*; *Helicobacter Pylori Infection*.

Ulcerative Colitis See *Inflammatory Bowel Disease*.

Urethritis, Nonspecific See *Nonspecific Urethritis*.

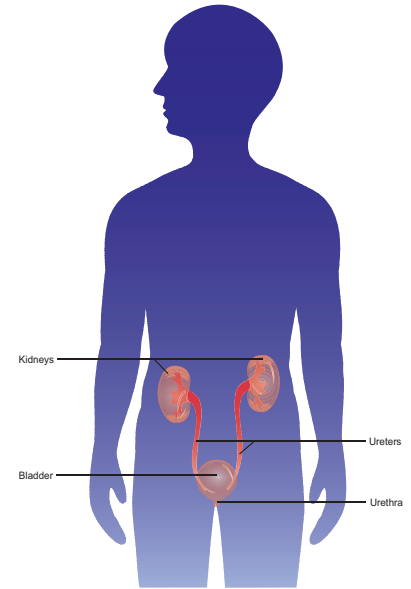
Urinary Tract Infections

A urinary (YOOR-ih-nair-e) tract infection, or UTI, is an infection that occurs in any part of the urinary tract. The urinary tract is made up of the urethra*, bladder*, ureters*, and kidneys*.

What Are Urinary Tract Infections?

A UTI usually is caused by bacteria that under normal circumstances should never be present in the urine. The bacterium most often responsible for UTIs is *Escherichia coli* (eh-sheer-IH-she-ah KOH-lye). Many kinds of *E. coli* bacteria normally are found in human intestines*, but sometimes they are able to make their way into the urethra. When this happens, the bacteria can spread up into other parts of the urinary tract and cause an infection. Other types of bacteria from the intestines and some viruses also can produce infections in the urinary tract. The bacteria *Chlamydia* (kla-MIH-dee-uh) and *Mycoplasma* (my-ko-PLAZ-muh) can cause UTIs as well, but these types of infections usually stay in the urethra or reproductive system.

The type of UTI that a person contracts depends on which part of the urinary system is infected with bacteria. If bacteria grow in the urethra and cause inflammation, the condition is called urethritis (yoo-ree-THRY-tis). If the infection involves the bladder, the condition is called cystitis (sis-TIE-tis). If infection has spread to the kidneys, the condition is called pyelonephritis (py-uh-lo-nih-FRY-tis).



The organs of the urinary tract, any of which may become the site of infection. Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.

* **urethra** (yoo-REE-thra) is the tube through which urine passes from the bladder to the outside of the body.

* **bladder** (BLAD-er) is the sac that stores urine produced by the kidneys prior to discharge from the body.

* **ureters** (YOOR-eh-ters) are tube-like structures that carry urine from the kidneys to the bladder.

* **kidneys** are the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

* **intestines** are the muscular tubes that food passes through during digestion after it exits the stomach.

- * **anus** (A-nus) is the opening at the end of the digestive system, through which waste leaves the body.
- * **kidney stone** is a hard structure that forms in the urinary tract. This structure is composed of crystallized chemicals that have separated from the urine. It can obstruct the flow of urine and cause tissue damage and pain as the body attempts to pass the stone through the urinary tract and out of the body.
- * **prostate** (PRAH-state) is a male reproductive gland located near where the bladder joins the urethra. The prostate produces the fluid part of semen.
- * **urinary catheters** are thin tubes used to drain urine from the body.
- * **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.
- * **nitrates** (NYE-trayts) are chemical substances that can be produced by the breakdown of proteins by certain bacteria.

How Common Are Urinary Tract Infections?

Urinary tract infections are very common: Millions of people, especially women, have them every year. It is estimated that one in five women have at least one UTI in her lifetime, and some women have them repeatedly. UTIs are not uncommon in children; by the time children reach their eleventh birthday, 3 in 100 girls and 1 in 100 boys have had a UTI. Women and girls are at a higher risk of UTIs because the female urethra is much shorter than the male urethra. A shorter urethra means a shorter distance for bacteria to travel to enter the urinary tract. Also, because the opening of the urethra is much closer to the anus* in females, if a girl has a bowel movement and any bacteria are left on the skin nearby, it is easy for them to invade the urethra.

Males may have UTIs too, but these infections usually result from something in the urinary tract that blocks the normal flow of urine from the body, such as a kidney stone* or an enlarged prostate* in older men. In fact, anyone who has a problem with the structure of the urinary tract or the way it functions is more likely to have UTIs. Urinary catheters* can cause UTIs in either men or women because bacteria can enter the urinary tract more easily when a catheter is present. For this reason, UTIs can be a serious problem among patients in hospitals, where catheters are used frequently. UTIs are not contagious, which means that a person cannot catch a UTI from someone who has one. *Chlamydia* and *Mycoplasma* bacteria, however, can be transmitted through sexual intercourse.

What Are the Signs and Symptoms of a Urinary Tract Infection?

Some people may not have any symptoms of a UTI, but when the infection occurs, it usually brings with it a burning or stinging feeling during urination. People with UTIs may feel as if they have to urinate more frequently and more urgently than usual, but when a person does urinate, sometimes very little urine comes out. A UTI can make a person feel very tired or feverish; it also can produce a feeling of pressure in the lower belly in women and a sensation of pressure or fullness in the rectum* in men. The urine itself can be cloudy or have a bit of blood in it, and it may smell bad. If the bacteria spread to the kidneys and cause pyelonephritis, the person typically feels very ill, with fever, chills, nausea (NAW-zee-uh), vomiting, and sharp pain in the back or side.

How Do Doctors Diagnose Urinary Tract Infections?

If a doctor suspects that a patient has a UTI, he or she will ask about the person's symptoms to rule out other conditions. For example, an allergic reaction to a soap may cause irritation of the urethra that could lead to stinging when a person urinates, mimicking a UTI. The doctor may take a urine sample and then dip a special strip of paper into it, testing for infection-fighting white blood cells, protein, nitrates*, and blood, which can all be signs that a UTI might be present. The urine sample may be examined under a microscope for bacteria and types of white blood cells that might point to

infection. To confirm the presence of a UTI, the urine sample may be cultured*. Any bacteria that grow are tested to see which antibiotics will kill them, which helps the doctor choose a medication for treating the UTI.

If an infant has a UTI or if an adult or child has repeated UTIs, the doctor may want to see if there are any problems in the urinary tract that may be causing or contributing to the infections. The doctor may order tests (such as special x-rays or ultrasound* images of the urinary tract) to take a better look at the shape and function of the kidneys, bladder, and ureters. If there are any problems, the patient may be referred to a urologist, a doctor who specializes in diagnosing and treating problems of the urinary tract. The urologist can examine the urethra and bladder with a cystoscope (SIS-tuh-skope), a special lighted tube with lenses that is inserted into the urethra.

What Is the Treatment for Urinary Tract Infections?

Once a doctor confirms that a bacterial UTI is present, antibiotics are prescribed, which usually clear up the infection. If the UTI involves the kidneys, the condition can be more serious. Patients with a kidney infection usually need to be treated in a hospital. Antibiotics and fluids may be given intravenously* until fever disappears and the patient begins to feel better. Even if they have no symptoms, all men typically are treated if they are found to have a UTI, and so are women who are pregnant and those who have diabetes* or abnormalities of the urinary tract. Treatment is necessary in these cases because there is a higher risk of pyelonephritis. Young women who have bacteria in the urine but who do not have symptoms of a UTI usually do not need treatment.

A person taking antibiotics for urethritis or cystitis usually feels much better soon after starting the medication. During the first few days of treatment, a heating pad can help soothe some of the lower belly pain that may come with UTIs. There are also medicines that ease discomfort during urination. It is important to remember that these medicines do not treat the infection; they treat only the symptoms of stinging and burning. Doctors advise people with UTIs to take all prescribed antibiotics, which usually are given for about a week. Taking all of the prescribed medication is necessary even if a patient begins to feel better right away. Stopping the antibiotics early can mean that the infection will come back, because all the bacteria may not have been killed. A person with pyelonephritis typically can expect a longer recovery time, possibly up to several weeks. It is very important that kidney infections be cured completely because they can lead to serious problems, such as permanent kidney damage, high blood pressure*, and even kidney failure later in life.

Can Urinary Tract Infections Be Prevented?

When it comes to preventing UTIs, practicing good hygiene is a major part of keeping bacteria from entering the urinary tract. It is wise for men and women to keep the genital*, urinary, and anal areas clean. It is recommended that women wipe from front to back, from the urinary tract opening to the anus, after going to the toilet.

* **cultured** (KUL-churd) means subjected to a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

* **intravenously** (in-tra-VEE-nus-lee) means given or injected directly through a vein.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **high blood pressure** also called hypertension, is a condition in which the pressure of the blood in the arteries is above normal.

* **genital** (JEH-nih-tul) refers to the external sexual organs.

- * **malformation** (mal-for-MAY-shun) is an abnormal formation of a body part.
- * **uterus** (YOO-teh-rus) is the muscular, pear-shaped internal organ in a woman where a baby develops until birth.
- * **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.

Doctors advise that people who want to keep UTIs at bay drink plenty of water, which helps flush out the urinary tract. Going to the bathroom when a person feels the need to go, instead of holding urine in, also can help deter UTIs. Finally, some foods or drinks (such as spicy foods or foods or drinks that contain caffeine) can irritate the bladder; it is a good idea for a person with a UTI to avoid them if they cause irritation. Some research suggests that drinking cranberry juice may have a beneficial effect in preventing UTIs.

Infants, children, and adults who have UTIs as a result of a malformation* or other problems in the urinary tract are at increased risk of contracting UTIs. Their doctors may prescribe small doses of antibiotics to take every day for several months or longer to help prevent infections and possible damage to the kidneys over time.

▶ See also **Pinworm Infestation • Schistosomiasis • Sexually Transmitted Diseases (STDs)**

Resources

Books and Articles

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West, Krista. *Urinary Tract Infections*. New York: Rosen, 2007.

Organizations

Healthcommunities.com, Inc. 136 West Street, Northampton, MA, 01060. Toll free: 888-950-0808. Web site: <http://www.urologychannel.com>.

National Kidney and Urologic Diseases Information Clearinghouse. 3 Information Way, Bethesda, MD, 20892-3580. Toll free: 800-891-5390. Web site: <http://kidney.niddk.nih.gov/Kudiseases/pubs/utiadult>.

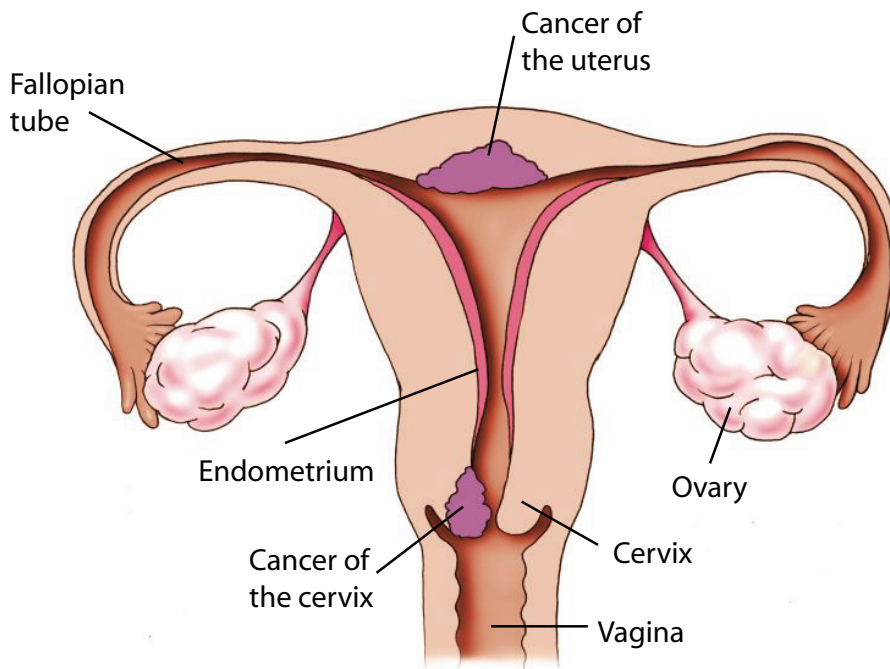
National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web site: <http://www.4woman.gov/faq/Easyread/uti-etr.htm>.

Uterine Cancer

Uterine (YOO-te-rin) cancer occurs in the tissue of the uterus, part of the reproductive tract of women.

What Is the Uterus?

The uterus* is the hollow, pear-shaped organ in which a fetus* develops when a woman is pregnant.



Anatomy of the female reproductive system showing uterine and cervical cancers. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

What Is Uterine Cancer?

Uterine cancer is the fourth most common type of cancer among women. It occurs when cells in a woman's uterus undergo abnormal changes and start dividing without control or order, forming tumors*.

Uterine cancer* usually begins in the cells of the endometrium (en-do-MEE-tree-um), the thin layer of tissue that lines the inside of the main part of the uterus. That is why it is sometimes called endometrial (en-do-MEE-tree-al) cancer.

Uterine cancer is more common in women who have gone through menopause* (usually 50 years old or older), but it can occur earlier. It usually develops gradually, with some of the cells first undergoing precancerous changes. These cells are not yet cancerous, but they have undergone some abnormal changes that indicate that they could turn into cancer.

What Causes Uterine Cancer?

Although the cause of uterine cancer is not fully understood, cancer of the uterus occurs more frequently in those women who have an imbalance of reproductive hormones*, particularly estrogen (ES-tro-jen). Researchers as of 2009 were exploring the connection between estrogen and uterine cancer. There are several known risk factors associated with uterine cancer. These include:

- A high fat diet
- Obesity
- Hypertension (elevated blood pressure)
- Diabetes (increased sugar in the blood)

* **tumors** (TOO-morz) are abnormal growths of body tissue that have no known cause or physiologic purpose. Tumors may or may not be cancerous.

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

* **menopause** (MEN-o-pawz) is the end of menstruation.

* **hormones** are chemical substances that are produced by various glands and sent into the bloodstream carrying messages that have certain effects on other parts of the body.

Important Statistics About Uterine Cancer

The American Cancer Society published important facts and statistics about Uterine Cancer in 2008. These include:

- Cases of uterine cancer decreased steadily between 1998 and 2008.
- The odds of a woman being diagnosed with uterine cancer in her lifetime are about 1 in 41.
- The average five-year survival rate of uterine cancer is 88 percent.

* **Pap smear** is a common diagnostic test used to look for cancerous cells in the tissue of the cervix.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **biopsy** (BI-op-see) is a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **fallopian tubes** (fa-LO-pee-an tubes) are the two slender tubes that connect the ovaries and the uterus in females. They carry the ova, or eggs, from the ovaries to the uterus.

* **ovaries** (O-vuh-reez) are the sexual glands from which ova, or eggs, are released in women.

* **menstrual** (MEN-stroo-al) refers to menstruation (men-stroo-AY-shun), the discharging through the vagina of blood and tissue from the uterus that recurs each month in women of reproductive age.

- Early onset of menstruation/late onset of menopause
- Never having been pregnant
- Certain hormone therapies

How Is Uterine Cancer Diagnosed and Treated?

Uterine cancer is usually curable if it is found early, but unfortunately, there are no reliable routine tests for this disease (although a Pap smear* sometimes can detect early forms). Typically, it is found only after a woman experiences symptoms, such as unusual bleeding or other discharge from the vagina, pain or pressure, or weight loss.

If it is not caught early, uterine cancer can grow through the wall of the uterus and metastasize (spread) to nearby organs. The cancer cells also can enter nearby lymph nodes* and be carried to other parts of the body. Uterine cancer affects about 40,000 women each year.

If doctors suspect uterine cancer based on a woman's symptoms and a physical examination, a biopsy* is necessary to confirm the diagnosis.

The most common treatments are surgery, radiation therapy, and chemotherapy*. Surgery involves hysterectomy (the removal of the uterus and nearby reproductive organs such as the fallopian tubes* and ovaries*) and the removal of the lymph nodes near the tumor.

After the treatment is finished, most women can lead normal lives. If their uterus was removed, however, they can no longer bear children. This often is not an issue for women in their 50s and 60s, but younger women in their 20s, 30s, and 40s may find it hard to adjust to this loss.

How Can Uterine Cancer Be Prevented?

Because the causes of uterine cancer are not fully understood, prevention is not understood either. Smoking should be avoided, and it is essential that women see their doctors yearly for an examination and a Pap smear. Women who have irregular menstrual* periods, which may indicate that they have a hormonal imbalance, should be evaluated by a doctor. Hormonal treatment may reduce the risk of uterine cancer. Maintaining a healthy diet high in fruits and vegetables and low in animal fat and proper body weight seem to play some role in lowering the risk of developing this cancer.

▶ See also **Cancer: Overview • Cervical Cancer • Genital Warts**

Resources

Books and Articles

Hartmann, Lynn C., and Charles L. Loprinzi. *Mayo Clinic Guide to Women's Cancers*. New York: Mayo Clinic, 2005.

Luesley, David M., Frank Lawton, and Andrew Berchuck, eds. *Uterine Cancer*. New York: Taylor and Francis Group, 2006.

Organizations

American Cancer Society. 1599 Clifton Road NE, Atlanta, GA, 30329-4251. Toll free: 800-227-2345. Web site: http://www.cancer.org/docroot/lrn/lrn_0.asp.

National Cancer Institute. Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD, 20892-8322. Toll free: 800-4-CANCER. Web site: <http://www.cancer.gov/cancertopics/wyntk/uterus>.

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web site: <http://www.4women.gov/FAQ/uterine-cancer.cfm>.

V

Vaccination (Immunization)

Vaccination (vak-sih-NAY-shun) is a way of producing immunity to a specific disease by introducing into a person's body an inactive, altered, or weakened form of a microorganism* and thereby provoking an immune response.*

Vaccination Development

Before the 19th century, a dangerous disease known as smallpox killed millions of people throughout the world. All that was soon to change as the result of an observation made by Edward Jenner (1749–1823), an English country doctor, in 1796. Jenner reported that milkmaids who milked cows infected with a disease known as cowpox did not contract smallpox. Instead, the milkmaids had a mild case of a similar rash-producing disease. Jenner concluded that cowpox must somehow protect these milkmaids against the smallpox infection.

Although Jenner is credited with being the discoverer of the principles of immunization and the developer of the first vaccine against smallpox, men and women had grasped or intuited the principles of immunization for at least several thousand years before him. There are historical accounts of successful vaccinations against contagious illnesses in Ancient Greece, India, and China. In England, approximately 75 years before Jenner's pioneering work, Lady Mary Wortley Montagu (1689–1762), wife of the British ambassador to the Ottoman Empire, vigorously promoted the practice of variolation (administering material from smallpox lesions to healthy people to produce immunity to smallpox). Montagu had observed this practice while living in what later became Turkey. She studied the method of Turkish women, who for centuries had collected in walnut shells the fluid from lesions of persons with smallpox and used lancets to press this material into the skin of healthy people to protect them from the disease. Back in England, she enthusiastically promoted this method and witnessed its many successes, albeit not without encountering a fair amount of resistance from the British medical establishment.

The milkmaids observed by Jenner who had contact with cows with cowpox had in fact become ill with cowpox themselves. (Cowpox infected humans as well as cows and in humans produces symptoms similar to those of smallpox, but cowpox in humans is a relatively benign* illness.)

* **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.

* **microorganism** is a tiny organism that can be seen only by using a microscope. Types of microorganisms include fungi, bacteria, and viruses.

* **benign** (be-NINE) refers to a condition that is not cancerous or serious and will probably improve, go away, or not get worse.

- * **poliomyelitis** (po-lee-o-my-uh-LYE-tis) is a condition caused by the polio virus that involves damage of nerve cells. It may lead to weakness and deterioration of the muscles and sometimes paralysis.
- * **diphtheria** (dif-THEER-ee-uh) is an infection of the lining of the upper respiratory tract (the nose and throat). It is a disease that can cause breathing difficulty and other complications, including death.
- * **pertussis** (per-TUH-sis) is a bacterial infection of the respiratory tract that causes severe coughing.
- * **vaccines** (vak-SEENS) are preparations of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.
- * **antigen** (AN-tih-jen) is a substance that is recognized as a threat by the body's immune system, which triggers the formation of specific antibodies against the substance.
- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

The milkmaids became ill with cowpox, but they did not get the more serious illness. Jenner concluded that having had cowpox somehow protected these milkmaids against the smallpox infection.

As an experiment, Jenner extracted material from the blister-like lesions of persons with cowpox and inoculated healthy people with the cowpox material (introduced this material into their systems). Jenner deliberately gave people the mild cowpox infection. Jenner was experimenting with vaccination. He discovered that the body's natural defense system can be stimulated to become protective against a specific illness after having been ill with a similar and more benign version of that illness. In the late 19th century, the French scientist Louis Pasteur (1822–1895) developed the concept further and named it “vaccination,” a word derived from the Latin word for cow, “vacca.” The first vaccine Pasteur developed was a vaccine for animals against sheep anthrax (AN-thraks).

After Jenner's time, scientists developed many effective vaccines, including ones against poliomyelitis*, measles, diphtheria*, and pertussis* (whooping cough). Overall, these vaccinations prevented disease and saved hundreds of millions of lives.

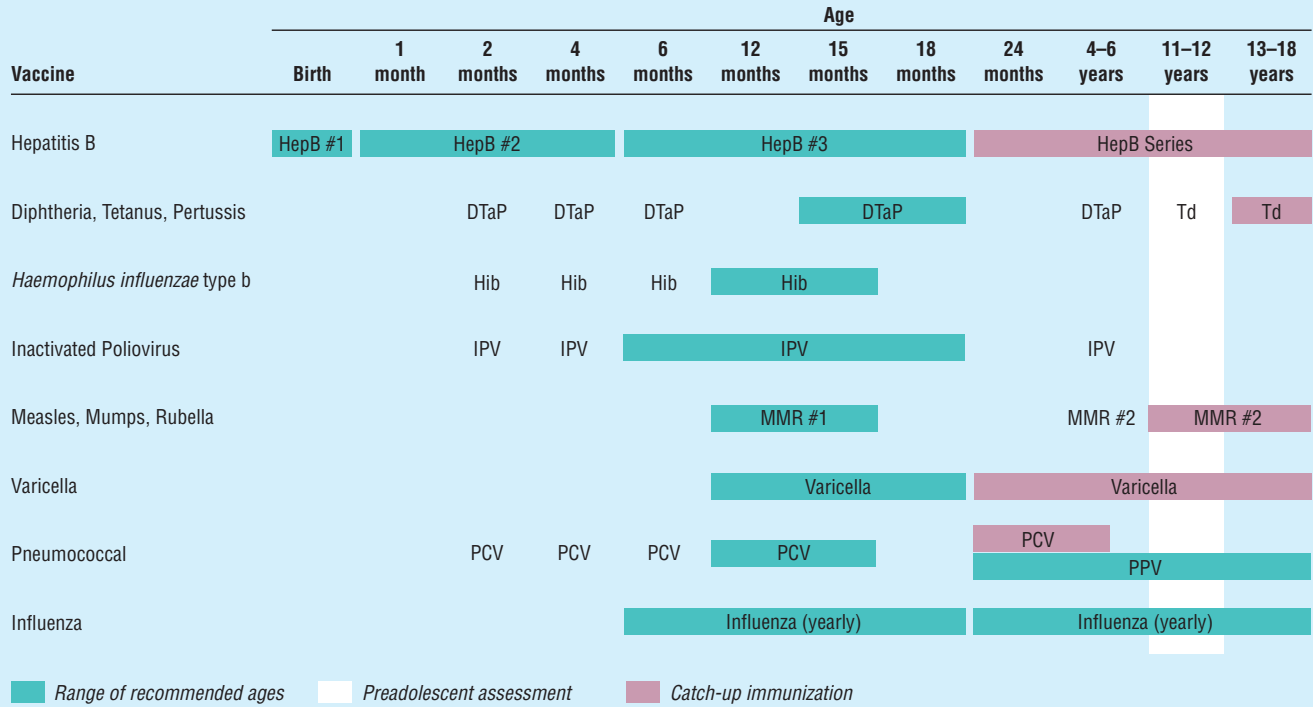
What Is Vaccination?

Vaccines*, the preparations used in vaccinations, stimulate the body's immune response by mimicking the substances that cause disease. Small amounts of antigenic* material (the vaccines themselves) are administered by oral ingestion or injection (usually intramuscular injection). Vaccines mimic a natural infection without actually causing disease. The antigenic substances promote immunologic memory, whereby specialized cells of the immune system become memory cells, that is, able to recognize and respond to any substance that bears the same antigen (if and when the actual disease-causing agent enters the body). When a person's immune system* can respond rapidly and effectively to an infection that is just beginning so that it cannot spread and cause damage within the body, that person has developed resistance to the infectious agent.

Booster vaccinations are second (or subsequent) vaccinations, separated from the first or prior vaccination by certain periods (often a span of several years) that result in an upsurge in or an extension of the effectiveness of the original vaccinations. Booster vaccinations take advantage of immunologic memory. When the white blood cells that have the ability to recognize and respond to a particular antigen are exposed to that antigen as part of a booster vaccination, those abilities are strengthened and reinforced. Some vaccinations require booster doses, whereas others do not.

Vaccinations protect more people than just the persons who receive them. They also protect unvaccinated people who live around those who have been vaccinated, a concept known as “herd immunity.” A vaccination protects a person from contracting and then spreading an infection. When enough people living in an area have been immunized, the relevant

Recommended childhood and adolescent immunization schedule, United States



SOURCE: Department of Health and Human Services Centers for Disease Control and Prevention, 2005.

disease-causing agent will have difficulty spreading in that area because it cannot find new human hosts*. The disease is much less likely to be passed on, even to those few people who remain unvaccinated. It is estimated that the protection of unvaccinated people in a community occurs when the proportion of persons in that community who are vaccinated reaches 95 percent.

Vaccinations boost immunity through a so-called active process, meaning that the immune system, in responding to an antigen, is reacting actively. There is also passive immunity, which is immunity acquired through the transfer of antibodies*. Infants are born with a passive immunity that protects them from some diseases. This immunity arises from the protective antibodies passed from mother to fetus and after birth from the mother's breast milk to the infant. A mother who has immunity against tetanus, a disease of the central nervous system caused by the toxin secreted by the tetanus bacterium, for example, will pass this immunity along to the developing fetus through the transfer of antibodies while she is pregnant. The offspring's immunity is only temporary, however. The infant's passive immunity disappears in the months after birth. Infants later make their own antibodies after being exposed to an infectious agent or receiving a vaccine.

▲
 Illustration by GGS Information Services, Inc. Reproduced by permission of Gale, a part of Cengage Learning.

* **hosts** are organisms that provide another organism (such as a parasite or virus) with a place to live and grow.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

- * **mucus** (MYOO-kus) is a thick, slippery substance that lines the insides of many body parts.
- * **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.
- * **respiratory failure** is a condition in which breathing and oxygen delivery to the body are dangerously altered. This may result from infection, nerve or muscle damage, poisoning, or other causes.

How Successful Are Vaccinations?

Vaccinations are one of the great success stories of public health programs in the 20th century. Widespread use of vaccines has brought about dramatic reductions in illness, disability, and death from many diseases, including potentially deadly and disabling childhood diseases such as diphtheria, tetanus, pertussis (whooping cough), measles, and poliomyelitis. Before measles vaccination began in the United States in 1963, for example, an estimated 500,000 cases and 500 measles-associated deaths in the United States were reported each year, according to the Centers for Disease Control and Prevention (CDC). After immunizations began, these statistics dropped sharply. In the year 2000, there were only 86 confirmed measles cases in the United States, and there were no deaths.

In the 1920s, before vaccination for diphtheria was available, approximately 150,000 cases of diphtheria occurred annually in the United States. Diphtheria is a frightening and painful disease. The thick mucus* produced in the throat and nasal passages in the course of the disease closes the airway and can lead to suffocation. After the introduction of diphtheria vaccine, millions of people were protected from this disease. Because of diphtheria vaccination, diphtheria illness became virtually nonexistent in developed nations.

Poliomyelitis, a viral disease characterized by inflammation of nerve cells in the brain and spinal cord, also known as polio and infantile paralysis, was a health scourge in the United States until the 1950s. The virus can spread along nerve fiber pathways, damaging and even destroying motor neurons (especially the motor neurons that supply muscles in the legs). As a result of this damage to nerve tissue, the illness often produces muscle weakness and paralysis*. The virus may damage neurons that supply the chest wall muscles and the diaphragm, a thin sheet of muscle separating the chest from the abdomen that is essential to breathing. Paralysis of these muscles can lead to respiratory failure* and death. In 1952 there were more than 21,000 cases of paralytic (pair-uh-LIH-tik) poliomyelitis in the United States. After the introduction of polio vaccine in 1955, the incidence of this disease steadily declined, and between 1979 and 2009 there were no naturally occurring cases in the United States.

Smallpox is the only disease that has been eradicated entirely from the global population through an aggressive international immunization program. This highly contagious disease once killed as many as one out of every three infected individuals, but as of 2009, the last known naturally occurring case was reported in Somalia, Africa, in 1977. The World Health Organization declared smallpox to be eradicated in 1980.

What Vaccines Are Used in the 21st Century?

The 20th century saw both tremendous success of vaccines and advances in vaccine technology. Some earlier vaccines were improved, and new vaccines were introduced. There were four different types of vaccines available as of 2009:

- *Live attenuated vaccines* contain virus particles that have been cultivated under conditions that considerably weaken them. Attenuated (ah-TEN-yoo-a-tid) types of vaccine contain live but weaker forms of a virus. These viruses usually do not cause disease symptoms, but they do stimulate the body to develop immunity to the virus. Attenuated vaccines include the combined vaccine for measles, mumps*, and rubella* (German measles), known as the MMR vaccine; the vaccine for varicella (var-uh-SEH-luh), or chicken-pox; and the oral polio vaccine. Although these immunizations last longer than others, vaccines of this type occasionally create serious infections in people, particularly those with weakened immune systems.
- *Killed vaccines* contain microorganisms (bacteria or viruses) that have been killed with chemicals or heat. Examples of this type of vaccine are the influenza* virus; the hepatitis A virus vaccine; the injected polio vaccine; and the cholera vaccine. Although they are not alive, the microorganisms in these vaccines cause an immune response in the body. These vaccines are considered safe for people with weakened immune systems.
- *Toxoid (TOX-oyd) vaccines* contain a (partially inactivated) toxin (poison) produced by the infecting microorganisms (and not the microorganisms themselves). This type of vaccine is used for diseases in which the symptoms are caused principally by the toxin, rather than by the microorganism. If and when the body encounters live invading organisms that secrete the same toxin, the immune system responds. Diphtheria and tetanus vaccines are both of the toxoid type.
- *Subunit or component vaccines* contain fragments or parts of the disease-causing microorganisms (and not the microorganisms themselves) that are able to trigger the immune response. The acellular vaccine for pertussis (“acellular,” meaning it contains no whole cells) is an example of a subunit vaccine. Some subunit vaccines are semi-synthetic compounds, that is, compounds isolated from natural sources that have undergone man-made modifications. One example is the Haemophilus influenzae type B (Hib) vaccine, which contains two naturally occurring antigens combined to make a conjugate molecule.

* **mumps** is a contagious viral infection that causes inflammation and swelling in the glands of the mouth that produce saliva.

* **rubella** (roo-BEH-luh) is a viral infection that usually causes a rash and mild fever.

* **influenza** (in-floo-EN-zuh), also known as the flu, is a contagious viral infection that attacks the respiratory tract, including the nose, throat, and lungs.

What Vaccinations Are Recommended in the United States?

Vaccine preparations are produced by drug manufacturers and in the United States must be approved for use and licensed by the Food and Drug Administration. Vaccines are also patented, which diminishes their availabilities.

A vaccination schedule is a list of recommended vaccines that includes the recommended timings of all vaccine doses. Vaccination schedules are

* **cirrhosis** (sir-O-sis) is a condition that affects the liver, involving long-term inflammation and scarring, which can lead to problems with liver function.

* **meningitis** (meh-nin-JY-tis) is an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.

* **sepsis** is a potentially serious spreading of infection, usually bacterial, through the bloodstream and body.

compiled by the Advisory Committee on Immunization Practices (ACIP), a 15-member panel that advises the Centers for Disease Control and Prevention (CDC) and the Department of Health and Human Services. Vaccines are usually administered during early childhood, although some vaccinations may need to be given later in life.

The ACIP and the CDC recommend vaccinations. For the general population (including the general pediatric population), vaccinations are recommended but not mandated. However, in the United States all fifty states require children to be immunized against measles, diphtheria, Haemophilus influenza type B, poliomyelitis, and rubella in order to enroll in day care and/or public school.

In 2009 the CDC in its Recommended Childhood Immunization Schedule recommended the following vaccines for children six years of age or younger:

- *Hepatitis B vaccine* (HBV) protects against hepatitis B virus infection. This is the most dangerous of the hepatitis viruses, and hepatitis B (the illness) often has a severe course and can be life-threatening. People who are infected with hepatitis B are at risk for chronic liver disease, cirrhosis* of the liver, and liver cancer. Hepatitis B is one of the most common causes of cancer deaths worldwide. Hepatitis B vaccine is usually given as a series of three inoculations: one shortly after birth, another at one or two months of age, and the third at six to 18 months of age.
- *Hepatitis A vaccine* is caused by the hepatitis A virus and is the most common form of hepatitis. The illness usually follows a mild course and does not cause permanent liver damage. Hepatitis A vaccine is recommended for all children beginning at one year of age. Two separate doses are given six months apart. The CDC made this recommendation in 2006.
- *Pneumococcal conjugate vaccine* (PCV) is intended to protect infants and young children against diseases caused by the bacterium *Streptococcus pneumoniae* (also known as pneumococcus, or pneumococcal bacteria), including pneumonia, meningitis*, and sepsis*. The word “conjugate” refers to the conjugation (joining) of two components. PCV is given as a series of four shots, when an infant is 2 months, 4 months, 6 months, and 12 to 15 months old.
- *Diphtheria-tetanus-pertussis vaccine* (DTaP, the “aP” referring to acellular pertussis) is a mixture of three vaccines that protects against these three diseases. The acellular vaccine uses antigenic fragments of the pertussis bacterium due to the enhanced safety of this vaccine. DTaP is given as a series of five shots, usually administered to a child at the age of 2 months, 4 months, 6 months, 15 to 18 months, and 4 to 6 years (or before starting school). Five years after the last of these immunizations, generally at age 11 or 12, children receive a booster shot for diphtheria, tetanus, and pertussis known as dTap or Tdap

(the lowercased “d” and “p” indicating the reduced concentrations of the diphtheria and pertussis components). Doctors recommend that people receive dTap/Tdap boosters once every 10 years after that, throughout adulthood. DTap should not be given to persons 7 years of age or older. It is licensed for children under the age of 7 years.

- *Haemophilus influenzae type b vaccine* protects against the serious disease caused by the *Haemophilus influenzae* bacterium, type b (Hib), which usually strikes children under the age of 5 years, once a leading cause of meningitis in children. The vaccine is given by injection to children at age 2 months, 4 months, and 6 months. A booster dose is given at age 12 to 15 months.
- *Inactivated polio vaccine (IPV)* protects against poliomyelitis infection. It is given by injection at age 2 months, 4 months, 6 to 18 months, and 4 to 6 years (or before entering school).
- *Measles-mumps-rubella vaccine* is a mixture of three live, attenuated viruses administered by injection that protects against measles, mumps, and rubella (German measles). The vaccine is administered in two doses, the first at age 12 to 15 months and the second before a child starts school, generally at age 4 to 6 years.
- *Varicella (chickenpox) vaccine* protects against varicella (caused by the varicella virus), also known as chickenpox, a common childhood viral illness. Children who have never had chickenpox are given two doses of the vaccine (via injection): at age 12 to 15 months, and at 4 to 6 years. Children who have had chickenpox do not need the vaccine. Older children and adults who have never had chickenpox can also receive the vaccine.
- *Influenza vaccine* is recommended for all children, but it is particularly recommended for children with certain conditions, including diabetes* and sickle-cell disease*, which put them at even greater risk of serious influenza infection.
- *Rotavirus vaccine* protects against rotavirus, which causes severe diarrhea in infants and young children and is the leading cause of severe diarrhea in that population. The vaccine is given orally. Vaccination is recommended for infants at age 2 months, 4 months, and 6 months.

The CDC recommends the following vaccines for adolescents between the ages of 11 and 18 years:

- DTaP (described above) is recommended for young people between the ages of 11 or 12. This booster dose of DTaP protects them against pertussis.
- *Human papillomavirus vaccine* (for girls) protects against the human papillomavirus (HPV), the most common sexually transmitted virus in the United States. The virus has many subtypes. Two of these cause about 70 percent of all cervical cancer cases

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **sickle-cell disease** is a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body.

* **tetanus** (TET-nus) is a serious bacterial infection that affects the body's central nervous system.

* **rabies** (RAY-beez) is a viral infection of the central nervous system that usually is transmitted to humans by the bite of an infected animal.

* **epidemic** (eh-pih-DEH-mik) is an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.

in the United States. This vaccine prevents most cases of cervical cancer and is recommended for girls 11 and 12 years of age. It is also recommended that girls receive the vaccine prior to their first sexual contact. The vaccine is given by injection in three doses.

- *Meningococcus vaccine* protects against meningococcal disease, which is a leading cause of bacterial meningitis in persons between the ages of 2 to 18 years in the United States. The vaccine is recommended for adolescents between the ages of 11 and 18 years. College students who live in dormitories and adolescents age 15 to 19 years are at increased risk for meningococcal disease.

In addition to children and adolescents, adults require vaccines. For example, adults generally need a tetanus booster vaccination every 10 years, and older adults or adults with some medical conditions are advised to get a flu shot every year. Adults who did not undergo immunization as children, those who have emigrated from a country where vaccines are not readily available, and those who travel to areas where there is a higher risk of certain infectious diseases also receive vaccinations.

Vaccines against tetanus* and rabies* may prevent disease if they are given immediately after exposure to the disease-causing agent. But the vaccines are effective only within a very short time period after exposure. A rabies vaccine is typically administered after a person is bitten by an animal that could have the disease or when a person plans to spend more than 30 days in a place where rabies is common.

What Are Common Fears about Vaccinations?

Vaccinations have been proven to reduce (and reduce drastically) the incidence and mortality rates of many diseases and to eradicate (eliminate) some diseases from entire populations. Still, some parents are reluctant to vaccinate their children for a variety of reasons. Some parents feel that children receive too many vaccines and that the administration of vaccines begins too early. Others worry about possible adverse reactions. Still others believe, erroneously, that with lower rates of certain diseases in the United States, regular vaccinations are no longer necessary.

A dramatic example proves otherwise. The United Kingdom, Japan, and Sweden cut back their use of pertussis vaccine in the 1970s when some medical experts in those countries believed that the risks of using the vaccine outweighed the benefits. Between 1971 and 1979, the United Kingdom experienced more than 100,000 cases of the disease and 36 pertussis-related deaths. From 1974 to 1979, Japan's vaccination coverage in the general population dropped from 80 percent to 20 percent, while the annual number of pertussis cases rose from a low of 393 in 1974, with no deaths, to an epidemic* high of 13,000 cases and 41 deaths. In Sweden, the annual incidence of pertussis per 100,000 children up to age six leaped from 700 in 1981 to 3,200 in 1985.

Another common belief is that vaccines cause the infectious diseases that they are intended to protect against. In fact, killed vaccines or those

made from only a component of the infectious agent, such as a protein, cannot cause the infectious disease. In addition, continual efforts are made by the manufacturers of vaccines to minimize the possibility of contracting disease from a live vaccine. For example, in January 2000 the ACIP recommended that the polio vaccine be switched from an attenuated oral version to a killed vaccine to reduce or eliminate whatever risk there was of contracting vaccine-associated paralytic polio. Although the live oral vaccine was largely responsible for ridding the United States of polio, it caused polio in one of every 1.4 million people who received their first dose of the vaccine. The killed version, however, cannot cause polio.

What Are the Side Effects of Vaccination?

Although vaccinations prevent many cases of serious, and even fatal, illness, any vaccine can have side effects, and many people experience them after receiving vaccines. Potential side effects for all of the vaccines listed in this entry include low-grade fever; mild pain, tenderness, and redness at the site of the injection; rash; and irritability. Less common, but more serious, reactions include seizures*, usually as a result of fever, and allergic reactions to components of the vaccine. Reports that link childhood vaccinations to autism*, sudden infant death syndrome*, and brain damage had not been proven as of 2009 but remained hotly debated.

Why Is It Important to Vaccinate?

Vaccination provides the best protection against many well-known childhood diseases, and preventing the spread of these diseases is vital to public health. Vaccines protect the people who receive them, and they also prevent the spread of disease to people who have not been vaccinated. Modern science has produced many effective vaccines. International travel and a rapidly shrinking globe means that diseases can easily cross national and continental lines. Diseases once rarely seen in one country can be easily imported from another. This fact makes receiving vaccinations an ongoing necessity. If people somehow start to believe that they or their children do not need to get vaccinated or if they depend on others to get vaccinated, overall vaccination levels will drop. This could lead to the return of diseases that are easily prevented by vaccination.

What Vaccines May Be Developed in the Future?

In the early 21st century, medical researchers continued to work to develop vaccines for a wide range of diseases, including HIV*/AIDS*. The quest for an HIV/AIDS vaccine was complicated by the fact that HIV mutates (changes) rapidly (leading to the existence of a large number of distinct viral subspecies) and because HIV damages the very cells that are needed by the body in any response to an antigen. Malaria vaccines were also the subject of intensive research. Several drug manufacturers continue to work on the development of vaccines that will protect against tuberculosis infection, and several clinical trials were underway as of 2009. But there was no effective tuberculosis vaccine available as of 2009. In 2006 the

* **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.

* **autism** (AW-tih-zum) is a developmental disorder in which a person has difficulty interacting and communicating with others and usually has severely limited interest in social activities.

* **sudden infant death syndrome** or SIDS, is the sudden death of an infant less than a year old that is not explained even after an autopsy or examination of the death scene. Most cases occur while the otherwise well baby is asleep on its stomach.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

- * **virus** (VY-rus) is a tiny infectious agent that can cause infectious diseases. A virus can only reproduce within the cells it infects.
- * **herpesvirus family** (her-peeZ-VY-rus) is a group of viruses that can stay themselves permanently in the body. The family includes varicella zoster virus, Epstein-Barr virus, and herpes simplex virus.
- * **herpes** (HER-peeZ) is a viral infection that can produce painful, recurring skin blisters around the mouth or the genitals, and sometimes symptoms of infection elsewhere in the body.
- * **vaccines** (vak-SEENS) are preparations of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.

FDA approved the first vaccine for adult shingles, a painful viral disease caused by viral infection of nerve endings in skin.

In general, however, such research takes years and is costly. Because almost all vaccinations carry some risk, an important part of their development is to assess how effective they are and whether the benefits of a new vaccine outweigh the risks.

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Organizations

- Centers for Disease Control and Prevention.** 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/vaccines>.
- Immunization Action Coalition.** 1573 Selby Avenue, Suite 234, St. Paul, MN, 55104. Telephone: 651-647-9009. Web site: <http://www.immunize.org>.

Vaginal Yeast Infection See *Yeast Infection, Vaginal*.

Valley Fever See *Coccidioidomycosis*.

Varicella (Chicken Pox) and Herpes Zoster (Shingles)

Infection with the varicella zoster (var-uh-SEH-luh ZOS-ter) virus (VZV), a member of the herpesvirus family*, causes the common childhood illness varicella or chicken pox. Reactivation of the virus later in life causes herpes* zoster, commonly known as shingles. Vaccines* are available that prevent or ameliorate (reduce) the symptoms of both diseases.*

What Are Varicella and Herpes Zoster?

Varicella or chicken pox is a highly contagious* disease caused by the initial or primary infection with VZV. It is characterized by the appearance of red, itchy spots on the skin. The spots progress to blisters and eventually crust over.

Most people cannot contract varicella a second time because the body's immune system* makes protective antibodies*. However VZV remains in the nerve tissues of the body in a dormant or inactive state. Years later—most often after a person is 50 years of age—VZV can be reactivated in the form of herpes zoster or shingles. Sometimes this reactivation occurs at a time of emotional or physical stress. Shingles usually appears first as one or more local areas of intense pain, followed by a red rash or blisters. Sometimes, especially in the elderly, shingles causes nerve damage that can result in severe pain called post-herpetic neuralgia that may last for months or years.

How Common Are Varicella and Herpes Zoster?

Chicken pox was once a disease experienced by nearly every child, causing an estimated 4 million illnesses, 11,000 hospitalizations, and 100 deaths each year in the United States. After the introduction of a varicella vaccine in 1995, the incidence* of chicken pox, especially in younger children, decreased dramatically. However, in the early 2000s, chicken pox remains relatively common among unvaccinated children and adults and 10 to 15 percent of vaccinated children also contract the disease.

Nearly one in three Americans eventually develops shingles, and there are at least one million cases in the United States each year. Anyone who has ever had chicken pox or received the varicella vaccine is at risk for shingles. About half of all cases occur in people 60 years of age or older. The risk of shingles increases with age and with any condition that weakens the immune system. Susceptibility* to shingles tends to run in families.

Are Varicella and Herpes Zoster Contagious?

Most people who have never had chicken pox or been vaccinated against it will contract varicella if they come in close contact with someone who has the illness. Anyone with chicken pox is contagious from one or two days before the rash first appears until the pox blisters have crusted over. VZV is spread in the air through the coughs or sneezes of an infected person. It can also be spread by contact with the fluid in pox blisters.

Shingles itself is not contagious. However, the virus can be transmitted to someone who has never had chicken pox by direct contact with the shingles rash. That person will develop chicken pox. Only people who have had chicken pox or received the varicella vaccine can get shingles.

How Do People Know They Have Chicken Pox or Shingles?

The symptoms and signs of chicken pox usually appear within two to three weeks after exposure to the virus and typically begin with fever, headache, and fatigue. The classic chicken pox rash starts as red spots on



▲ The majority of children in the United States contracted chicken pox until a vaccine, which became available in 1995, dramatically reduced the rate of infection. © Justin Leighton/Alamy.

Chickpea pox?

The term “chicken pox” may come from *cicer*, the Latin word for “chickpea.” Chickpeas or garbanzo beans, a popular ingredient in salads and spreads such as hummus (HUH-mus), are round, buff-colored, and a bit larger than green peas. Chicken pox blisters look a bit like chickpeas on the skin.

* **contagious** (kon-TAY-jus) means transmittable from one person to another, usually referring to an infection.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.



▲
The shingles rash is a patch of small blisters filled with the herpes zoster virus.
Biophoto Associates/Photo Researchers, Inc.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **incidence** means rate of occurrence.

* **susceptibility** (su-sep-ti-BIL-i-tee) means having less resistance to and higher risk for infection or disease.

* **nausea** (NAW-zha) refers to a feeling of being sick to one's stomach or needing to vomit.

* **diarrhea** (di-ah-RE-a) refers to frequent, watery stools (bowel movements).

* **antihistamines** (an-tie-HIS-tuh-meens) are drugs used to combat allergic reactions and relieve itching.

* **Reye's syndrome** (RYES SIN-drome) is a rare condition that involves inflammation of the liver and brain, and sometimes appears after illnesses such as chicken pox or influenza. It has also been associated with taking aspirin during certain viral infections.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

the face, chest, back, buttocks, and, less commonly, arms and legs. The spots quickly turn into blisters that break, ooze fluid, and then crust over. The pox often pop up in groups over a period of four or five days. The number of blisters varies from very few to hundreds. The rash ranges from mildly to severely itchy.

The first symptoms of shingles are local areas of intense tingling, burning, itching, or severe pain, usually on one side of the face or body (people suffering from impairment of the immune system may developed more generalized shingles covering larger areas of the body). A rash or fluid-filled blisters on reddened skin appears next. The rash follows the path of the inflamed nerve tissue and looks like a streak or a band. Before the rash develops the pain of shingles is easily confused with other conditions. The rash can last two to three weeks before healing and scabbing over. Shingles pain usually subsides when the rash disappears, but it may last much longer, with one in five people developing post-herpetic neuralgia.

Uncommon symptoms of shingles include:

- Chills
- Fever
- Headache
- Nausea*
- Stomach pain
- Diarrhea*

How Do Doctors Diagnosis and Treat Chicken Pox and Shingles?

Diagnosis Doctors usually recognize chicken pox or shingles by their distinctive rashes. Laboratory tests on the fluid in blisters from either disease can diagnose VZV infection. Blood tests for antibodies against VZV can determine whether a person is immune to chicken pox.

Treatment In general, the goal of chicken-pox treatment is to ease the discomfort caused by itchy blisters. Cool compresses or lukewarm baths in water sprinkled with uncooked oatmeal or baking soda can soothe the skin and relieve itching. Over-the-counter antihistamines* can also help control itching. Children with chicken pox should not be given aspirin for fever due to the risk of Reye's syndrome*. A non-aspirin fever reducer such as acetaminophen* is recommended instead. A child's fingernails should be cut short, because scratching the blisters can lead to secondary skin infections caused by bacteria*. Children usually recover from chicken pox within one to two weeks. Adults may take longer to recover. Adults and those with weakened immune systems are at greater risk for complications of chicken pox and may be treated with antiviral medications for a few days to control the infection.

If shingles is recognized soon after the rash first appears, it can be treated with oral* antiviral medication, which may shorten the course

of the disease and minimize pain. Blisters from shingles typically clear up after two to three weeks, but the nerve pain can linger for weeks or months, sometimes even years.

Complications The most common complication of chicken pox is cellulitis*, a skin infection caused by bacteria such as streptococci (strep-tuh-KAH-kye) and staphylococci (stah-fih-lo-KAH-kye), which can invade the skin through repeated scratching of pox sores.

If a woman becomes infected with chicken pox during the first 20 weeks of pregnancy, there is a 2 percent risk that her baby will be born with congenital* varicella syndrome*, including multiple birth defects. Maternal infection during the final stages of pregnancy, before the mother has developed antibodies, can cause life-threatening varicella infection in her baby.

People with weakened immune systems, such as those with HIV*/AIDS* or cancer* or who are undergoing chemotherapy* are at particular risk for widespread infection from either chicken pox or shingles. Varicella infection can spread to the lungs causing pneumonia*. Even in healthy people pneumonia from varicella can be dangerous and potentially fatal. Newborn babies, teens, and adults are at greater risk than children. Adults are also more at risk for other serious—but rare—complications, including liver* and kidney* disease and encephalitis*.

Untreated shingles rash on the face can spread to the eye. Involvement of the cornea* can lead to temporary or permanent blindness. Rarely shingles can cause hearing loss or death.

Can Chicken Pox and Shingles Be Prevented?

The American Academy of Pediatrics recommends that all children be vaccinated against chicken pox before two years of age. Older children and teens who have not had chicken pox are usually vaccinated as part of routine health care. Women who have not had chicken pox or been previously vaccinated should be vaccinated before they become pregnant. Pregnant women cannot be vaccinated because the vaccine contains live virus that could harm the fetus*. However, vaccinations* for family members and others in close contact with a pregnant woman can help protect her from infection. People who become infected with varicella despite vaccination usually have a milder case of chicken pox.

A single dose of varicella zoster immune globulin* (VZIG) can be administered intravenously* to protect a person with a weakened immune system who comes into contact with the virus. VZIG contains antibodies against VZV and, if it is given within three to four days of exposure, offers temporary protection. Exposure to varicella by a non-immune pregnant woman can also be treated with VZIG to reduce the risk of transmitting the virus to her fetus.

People with shingles should avoid contact with anyone who has not had chicken pox or been vaccinated, particularly pregnant women, newborns, and those with weakened immune systems.

* **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.

* **oral** means by mouth or referring to the mouth.

* **cellulitis** (sel-yoo-LYE-tis) is an infection of the skin and the tissues beneath it.

* **congenital** (kon-JEH-nih-tul) means present at birth.

* **syndrome** is a group or pattern of symptoms or signs that occur together.

* **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).

* **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

* **cancer** is a condition characterized by abnormal overgrowth of certain cells, which may be fatal.

* **chemotherapy** (KEE-mo-THER-a-pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **pneumonia** (nu-MO-nyah) is inflammation of the lungs.

* **liver** is a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.

* **kidney** is one of the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.

- * **encephalitis** (en-seh-fuh-LYE-tis) is an inflammation of the brain, usually caused by a viral infection.
- * **cornea** (KOR-nee-uh) is the transparent circular layer of cells over the central colored part of the eyeball (the iris) through which light enters the eye.
- * **fetus** (FEE-tus) is the term for an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.
- * **vaccinations** (vak-sih-NAY-shunz), also called immunizations, are the giving of doses of vaccines, which are preparations of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself.
- * **immune globulin** (ih-MYOON GLAH-byoo-lin), also called gamma globulin, is the protein material that contains antibodies.
- * **intravenous** (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.
- * **tuberculosis** (too-ber-kyoo-LO-sis) is a bacterial infection that primarily attacks the lungs but can spread to other parts of the body.

A single-dose vaccine against shingles became available in 2006 and was recommended for most people 60 years of age and older. It appeared to prevent shingles in about 50 percent of vaccinated people and reduces the pain associated with shingles in others. It was believed to help prevent post-herpetic neuralgia. People should not receive the shingles vaccine if any of the following conditions apply to them:

- Have a weakened immune system
- Have active, untreated tuberculosis*
- Are pregnant or could become pregnant within three months of being vaccinated
- Have a moderate or severe illness or fever

▶ See also **Congenital Infections • Encephalitis • Herpes Simplex Virus Infections • Immune Deficiencies • Mononucleosis, Infectious • Skin and Soft Tissue Infections • Staphylococcal Infections • Streptococcal Infections**

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Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

Varicose Veins

Varicose veins are damaged superficial veins that have become stretched, enlarged, and/or twisted. They can develop virtually anywhere in the body, but they develop most commonly in the legs. They can often be seen on the legs, just below the surface of the skin, and they may give affected areas a lumpy appearance.

What Are Veins and Arteries?

The circulatory system has two main types of vessels for carrying blood to and from all of the body's cells, tissues, and organs. Arteries carry oxygen-rich blood from the heart to the organs, and veins return oxygen-poor blood to the heart. Both arteries and veins are vessels or tubes through which blood flows, but they are dissimilar in many ways. Arteries have much thicker walls than veins of comparable size. Both arteries and veins have rings of smooth muscle surrounding them, but arteries have thicker rings. Arteries have many more elastic fibers than veins and have the property of elasticity. Veins are relatively inelastic. In addition, blood pressure in the veins is much lower than it is in the arteries. Veins do have valves, which help to keep blood from pooling in the veins. When these valves start to break down, as often happens in older or inactive people, the veins sometimes dilate* or collapse and become varix, varices, varicose*. The result is varicose veins. Although varicose veins can be painful, most varicose veins are relatively benign*.

Where Do Varicose Veins Occur?

Varicose veins very often in the area behind the knee joint and in the calf area. The veins look bluish and may become swollen, which may give the affected area a lumpy appearance. About 15 percent of adults in the United States have varicose veins. Women have varicose veins more often than men do and are particularly prone to developing them during pregnancy. In addition, varicose veins tend to run in families.

What Is the Treatment for Varicose Veins?

Many people with varicose veins have no symptoms, but some people feel pain in their legs, especially when they stand for long periods of time. People with varicose veins will sometimes seek treatment for cosmetic reasons.

Conservative treatment In mild cases, doctors usually suggest that their patients exercise to improve circulation and that they wear support hose or stockings to promote circulation in the legs and the return of blood to the heart. Doctors also typically tell people with varicose veins to sit with their feet up as often as possible and to avoid standing for prolonged periods of time.

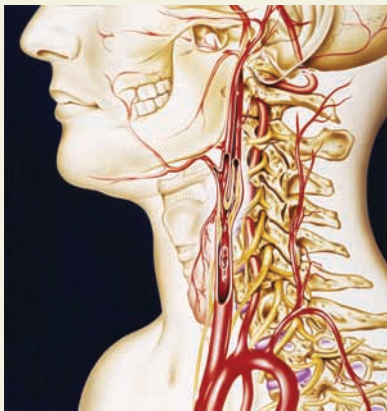
Interventional treatment Medical intervention can be divided into two classes: surgical and non-surgical. Varicose veins can be removed surgically via a process known as vein stripping. This process takes about 30 minutes and is often quite successful. Vein stripping is commonly used to improve the appearance of the legs. There are also less invasive treatments include sclerotherapy, endovenous laser therapy ablation, and radiofrequency ablation.

Sclerotherapy is the injection of a chemical irritant into a vein to "sclerose" or harden it. The chemical substance irritates the lining of the vein, causing it to swell and the blood to clot. The vein loses its function

* **dilate** (DY-late) means to become enlarged or stretched beyond the usual boundaries.

* **varix, varices, varicose** are the Latin words that describe veins, arteries, or lymph vessels that have become stretched or enlarged.

* **benign** (be-NINE) refers to a condition that is not cancerous or serious and will probably improve, go away, or not get worse.



▲ A blood clot (lower center) approaches a junction (center) of the left carotid artery that has been narrowed by atherosclerotic plaques (yellow). These fatty deposits of cholesterol on the artery walls have caused stenosis (narrowing) of the artery. If the blood clot lodges (an embolism), then the oxygenated blood supply to the head and brain will be interrupted. This will cause an ischemic stroke, where the brain is damaged due to hypoxia (lack of oxygen). The blood clot (thrombus) may have detached from a site of deep vein thrombosis. The backbone, its nerves (yellow), and skull bones and throat structures are also seen.
John Bavosi/Photo Researchers, Inc.

- * **cholesterol** (ko-LES-ter-ol) is a fatlike substance found in the blood and body tissues.
- * **plaque** (PLAK) is a raised patch or swelling on a body surface. Arterial plaque occurs on the inner surface of an artery and is produced by fatty deposits.
- * **blood clot** is a thickening of the blood into a jelly-like substance that helps stop bleeding. Clotting of the blood within a blood vessel can lead to blockage of blood flow.
- * **heart attack** is a general term that usually refers to a sudden, intense episode of heart injury. It is usually caused by a blockage of a coronary artery, which stops blood from supplying the heart muscle with oxygen.

entirely. Most of the vein tissue turns into scar tissue. Blood flow shifts to nearby healthy veins. Endovenous laser ablation therapy is a treatment for varicose veins in which a laser source is inserted into the vein to be treated, and laser light is emitted that strikes the interior of the vein. This causes the vein to contract, and the laser source is then withdrawn. An alternative treatment is radiofrequency ablation, which is similar to endogenous laser therapy, but uses electromagnetic radiation of the radio-frequency range instead of laser light to close the vein.

Resources

Organization

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: http://www.nhlbi.nih.gov/health/dci/Diseases/vv/vv_what.html.

Vascular Diseases

Vascular diseases include a group of conditions that affect blood vessels. These conditions are common, affecting about 20 to 30 million Americans yearly. Major types are heart disease, including diseases that affect the peripheral arteries (arteries other than the coronary arteries, such as those that carry blood to the limbs, the carotid arteries that carry blood to the brain, or the renal arteries that carry blood to the kidneys); aneurysms; Raynaud's phenomenon; Buerger's disease, varicose veins; blood clotting disorders; and lymphedema. Each of these has its own underlying causes, symptoms, diagnostic requirements, and treatments.

What Are Some Types of Vascular Disease?

Heart disease and stroke Heart disease (also called coronary artery disease) occurs when the arteries that supply blood to the heart muscle narrow and harden. This condition is due to a process called atherosclerosis, in which cholesterol* combines with other substances to form plaque* that attaches in patches to arterial walls. As these patches expand in size, they may block blood flow to the heart muscle. Over time, this blockage can become complete enough to deprive the heart muscle of oxygen, damaging or destroying that area of heart muscle. Sometimes a blood clot* forms on top of the plaque, which can result in complete blockage of blood flow, leading to heart attack*. Other times, the blood clot may break away from the plaque, travel through the bloodstream, and cause a blockage in another location. If the blood clot stays within the circulation of the heart, a heart attack occurs; if the blood clot travels to the brain, a stroke* may occur.

Coronary artery disease is more common in people who have high concentrations of cholesterol in their blood, high blood pressure, diabetes*, family history of coronary artery disease, or who are smokers, obese*, or sedentary. Symptoms of coronary artery disease include bouts of angina (chest pain), frank heart attack (symptoms being pain in the jaw, neck, or back; chest pain; dizziness/faintness; pain in the arms or shoulders; shortness of breath), or signs of stroke (symptoms being sudden weakness or numbness in limbs or face; sudden confusion, difficulty speaking, or understanding others; sudden visual problems in one or both eyes; and sudden problems walking or maintaining balance).

Heart disease is diagnosed by correlating the results of a number of tests, including:

- Blood tests to look at cholesterol levels and the presence and levels of substances that indicate heart muscle damage
- Imaging studies that allow the coronary arteries to be visualized and demonstrate the presence of narrowing and plaque (such as cardiac catheterization, CT scans*, and MRIs*)
- Tests of the heart's electrical system (electrocardiogram*)
- Ultrasound* to observe the movements of the heart and any obstruction
- Tests that demonstrate the heart's functioning (echocardiogram*)
- Stress tests* to evaluate how well the heart performs during periods of exercise

Treating coronary artery disease is determined by the severity of the disease. In people who have more mild disease, lifestyle changes (e.g., weight loss, smoking cessation, increased exercise, learning to deal with stress, and eating a healthier diet) may be sufficient. In more complicated cases, blood cholesterol and high blood pressure may need to be lowered with medications. Other medications may also be used, including blood thinners (anticoagulants), beta blockers, calcium channel blockers, and nitroglycerin (to treat chest pain from angina).

When blockages are more severe, one of two surgical operations may be required. Angioplasty involves slipping a small balloon into an obstructed artery and inflating the balloon to widen the narrowed artery, a procedure that may be combined with stent placement, in which an artificial tube is permanently positioned inside the artery to keep it open. Coronary artery bypass grafting involves open-heart surgery. The obstructed sections of the coronary arteries are removed and replaced with grafts* made from arteries or veins that are harvested (taken) from elsewhere in the body, often times from a leg.

While coronary artery disease often runs in families, an individual's risk can be lowered by adhering to basic preventive measures, including maintaining a healthy weight, eating a low-fat/low-cholesterol diet, never smoking, drinking only moderate quantities of alcohol, exercising regularly, learning and practicing stress reduction, and following all prescriptions to maintain normal blood cholesterol and blood pressure.

* **stroke** is a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **obesity** (o-BEE-si-tee) is an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.

* **CT scans** or CAT scans are the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body.

* **MRI** which is short for magnetic resonance imaging, produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.

* **electrocardiogram** (e-lek-tro-KAR-dee-o-gram), also known as an EKG, is a test that records and displays the electrical activity of the heart.

* **ultrasound** also called a sonogram, is a diagnostic test in which sound waves passing through the body create images on a computer screen.

- * **echocardiogram** (eh-ko-KAR-dee-uh-gram) is a diagnostic test that uses sound waves to produce images of the heart's chambers and valves and blood flow through the heart
- * **stress test** measures the health of a person's heart while the heart is intentionally stressed by exercise or medication.
- * **grafts** are tissue or organ transplants.
- * **gangrene** (GANG-green) is the decay or death of living tissue caused by a lack of oxygen supply to the tissue and/or bacterial infection of the tissue.
- * **aorta** (ay-OR-ta) is the major large artery that carries blood from the heart to the rest of the body.
- * **aortic aneurysm** (ay-OR-tik AN-yoo-rizm) is a weak spot in the aorta, the body's largest blood vessel. The weak spot can rupture or break, causing massive internal bleeding.

Peripheral artery disease Peripheral artery disease develops when the arteries outside the heart narrow and harden. Like coronary artery disease, this condition develops because plaque obstructs blood flow. Peripheral artery disease has many of the same risk factors as coronary artery disease, including aging, family history, smoking, diabetes, high blood pressure, high cholesterol, and obesity, as well as high blood levels of a particular amino acid (homocysteine). Blockage in the carotid arteries, which carry blood through the neck to the brain) can lead to a transient ischemic attack, or stroke. Blockage in the arteries that carry blood to the legs can result in poor blood circulation in the legs, leading to leg pain and cramps with activity (called intermittent claudication), delayed healing, open ulcers, and even gangrene*. Initially, pain only occurs with activity, but over time it may also occur at rest. Blockage in the renal (kidney) arteries can result in high blood pressure, congestive heart failure, and, over time, kidney failure.

Peripheral artery disease is diagnosed by using a stethoscope to listen for abnormal sounds over the carotid arteries, comparing the blood pressure in the patient's arms and legs (called the ankle-brachial index), testing for high blood cholesterol and homocysteine, and demonstrating poor blood flow through the arteries of concern via ultrasound tests, MRI or CT scans, or angiography (during which dye is injected into the blood vessels to highlight areas of obstruction).

Treatment of peripheral artery disease can include the same types of lifestyle changes used to treat coronary artery disease (weight loss, smoking cessation, increased exercise, learning to deal with stress, and eating a healthier diet). Medications may be used to lower high cholesterol and high blood pressure; to avoid blood clots with blood thinners (anticoagulants), aspirin, or clopidogrel; and to improve the ability to walk distances pain-free with cilostazol. More severe arterial obstructions may require surgery. As with coronary arteries, both angioplasty and bypass grafting can be used to treat peripheral artery disease. Additionally, the carotid arteries may require endarterectomy, a surgical procedure which cleans out the plaque within the carotid arteries and places a permanent artificial tube or stent inside the artery to keep it open.

While peripheral artery disease is a common problem of aging and often runs in families, an individual's risk can be lowered by adhering to basic preventive measures, including maintaining a healthy weight, eating a low-fat/low-cholesterol diet, never smoking, drinking only moderate quantities of alcohol, exercising regularly, learning and practicing stress reduction, and following directions for taking all prescriptions to maintain normal blood cholesterol and blood pressure and treat diabetes.

Aneurysms Aneurysms are abnormal bulges in the wall of an artery. Any artery can develop an aneurysm, although aneurysms are simultaneously most common and most dangerous when they occur within the largest artery of the body, the aorta* (called an abdominal aortic aneurysm* or thoracic aortic aneurysm, depending on its specific location), and when they occur within arteries of the brain (called intracerebral

aneurysms). An aneurysm may be present at birth (congenital) or may occur over time.

Some of the same factors that cause the atherosclerosis responsible for coronary artery disease and peripheral artery disease can also increase an individual's risk for developing an aneurysm. Risk factors for aneurysm include being a male over age 60, having a family history of aneurysm, high blood pressure, smoking, high cholesterol, and excess alcohol intake. Additionally, aneurysms may occur in conjunction with a number of other medical conditions, such as Kawasaki syndrome, Marfan syndrome, presence of an abnormal bicuspid aortic valve, giant cell arteritis, polycystic kidney disease, systemic lupus erythematosus, and Ehler-Danlos syndrome. Initially, an aneurysm does not usually cause symptoms, but it will continue to expand over time very gradually. Clots may form over the area of an aneurysm, risking obstruction of the blood vessel. The clot may also break off of the site, travel through the blood circulation, and obstruct a vessel at a distance, causing death or disability. Alternatively, the aneurysm may eventually reach a size at which it presses on other structures, organs, or nerves in the vicinity, causing pain or disability. Most dangerous, as an aneurysm grows, the adjacent area of artery wall becomes thinner and more fragile. Eventually, the aneurysm may rupture (burst) and cause life-threatening hemorrhage* (bleeding).

Rupture of an aneurysm is a serious emergency. Symptoms of a ruptured aneurysm depend on its location. Rupture of an aortic aneurysm leads to severe abdominal and back pain, low blood pressure, dizziness, lightheadedness, and ultimately unconsciousness. Rupture of a brain aneurysm leads to stroke symptoms, such as severe headache, confusion, facial drooping, visual problems, problems speaking or understanding speech, difficulty walking, weakness or paralysis of the muscles on one side of the body. An aneurysm may be suspected when a physician discovers a pulsing abdominal mass during a physical examination, although aneurysms are often discovered incidentally during tests for other conditions. Tests to confirm the presence of an aneurysm include ultrasound, CT scan, and angiography.

Smaller aneurysms can be monitored over time, without specific treatment. Some aneurysms can be repaired and reinforced by permanently placing a graft made of artificial material into the area of artery where the aneurysm is located. A large aneurysm may call for surgery to remove the aneurysm and replace that area with a graft. A ruptured aneurysm requires immediate, emergency surgery. While coronary artery disease often runs in families, an individual's risk can be lowered by adhering to basic preventive measures, including maintaining a healthy weight, eating a low-fat/low-cholesterol diet, never smoking, drinking only moderate quantities of alcohol, exercising regularly, learning and practicing stress reduction, and following all directions for taking prescription medications to maintain normal blood cholesterol and blood pressure. Prevention of aneurysms requires practice of the same measures.

Raynaud's disease Raynaud's disease is an abnormality of the small arteries that bring blood to the fingers and toes. In this disease,

* **hemorrhage** (HEH-muh-rij)
is uncontrolled or abnormal
bleeding.

* **chemotherapy** (KEE-mo-THER- α -pee) is the treatment of cancer with powerful drugs that kill cancer cells.

* **ulcers** are open sores on the skin or the lining of a hollow body organ, such as the stomach or intestine. They may or may not be painful.

certain factors (exposure to cold temperatures or stressful and emotional situations) cause these arteries to spasm, preventing normal blood flow. About 75 percent of all Raynaud's sufferers are women between the ages of 15 and 40.

Risk factors for Raynaud's disease include repetitive stress injuries, exposure to certain chemicals, nicotine, caffeine, certain medicines (including chemotherapy* agents, drugs used to treat migraine headache or high blood pressure, nonprescription cold and allergy medicines, oral contraceptives); previous injury due to frostbite or other extreme cold exposure/hypothermia); and other diseases such as rheumatoid arthritis, Sjogren's syndrome, Buerger's disease, scleroderma, systemic lupus erythematosus, dermatomyositis, polymyositis, and atherosclerotic disease.

Symptoms of Raynaud's disease occur when the small arteries spasm, preventing blood and oxygen from reaching the tissues. The skin turns white or blue, very cold, numb, tingly, and painful. In severe cases, Raynaud's disease can result in poorly healing ulcers* and even gangrene and tissue death. Bouts may occur several times daily and may last between 15 minutes and several hours.

Raynaud's disease is often provisionally diagnosed based on the very characteristic symptoms that are reported. Testing can be done to confirm the condition, including a cold simulation test that uses temperature sensors affixed to the fingers to measure the response to cold exposure. Nailfold capillaroscopy involves placing a drop of oil on the skin at the base of fingernail, and then examining the area with a microscope, which may reveal the presence of abnormal blood vessels. A variety of blood tests may be done to evaluate for the presence of one of the conditions that are strongly associated with Raynaud's disease.

Raynaud's disease is treated by encouraging sensible lifestyle changes, such as avoidance of cold temperatures and use of gloves and mittens when they cannot be avoided. Known precipitants (factors that bring on attacks), such as medications, chemicals, activities, or stress should be avoided. A variety of medications may be used to improve dilatation of blood vessels. Aspirin and heparin may be used to prevent blood clotting. Very severe cases may require surgery to cut the nerve responsible for the spasms in small arteries or to perform a bypass to replace the length of malfunctioning blood vessel with a graft.

Buerger's disease Buerger's disease, also called thromboangiitis obliterans, occurs when small- and medium-sized arteries and veins develop severe inflammation. Although this rare condition is not due to the presence of atherosclerotic plaque, it can result in similar problems, because the inflamed arteries and veins become narrowed and significantly decrease blood flow. Organs and tissues are deprived of oxygen and nutrients. Blood clots may form within the inflamed blood vessels, resulting in further obstruction. Arms and legs are most frequently affected. Buerger's disease usually begins prior to the age of 40 and is more common in men, smokers, and people who live in Asia, the Far East, and the Middle East.

Symptoms of Buerger's disease include pain with activity and at rest, decreased sensation in the affected limb, poor healing, and open ulcers and sores. Over time, gangrene may develop, with the necessity of amputation (surgical removal of a body part). There is no one test that can definitely diagnose Buerger's disease. Blood tests and an echocardiogram may be done in order to rule out other disease. Angiography involves taking x-rays, CT scans, or MRI scans, after the injection of dye into blood vessels. This test allows any obstructions to be visualized.

The first step of treatment in Buerger's disease is smoking cessation. Very severe cases may require surgery to cut the nerve responsible for the spasm or to perform a bypass to replace the length of malfunctioning blood vessel with a graft. If gangrene develops, amputation may be necessary and life-saving. Although imperfect, avoiding smoking is the only potential form of prevention.

Varicose veins Varicose veins are enlarged, twisted veins. Milder cases are simply a cosmetic annoyance; more severe cases can cause pain and disability. Varicose veins happen when there is increased back-pressure on the veins that are attempting to carry blood to the heart (for example, during pregnancy). Veins become less elastic, more extended, and unable to prevent the backflow of blood, due to weakening of the valves within the veins that normally keep blood flowing toward the heart. When blood accumulates within the veins, the veins stretch even more, become more enlarged, and begin to take on a gnarled, twisted appearance. Because the blood within the veins has already delivered oxygen to the tissues, it is bluer in color, which causes the varicose veins to appear very blue and more obvious under the skin.

About 15 percent of all men and 25 percent of all women in the United States have varicose veins. The tendency seems to run in families and increases with increasing age. Predisposing conditions include pregnancy, obesity, history of long periods of standing, and use of oral contraceptives or estrogen replacement therapy. Symptoms of varicose veins include their characteristic appearance of thick, winding, blue cords visible beneath the skin. Other symptoms may include a heavy, aching in the legs; itchiness in the area around visible veins; poorly healing sores; and the emergence of ulcers in the skin around the ankles.

Diagnosis is usually straightforward, because varicose veins are so visible. An ultrasound test of the affected veins may be performed to evaluate whether the valves are working, how hampered the blood flow is, and whether any blood clots are forming within the veins. Treatment usually begins with basic steps, such as maintaining a normal weight, exercising, avoiding tight clothing, avoiding prolonged sitting (with legs dangling) or standing, and keeping feet and legs elevated when possible. For more severe and symptomatic varicose veins, a number of procedures are available:

- Sclerotherapy (in which a caustic chemical solution is injected into affected veins, thus scarring them closed)
- Laser surgery (which uses light to get rid of the affected vein)

- Catheter-assisted procedures (in which a narrow, flexible tube is placed into a varicose vein; the tube heats the vein, causing it to seal closed)
- Vein stripping (the removal of veins through tiny incisions in the leg)
- Endoscopic vein surgery (which also removes the veins through tiny incisions, but requires the insertion of a tiny camera in order to visualize, close, and remove the affected vein)

Clotting disorders Clotting disorders include both conditions that prevent normal blood clotting and those that promote abnormal blood clotting.

BLEEDING DISORDERS Bleeding disorders are diseases that interfere with the blood's ability to form a clot. Twenty different clotting factors are involved in the ability of the blood to clot normally; absence or deficiency in any of these factors can result in a tendency to bleed. Types of bleeding disorders include von Willebrand's disease and various forms of hereditary hemophilia, such as hemophilia A (also called classic hemophilia or factor VIII deficiency), hemophilia B (also called Christmas disease or factor IX deficiency), and hemophilia C (also called factor XI deficiency). People with bleeding disorders are at risk of severe bleeding and hemorrhage from seemingly minor cuts or trauma. Severe hemophiliacs can begin to bleed spontaneously, resulting in unexpected gushing nosebleeds, severe bruising, bleeding into the joints, or bleeding from the gastrointestinal or urinary tract.

Hemophilia is an inherited disorder, often affecting many members of a family. Some types of hemophilia only affect males; other types can strike either males or females. Hemophilia is often suspected due to a family history of the disorder, although some mild cases are only diagnosed after an injury or surgical procedure results in excess bleeding. Blood tests may reveal a lack of specific clotting factors associated with hemophilia or decreased levels of the specific protein (von Willebrand factor) deficient in von Willebrand's disease. Treatment of hemophilia may require infusions of fresh frozen plasma (fluid part of blood) or specific clotting factors to help stop or prevent bleeding.

HYPERCOAGULATION DISORDERS The opposite of hemophilia occurs when the blood has a tendency to clot too easily, resulting in the formation of thromboses (blood clots) that can obstruct the blood circulation, causing ischemia (oxygen deprivation) in tissues or organs that are unable to receive normal blood flow. One form of this condition is called deep-vein thrombosis or DVT, in which clots form spontaneously in the deep veins of the legs. A DVT will cause swelling in the affected leg, as well as warmth, redness, and pain in the area of the clot. This condition is particularly dangerous, because pieces of the clot (or the entire clot) can break loose, travel through the bloodstream, and obstruct blood vessels. The blood clot can lodge in the heart, resulting in heart attack; the lungs

(pulmonary embolism), resulting in extreme difficulty breathing or even respiratory arrest; or brain (resulting in stroke).

Hypercoagulation (excessive clotting) may be hereditary (as in protein S deficiency) or acquired. People at risk of developing thromboses include women who are using oral contraceptives, estrogen replacement therapy, or who are pregnant; smokers; cancer patients; people who have recently had surgery or suffered trauma; hospitalized or debilitated patients; and individuals who are obese and/or sedentary. Diagnosis of hypercoagulation disorders usually involves demonstrating the presence of a DVT, via ultrasound, CT, MRI or venography (in which dye is injected into the vein and images are taken that can reveal the presence of a blood clot). Blood tests may reveal an elevation of a substance called D dimer. Treatment of hypercoagulation requires anticoagulation via blood thinner medications such as heparin and warfarin.

Lymphedema Lymphedema occurs when there is an obstruction in the lymphatic system*, reducing the normal flow of lymph (clear fluid that contains white blood cells) through the lymph vessels. As lymph fluid backs up, the vessels become leaky, allowing the fluid to seep out into the surrounding tissues and causing swelling in the affected arm or leg or other part of the body.

Lymphedema can occur due to congenital (present at birth) malformation of the lymph vessels, as occurs in a number of diseases, including Milroy disease (congenital lymphedema); Meige disease (lymphedema praecox); and lymphedema tarda (late-onset lymphedema). Lymphedema can also occur in the following situations:

- After injury or disease damages the lymph vessels, such as after surgery that involves removal of lymph nodes or vessels (for example, due to a lymph node dissection during a mastectomy*)
- Due to scarring from radiation treatment
- Due to obstruction of lymph vessels by cancer cells or pressure from a nearby expanding tumor*
- After traumatic injury involving lymph vessels
- Due to parasitic infection that blocks the lymph vessels (such as filariasis, also known as elephantiasis)

The diagnosis may be quite obvious, depending on the individual's history, but further visualization of the area may be obtained through ultrasound, MRI or CT scans, or lymphoscintigraphy, during which radioactive dye is injected into the lymph vessels. Subsequent imaging of the dye flow can reveal the location of a lymphatic obstruction.

Treatment of lymphedema includes special exercises or massage to encourage better lymph flow; the wearing of elastic pressure bandages and special compression garments (such as a sleeve, stockings, or glove) to improve lymph flow back towards the heart; or the application of a pneumatic pressure device to “milk” the lymph fluid back into circulation. Prevention focuses on those individuals at particularly high risk of

* **lymphatic system** (lim-FAH-tik) is a system that contains lymph nodes and a network of channels that carry fluid and cells of the immune system through the body.

* **mastectomy** (mas-TEK-to-mee) is the surgical removal of the breast.

* **tumor** (TOO-mor) is an abnormal growth of body tissue that has no known cause or physiologic purpose. A tumor may or may not be cancerous.

developing lymphedema, such as women who have undergone mastectomy with lymph node dissection. These individuals should treat their at-risk limb with particular care, keeping it scrupulously clean; avoiding injury; carefully treating even small scratches, cuts or punctures; keeping it elevated above heart-level; avoiding application of heat; and making sure that clothing is not overly constricting.

▶ See also **Aneurysm**

Resources

Books and Articles

Ferri, Fred, ed. *Ferri's Clinical Advisor 2008*. Philadelphia, PA: Mosby Elsevier, 2008.

Sutton, Amy L., ed. *Blood and Circulatory Disorders Sourcebook*, 2nd ed. Detroit, MI: Omnigraphics, 2005.

Organizations

American Heart Association. 7272 Greenville Avenue, Dallas, TX, 75231-4596. Toll free: 800-AHA-USA1. Web site: <http://www.americanheart.org/presenter.jhtml?identifier=1200000>.

National Heart, Lung, and Blood Institute. P.O. Box 30105, Bethesda, MD, 20824-0105. Telephone: 301-592-8573. Web site: <http://www.nhlbi.nih.gov/index.htm>.

National Hemophilia Foundation. 116 West 32nd Street, 11th Floor, New York, NY, 10001. Telephone: 212-0328-3700. Web site: <http://www.hemophilia.org>.

Vascular Disease Foundation. 1075 S. Yukon, Suite 320, Lakewood, CO, 80226. Telephone: 303-989-0500. Web site: <http://www.aad.org>.

Venous Thrombosis See *Phlebitis and Venous Thrombosis*.

Vertigo

Vertigo (VER-ti-go) is dizziness which causes people to feel that they or their surroundings are moving, often causing loss of balance.

What Is Vertigo?

Vertigo is different from other forms of dizziness because it is caused by disturbances in the structures that control the sense of balance. These structures include the vestibule and semicircular canals in the ear, the vestibular (ves-TIB-u-lar) nuclei in the brain stem*, and the eyes. There are many different kinds of vertigo.

Benign paroxysmal vertigo of childhood Benign* paroxysmal (par-ok-SIZ-mal) vertigo is a condition that sometimes affects toddlers, who may suddenly lose their balance, roll their eyes, and become pale, dizzy, or nauseated for a few minutes. They usually recover quickly and often outgrow this form of vertigo.

Positional vertigo Positional vertigo may occur following changes in head position, especially when lying on one ear or when tipping back the head to look up. The symptoms tend to appear in clusters that last for several days. The vertigo begins several seconds after head movement and usually stops in under a minute. Some of the causes of positional vertigo are trauma to the ear, an ear infection, ear surgery, or degeneration due to aging inner ear organs that are involved in balance. Surgery can sometimes correct positional vertigo.

Ménière's disease Sometimes called Ménière's syndrome or recurrent aural vertigo, Ménière's disease is caused by damage to the balance organs in the ears, although doctors often do not know the cause of the damage. In addition to vertigo, symptoms are likely to include tinnitus (ti-NY-tis), which is a ringing, buzzing, or roaring in the ears. It may also cause gradual deafness in the affected ear. Ménière's disease can be controlled with medication, but it cannot be cured.

Labyrinthitis Labyrinthitis (lab-i-rin-THY-tis) is an inflammation of the labyrinth in the inner ear, possibly as a result of viral infection in the upper respiratory tract. The labyrinth is a group of canals in the inner ear that is important for balance. Symptoms of labyrinthitis are sudden onset of severe vertigo lasting for several days, hearing loss, and tinnitus in the affected ear. During the recovery period, which may last several weeks, rapid head movement causes temporary vertigo.

Vestibular neuronitis Vestibular neuronitis (noo-ro-NY-tis) is sometimes called epidemic vertigo and is thought to be the result of a virus that causes inflammation of the vestibular nerve cells. Vestibular neuronitis usually causes a single attack of severe vertigo with nausea and vomiting that lasts for a few days. There is no hearing loss or tinnitus, and doctors often prescribe medication to help with the dizziness and nausea.

Traumatic vertigo Traumatic vertigo is one of the most common types of vertigo. It usually follows a head injury. The symptoms generally start to improve within several days but may last for weeks. Deafness

* **brain stem** is the part of the brain that connects to the spinal cord. The brain stem controls the basic functions of life, such as breathing and blood pressure.

* **benign** (be-NINE) means a condition is not cancerous or serious and will probably improve, go away, or not get worse.

often accompanies the vertigo on the side of the head that received the trauma. In some cases, surgery may be required to correct damage to the ear structures.

Acoustic neuromas Acoustic neuromas are benign tumors that form in the vestibular nerve, affecting nerve signals for balance and hearing from the ear to the brain. Symptoms are hearing loss, tinnitus, dizziness, and unsteadiness. Surgery to remove the tumor improves the vertigo.

How Do Doctors Treat Vertigo?

Doctors often prescribe medication to reduce the dizziness, nausea, and sense of motion of vertigo. Other treatments vary according to the cause of the vertigo.

▶ See also **Deafness and Hearing Loss • Motion Sickness • Otitis (Ear Infections) • Tinnitus**

Resources

Books and Articles

Poe, Dennis, ed. *The Consumer Handbook on Dizziness and Vertigo*. Sedona, AZ: Auricle Ink, 2005.

Organizations

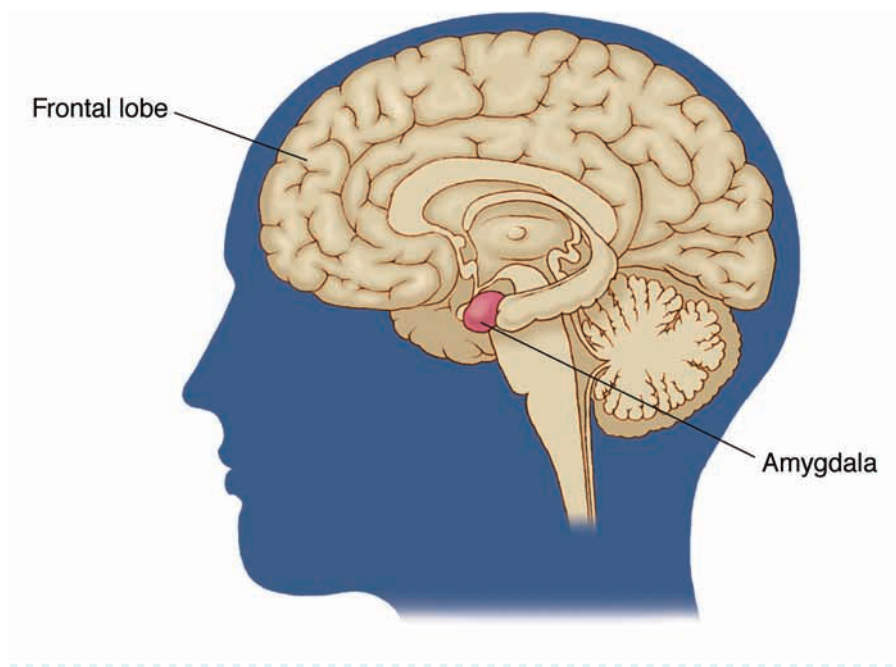
National Institute on Deafness and Other Communication Disorders, National Institutes of Health. 31 Center Drive, MSC 2320, Bethesda, MD, 20892-2320. Toll free: 800-241-1044. Web site: <http://www.nidcd.nih.gov>.

National Library of Medicine. 8600 Rockville Pike, Bethesda, MD, 20894, Web site: <http://www.nlm.nih.gov/medlineplus/dizzinessandvertigo.html>.

Vestibular Disorders Association. P.O. Box 13305, Portland, OR, 97213-0305, Web site: <http://www.vestibular.org>.

Violence

Violence is the use of physical force to injure people or property. Violence may cause physical pain to those who experience it directly, as well as emotional distress to those who either experience or witness it. Individuals, families, schools, workplaces, communities, national societies, and local and global environments all are harmed by violence.



The frontal lobe and amygdala are the parts of the human brain affected by anger and violence. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*



What Is Violence?

Violence is a social and health problem for all who experience and witness it. Violence takes many forms, including:

- Family violence, often referred to as domestic abuse, child abuse, child maltreatment, spouse abuse, and wife battering
- Peer group violence, which includes workplace violence, school violence, gang violence, and bullying*
- Sexual violence, which includes rape*, date rape, marital rape, intimate partner abuse, and child sexual abuse
- Abuse of power, which includes mistreatment of children, students, elders, people with disabilities, and others who are smaller or less powerful than the abuser
- Community violence, which includes assaults, fights, shootings, homicides, and most forms of peer violence
- Hate crimes and hate speech, which target victims based on gender, age, race, ethnicity, religious belief, or sexual orientation
- Media violence, shown on television, in film, and in video games.

Why Do People Behave Violently?

Research indicates that violent behavior may have many different causes, some of which are inborn but most of which are learned from experiencing or witnessing violent behavior by others, particularly those who are role models.

Genetics Chromosomes carry genetic messages from parents to offspring, and there is some research that suggests that, in some cases, aggressiveness may be inherited.

* **bullying** is when a person repeatedly intimidates or acts aggressively toward those with less power or ability to defend themselves.

* **rape** is when a person forces another person to have sexual intercourse, or engage in other unwanted sexual activities.

What Is Wrong with Media Violence?

Research indicates that media violence can lead to real violence in multiple ways. The surgeon general and the National Institute of Mental Health have both reported that watching violence depicted on television is an important predictor of aggressive behavior. Children's cartoons and music videos in particular often portray violence. American children see about 16,000 simulated murders and 200,000 acts of violence on television by age 18. In nearly 75 percent of those cases, punishment is not shown to be a consequence of violent behavior.

Perhaps even more serious is the link between violence and some interactive video games. During violent video games, the player identifies with the point of view of the aggressor and imitates or enacts violent thoughts, feelings, and simulated actions. For some people, with enough reinforcement, violent behaviors can become accessible or even automatic if and when the player later encounters conflict in real life.

Brain injury Injury to the front parts of the brain may remove some personal control over anger and aggression.

Antisocial personality disorder People with antisocial personality disorder often behave violently even as children. They may disregard their own safety and the safety of others. People with this disorder do not seem to understand that violence harms other people, and they do not seem to have a conscience that distinguishes between right and wrong. The terms sociopath and psychopath sometimes are used to describe people with antisocial personality disorder.

Alcohol and substance abuse Drinking and drugs often play a role in violence. For some, these substances interfere with otherwise good judgment or behavior. Some people try to use alcohol or drugs to treat their feelings of anger or depression, but instead feel worse. Violence toward others—or towards themselves—can result.

Desensitization Constantly viewing violence at home, in communities, or on television can lead people to believe that violence is a normal part of life. People who are surrounded by violence may reach a point at which they no longer notice violent events or remember that peaceful behavior is a possibility.

Learned helplessness People who accept the belief that violence is an inevitable part of their lives may give up trying to avoid or escape that violence. They may become passive and unable to create safety for themselves or their families. Battered wives who remain at home with battering husbands, for example, may believe that they are unable to escape violence. This resignation to violence exposes them to more of it.

Social modeling Children learn by observation and by imitation. Children who observe their home, school, or media role models behaving in violent ways may come to believe that turning angry feelings into angry actions is acceptable behavior or even the most effective way to solve problems. Such children may never learn peaceful behaviors or cooperative ways to solve problems.

Parents who model abusive behavior at home can create a cycle of violence, teaching children to grow up to be abusive adults. The importance of positive role models and the dangers of negative role models should not be underestimated.

Learning the boundaries between anger (emotion) and violence (physical force) is an important developmental task for all people and all cultures. It is possible to have angry feelings without turning those feelings into angry actions or violent behaviors. Expressing anger in a non-violent way can be healthy. However, parents, adult mentors, media, and community leaders first must model nonviolent conflict-resolution skills for young people to learn them.

SOCIAL MODELING AND SELF-REGULATION

Social psychologist Albert Bandura (b. 1925) began studying social modeling, observational learning, aggression, and self-regulation in the 1970s. Bandura's theories suggest that role models (social modeling) can influence people toward creativity or toward violence. If children observe violent behavior at home, in school, or on television, they may come to believe that turning angry feelings into angry actions is acceptable behavior. When these children become angry themselves, they may display the behaviors they have observed, and they even may create new angry behaviors that go beyond what they have learned from their models.

Another important aspect of Bandura's research focused on self-direction and self-efficacy or people's beliefs about their own abilities to influence and affect the world around them. If children observe adults failing to control their own angry feelings or violent behaviors or if they observe violent behavior going unpunished, they may come to believe that peaceful behaviors cannot succeed or are not worthwhile activities. They may lose their motivation to learn cooperative problem-solving skills, or they may quit before they achieve success in using these skills.

* **post-traumatic stress disorder**

(post-trau-MAT-ik STRES dis-OR-der) is a mental disorder that interferes with everyday living and occurs in people who survive a terrifying event, such as school violence, military combat, or a natural disaster.

How Is Violence Treated and Prevented?

People who experience or witness violence should react immediately. Police and violence hotlines should be called in an emergency. People who have been injured should be taken to a clinic or hospital emergency room for treatment. When an immediate crisis has ended, a family doctor or school counselor or member of the clergy should be contacted for counseling and referrals. Shelters and child protection agencies can help battered women and children. Counseling can help batterers and their families to learn better behaviors for managing stress, conflict, and anger. Therapists can help people with post-traumatic stress disorder* achieve emotional recovery from the aftermath of violence.

Those who commit violent acts or have violent or angry feelings need to receive treatment. Emotional problems, drug and alcohol abuse, and other conditions which make a person more prone to violence need to be handled. The social forces that prevent violence—family, friends, and the community—need to take positive steps to make violence less likely and to increase safety.

Physical violence is never an acceptable form of behavior. Everyone has choices. Becoming aware of the problems, deciding not to follow violent patterns, and making a commitment to learn new ways of relating are the keys to change and increased wellness. It is never too late to change the pattern of violence in families, communities, or society.

▶ See also **Antisocial Personality Disorder • Conduct Disorder • Oppositional Defiant Disorder • Personality and Personality Disorders • Post-Traumatic Stress Disorder • Rape**

Resources

Books and Articles

Armitage, Ronda. *Violence in Society: The Impact on Our Lives*. Chicago: Raintree, 2004.

Jones-Smith, Elsie. *Nurturing Nonviolent Children: A Guide for Parents, Educators, and Counselors*. Westport, CT: Praeger, 2008.

Monteverde, Matthew. *Making Smart Choices about Violence, Gangs, and Bullying*. New York: Rosen Publishings Rosen Central, 2008.

Organizations

Center for the Prevention of School Violence. 313 Chapanoke Road, Suite 140, Raleigh, NC, 27603. Toll free: 800-299-6054. Web site: <http://www.ncsu.edu/cpsv>.

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

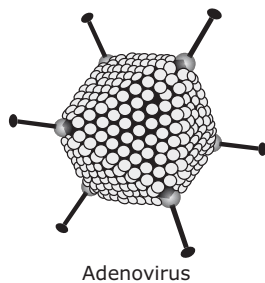
National Institute of Mental Health. Science Writing, Press, and Dissemination Branch, 6001 Executive Boulevard, Room 8184, MSC 9663, Bethesda, MD, 20892-9663. Toll free: 866-615-6464. Web site: <http://www.nimh.nih.gov/health/topics/child-and-adolescent-mental-health/children-and-violence.shtml>.

Viral Infections

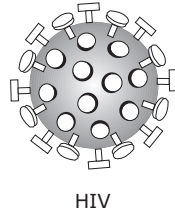
Viral infections occur when viruses enter cells in the body and begin reproducing, often causing illness. Viruses are tiny germs that can reproduce only by invading a living cell.

How Are Viruses Different from Bacteria?

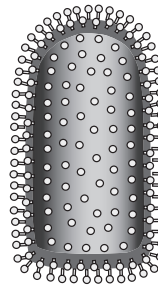
Viruses are far smaller than bacteria. They are so small that they could not be seen until the electron microscope was invented in the 1940s. Unlike most bacteria, viruses are not complete cells that can function on their own. They cannot convert carbohydrates to energy, the way that bacteria and other living cells do. Viruses depend on other organisms for energy.



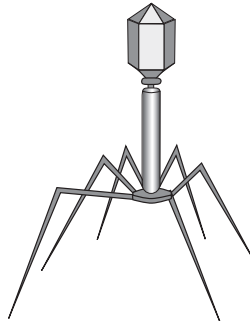
Adenovirus



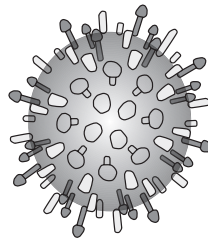
HIV



Rabies virus



Bacteriophage T2



Influenza virus

Moreover, viruses cannot reproduce unless they get inside a living cell. Most viruses consist only of tiny particles of nucleic acid (the material that makes up genes) surrounded by a coat of protein. Some have an outer envelope as well.

Thousands of viruses There are thousands of viruses, and in humans they cause a wide range of diseases. For instance, rhinoviruses cause colds, influenza viruses cause flu, adenoviruses* cause various respiratory problems, and rotaviruses cause gastroenteritis. Polioviruses can make their way to the spinal cord and cause paralysis, whereas coxsackieviruses (sometimes written as Coxsackie viruses) and echoviruses* sometimes infect the heart or the membranes surrounding the spinal cord or lungs. Herpesviruses cause cold sores, chickenpox, and genital herpes, which is a sexually transmitted disease. Other viruses cause a variety of conditions from measles and mumps to AIDS.

The body's defense system Most viruses do not cause serious diseases and are killed by the body's immune system*—its network of natural defenses. In many cases, people never even know they have been infected. But unlike bacteria, which can be killed by antibiotics, most viruses are not affected by existing medicines. Fortunately, scientists have been able to make vaccines, which help the body develop natural defenses to prevent many viral infections.

How Do Viruses Infect the Body?

Viruses can enter the human body through any of its openings, but most often they use the nose and mouth. Once inside, the virus attaches itself to the outside of the kind of cell it attacks, called a host cell. For example,

There are thousands of kinds of viruses. Most consist only of tiny particles of genetic material surrounded by a coat of protein and sometimes an outer envelope. Specific viruses attach themselves to the outsides of specific host cells, and then work their way inside through the host's outer membranes. Once inside their host cells, the viruses reproduce. The new viruses can destroy their host cells and then move on to attack new host cells. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

Are Viruses Alive?

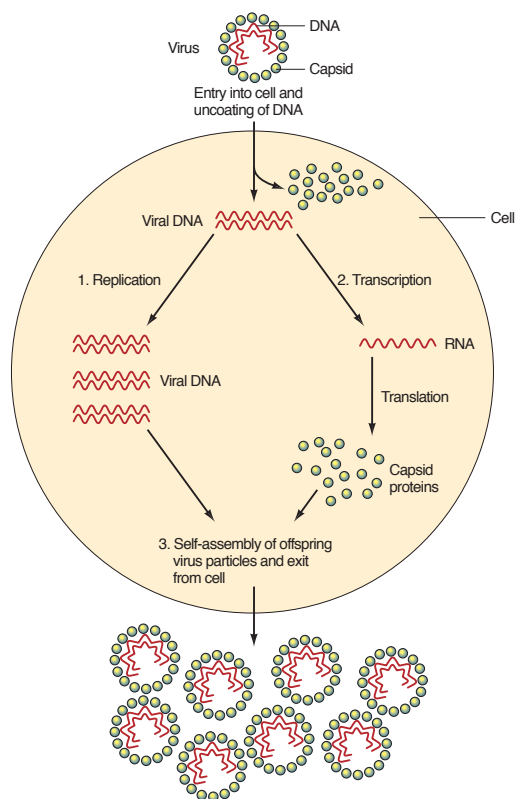
It would seem to be a simple matter to determine if something is alive. But biologists disagree on whether viruses are a form of life.

Viruses lack certain features that other forms of life have. They cannot convert carbohydrates, proteins, or fats into energy, a process called metabolism. They cannot reproduce on their own but must enter a living cell and use the host cell's energy. Yet, like all life forms, viruses do have genes made of nucleic acid that contain the information they need to reproduce.

Biologists have an elaborate way of classifying every form of life. Each is grouped into a kingdom (such as the animal kingdom) and smaller subcategories called the phylum, class, genus, and species.

Bacteria and fungi each have a kingdom of their own, but viruses are left out of this system. Many biologists think that, unlike the forms of life grouped into kingdoms, viruses did not evolve (develop) as a group. Instead, viruses may have developed individually from the kind of cells they now infect—animal cells, plant cells, or bacteria.

The replication of a virus. *Chart by Hans & Cassidy. Reproduced by permission of Gale, a part of Cengage Learning.*



* **adenoviruses** (ah-deh-no-VY-ruh-sez) are a type of viruses that can produce a variety of symptoms, including upper respiratory disease, when they infect humans.

* **echoviruses** a group of viruses found in the intestinal tract. The word echo in the name is acronym for enteric cytopathic human orphan viruses. When these viruses were named, they were not associated with any disease, hence the use of the word orphan. However, later these viruses were associated with various diseases, including meningitis and encephalitis.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

a rhinovirus attacks cells in the nose, whereas an enterovirus binds to cells in the stomach and intestines. Then the virus works its way through the host cell's outer membrane.

After entering the cell, the virus begins making identical viruses from the host cell's protein. These new viruses may make their way back out through the host cell's membrane, sometimes destroying the cell, and then attacking new host cells. This process continues until the body develops enough antibodies* and other defenses to defeat the viral invaders.

Not all viruses attack only one part of the body, causing what is called a localized infection. Some viruses spread through the bloodstream or the nerves, attacking cells throughout the body. For instance, HIV*, the human immunodeficiency virus that causes AIDS*, attacks certain cells of the immune system that are located throughout the body.

How Long Do Viral Infections Last?

In most types of viral infection, the immune system clears the virus from the body within days to a few weeks. But some viruses cause persistent or latent* infections, which can last for years. In these cases, a person may get infected and seem to recover or may not be aware of being infected at all. Then years later, the illness occurs again, or symptoms start for the first time. Viruses that can cause latent infections include herpesviruses, Hepatitis B and C viruses, and HIV.

How Do Viruses Cause Illness?

Viruses can cause illness by destroying or interfering with the functioning of large numbers of important cells. Sometimes, as mentioned earlier, the cell is destroyed when the newly created viruses leave it. Sometimes the virus keeps the cell from producing the energy it needs to live, or the virus upsets the cell's chemical balance in some other way. Sometimes the virus seems to trigger a mysterious process called "programmed cell death" or apoptosis (ap-op-TO-sis) that kills the cell.

Some persistent or latent viral infections seem to transform cells into a cancerous state that makes them grow out of control. It has been estimated that 10 to 20 percent of cancers are caused by viral infections. The most common are liver cancer caused by persistent infection with hepatitis B or hepatitis C virus and cancer of the cervix (the bottom of a woman's uterus or womb), both of which are linked to certain strains of the human papillomavirus.

Sometimes a viral illness is caused not by the virus itself, but by the body's reaction to it. The immune system may kill cells in order to get rid of the virus that is inside them. This process can cause serious illness if the cells being killed are very important to the body's functioning, such as those in the lungs or central nervous system, or if the cells cannot reproduce quickly enough to replace the ones being destroyed.

How Are Viral Infections Diagnosed and Treated?

Symptoms Symptoms vary widely, depending on the virus and the organs involved. Many viruses, like many bacteria, cause fever, and either respiratory symptoms (coughing and sneezing) or intestinal symptoms (nausea, vomiting, diarrhea). Viral illnesses often cause high fevers in young children, even when the illnesses are not dangerous.

Diagnosis Some viral infections, such as influenza, the common cold, and chickenpox, are easily recognized by their symptoms and no lab tests are needed. For many others, such as viral hepatitis, AIDS, and mononucleosis, a blood sample is analyzed for the presence of specific antibodies to the virus. If present, these antibodies help confirm the diagnosis. In some cases, a virus may be grown in the laboratory, using a technique called tissue culture*, or identified by its nucleic acid, using a technique called polymerase chain reaction (PCR). Tests such as tissue culture or PCR are used when antibody tests are not precise enough or when the actual amount of a virus in the body must be determined.

Treatment Viruses cannot be treated with the antibiotics that kill bacteria. Fortunately, a few drugs, such as ribavirin and acyclovir, can control the spread of viral invaders without destroying host cells. Intense research to find better treatments for AIDS led to development of many drugs

- * **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.
- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **latent** infections are dormant or hidden illnesses that do not show the signs and symptoms of active diseases.
- * **culture** (KUL-chur) is a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.

What Is a 24-Hour Virus?

When people have a mild illness—perhaps fever and an upset stomach, perhaps nausea and diarrhea—they often say they have a “24-hour virus” or a “stomach virus.” Many viruses can cause these kinds of symptoms, but there are many other possible causes as well, including bacterial infection or bacterial food poisoning. People usually recover from these brief or mild illnesses before doctors can do the tests that determine the causes. So a “stomach virus” may or may not be a virus at all.

that help fight the virus. Unfortunately, as of 2009, none of these drugs was able to treat viral infections as effectively as antibiotics treat bacterial infections.

How Are Viral Infections Prevented?

Hygiene and sanitation The first step in preventing the spread of viral infections is simply to practice good hygiene. Doing so involves washing the hands often, and eating only food that has been prepared properly. It also involves building and maintaining facilities for getting rid of sewage safely and for providing clean drinking water.

Vaccination Another important preventive measure is immunizing people against viruses. Immunization involves giving people vaccines that stimulate the immune system to make antibodies, proteins that target a specific germ. Vaccines to prevent hepatitis B, polio, mumps, measles, rubella (German measles), and chickenpox are usually given to babies and young children in the United States. Vaccines also can prevent influenza and hepatitis A.

Vaccines are useful only against certain kinds of viruses. For example, the polioviruses that cause poliomyelitis (polio), a greatcrippler of children in the past, are few in number and relatively stable. So it was possible in the 1950s to make a vaccine that protects children from getting polio (although the illness still occurs in the developing world where fewer children are vaccinated). By contrast, influenza viruses change in minor ways every few years and in a major way about every ten years, so a flu vaccine is useful for only a year or two.

One reason a vaccine for the common cold has never been developed is that there are at least a hundred different rhinoviruses that cause colds, and as of 2009 it had not been possible to make a vaccine that works against all of them. A similar problem with HIV, which has many different and fast-changing strains (variations), is one of several reasons why progress toward an AIDS vaccine was slow.

Resources

Books and Articles

Shors, Teri. *Understanding Viruses*. Sudbury, MA: Jones and Bartlett, 2009.

Sonenklar, Carol. *Virus Hunters*. Brookfield, CT: Twenty-First Century Books, 2003.

Organizations

American Society for Microbiology. 1752 N Street, NW, Washington, DC, 20036-2904. Telephone: 202-737-3600. Web site: <http://www.microbeworld.org/microbes/virus>.

HealthInsite. Editorial Team Service Access Programs Branch,
Department of Health and Ageing, MDP 2, GPO Box 9848,
Canberra, ACT, 2601, Australia. Telephone: 02 6289 8488.
Web site: http://www.healthinsite.gov.au/topics/Viral_Infections.

Karolinska Institutet. SE-171 77, Stockholm, Sweden. Telephone:
+46 8 524 800 00. Web site: <http://www.mic.ki.se/Diseases/C02.html>.

Vitamin Deficiencies See *Dietary Deficiencies*.

Vitiligo

Vitiligo is a condition that causes white patches of skin due to a loss of pigment in the cells and tissues of the body.

What Is Vitiligo?

Melanocytes (MEL-a-no-sites) are special skin cells that make the pigment* that colors the skin, hair, eyes, and body linings. If these cells die or cannot make pigment, the affected skin gets lighter or completely white, causing vitiligo (vit-i-LY-go). The hair in affected areas also may turn white, and people with dark skin may notice a loss of color inside their mouths. No one knows for sure what makes melanocytes die or stop working in vitiligo.

Who Gets Vitiligo?

Vitiligo affects people of all races and both sexes equally. It affects one or two out of every 100 people. About half of all people who have vitiligo begin to lose pigment before they are 20 years of age.

Vitiligo is common in people with certain immune system* diseases and in children with parents who have the condition. However, most people with vitiligo have no immune system disease, and most children will not get vitiligo even if a parent has it. In fact, most people with vitiligo are in good general health and do not have a family history of the condition.

Vitiligo is more obvious in people with dark skin. Light-skinned people may notice the contrast between patches of vitiligo and areas of suntanned skin in the summer. The amount of pigment that is lost varies from person to person. The first white patches often occur on the hands, feet, arms, face, or lips. Other common areas for patches to appear are the



▲
The hands of a person with vitiligo.
© Bruce Coleman Inc./Alamy.

* **pigment** (PIG-ment) is a substance that imparts color to another substance.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **ultraviolet** light is a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.

armpits, the groin (the area where the inner thighs join the trunk), and around the navel (belly button) and genitals.

There is no way to know if vitiligo will spread to other parts of the body, but it usually does spread over time. For some people, this spread occurs rapidly, but for other people, it takes place over many years. Both sides of the body usually are affected in a similar way. There may be a few patches or there may be many.

How Is Vitiligo Diagnosed and Treated?

Diagnosis To diagnose vitiligo, the doctor may ask about the person's symptoms, whether the person has an immune system disorder, and whether vitiligo runs in the person's family. The doctor also may suggest various tests to rule out other medical problems that can cause light skin patches.

Treatment Vitiligo does not always need treatment. For some people with light skin, simply avoiding a suntan on areas of normal skin is enough to make the patches of vitiligo almost unnoticeable. Other people use makeup, skin dyes, or self-tanning products to cover up the vitiligo. Self-tanning products are creams that give the skin a tan color, but not a true tan. The color tends to wear off after a few days. These strategies do not change the condition, but they can make the vitiligo less noticeable. In children, vitiligo usually is just covered up.

In adults, if covering up the vitiligo is not enough, a medical treatment may be tried, although results often cannot be seen for 6 to 18 months. The choice of treatment depends on the person's wishes, how many white patches the person has, and how widespread the patches are. Not every treatment works for every person. There are several choices:

- Corticosteroid (kor-ti-ko-STEER-oid) creams can be applied to the skin and sometimes can return color to small areas of vitiligo.
- Psoralen (SOR-a-len) and ultraviolet* therapy entails taking medication by mouth or applied to the skin and then exposing the light patches of skin to ultraviolet A light from a special lamp. Ultraviolet A is the part of sunlight that can cause the skin to tan, and psoralens are substances that react with ultraviolet light to darken the skin.
- Skin grafting is an operation that involves moving skin from normal areas to white patches. It is useful only for a small number of people with vitiligo.
- Depigmentation therapy involves using medication to fade the normal skin to match the whitened areas of vitiligo.

Living with Vitiligo

The white patches of vitiligo have no natural protection from the sun and are very easily sunburned. People with vitiligo should be careful to avoid exposure to midday sun, to cover up with clothing and a hat, and to use a sunscreen with a high SPF (sun protection factor) rating.

▶ See also **Immune Deficiencies • Skin Conditions**

Resources

Books and Articles

Thomas, Lee. *Turning White: A Memoir of Change*. Troy, MI: Momentum Books, 2007.

Organizations

American Academy of Dermatology. P.O. Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: http://www.aad.org/public/publications/pamphlets/common_vitilgo.html.

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 1 AMS Circle, Bethesda, MD, 20892-3675. Toll free: 877-226-4267. Web site: http://www.niams.nih.gov/health_info/Vitiligo/default.asp.

National Vitiligo Foundation. P.O. Box 23226, Cincinnati, OH, 45223. Telephone: 513-541-3903. Web site: <http://nvfi.org>.

W

Wall Eyes See *Strabismus*.

Warts

Warts are small growths on the skin or inner linings of the body that are caused by a type of virus.

What Are Warts?

Warts are small areas of hardened skin that can grow on almost any part of the body. Human papilloma (pah-pih-LO-mah) viruses, or HPV, causes warts. More than 100 different kinds, or strains, of HPV exist. Warts are usually skin-colored and bumpy or rough, but sometimes they are dark and smooth. The way a wart looks depends on where it is growing, and different kinds of warts appear on different parts of the body.

Common warts usually grow on fingers and hands, especially around fingernails. These warts usually have a rough, bumpy surface with tiny black dots, which are the blood vessels that feed the wart and allow it to grow. Flat warts are much smaller than common warts and are very smooth. This type of wart typically grows in little bunches on the face and legs; as many as 100 flat warts may grow together in one place. Common warts and flat warts generally are not painful except under certain circumstances, such as when the pressure of a pencil pushes against a wart on the finger while writing. Plantar warts, which grow on the soles of the feet, can be quite painful as a person walks on them, flattening them and pushing them back into the skin. Like a common wart, a plantar wart is covered with black dots marking the place of blood vessels.

Genital warts are small and pink, and they can grow one at a time or in bunches that make them look a bit like cauliflower. This type of wart can grow on the genitals*, the skin around the genitals, the rectum*, the buttocks, or in the vagina* or cervix*. Although most warts do not cause major health problems, genital warts may itch or bleed, and the ones caused by some strains of HPV are known to increase a woman's chances of developing cancer of the cervix without causing a wart.



▲ Warts commonly appear on the fingertips, where skin is more likely to be broken and susceptible to HPV infection. *Medical-on-Line/Alamy.*

- * **genitals** (JEH-nih-tuls) are the external sexual organs.
- * **rectum** is the final portion of the large intestine, connecting the colon to the outside opening of the anus.
- * **vagina** (vah-JY-nah) is the canal, or passageway, in a woman that leads from the uterus to the outside of the body.
- * **cervix** (SIR-viks) is the lower, narrow end of the uterus that opens into the vagina.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **chronic** (KRAH-nik) lasting a long time or recurring frequently.

* **pelvic exam** is an internal examination of a woman's reproductive organs.

* **Pap smear** is a common diagnostic test used to look for cancerous cells in the tissue of the cervix.

WARTS MYTHS

Warts have a long history in folklore, and the myths about them abound. Touching a frog, for example, has been thought both to cause and to cure warts. Other unconventional treatments have become popular. Among the many wart so-called remedies, none of which has been proven to work, are the following:

- Put pebbles in a bag with a silver coin. Then tie up the bag and throw it in the street. The person who finds the money and keeps it will also keep the warts.
- Rub a dirty washcloth on the warts. Next, bury the washcloth by the light of the full moon.
- Make the wart bleed. Put one drop of blood on seven grains of corn and feed it to a black hen.
- Apply a piece of raw meat to the warts and then bury the meat. As it decays underground, the warts will disappear.
- Mix brown soap with saliva and make a paste. Apply it to the warts and leave it there for 24 hours.
- Write a wish for your warts to disappear on a piece of paper, take it to the intersection of two roads, tear it up, and cast it to the winds.

Who Has Warts and Why?

About one in four people have common, flat, or plantar warts at some time in their lives. Children tend to have warts more often than adults do, and people who bite their fingernails or pick at hangnails may be more likely to have warts because tiny openings in the skin provide a way for HPV to enter the body. Someone with a weakened immune system*, due to a chronic* illness or an infection, for example, also may be more likely to have warts. Warts are very contagious because HPV can pass easily from one person to another by contact. Genital warts spread through sexual intercourse. In fact, they are the most common cause of sexually transmitted disease in the United States. In rare cases, a mother with genital warts can pass HPV to her baby during birth. The virus can cause growths on the baby's vocal cords or elsewhere in the infant's respiratory tract.

How Are Warts Diagnosed and Treated?

Healthcare providers can diagnose a wart by its appearance. If individuals have a wart, they should see a professional who can examine the wart, determine exactly what is growing on the skin, and recommend the best treatment. In the case of genital warts, a doctor may also screen a woman for cervical cancer by performing a pelvic exam*, including a Pap smear*. In some cases, warts eventually disappear without any treatment. However, if a person has several warts or if the warts are painful or seem to be spreading, several possible treatments exist.

Over-the-counter medicines containing salicylic (sah-lih-SIH-lik) acid can remove common warts. Depending on the particular brand of medicine, the person may be able to paint it on or may be able to use a stick-on patch that attaches directly to the wart. These over-the-counter medicines can take longer than other treatments do, but they are painless. People who have diabetes* or other conditions that affect the circulatory system should first consult with a doctor before using these over-the-counter medicines.

Another typical treatment for common warts and also for plantar warts is cryotherapy, or freezing. In cryotherapy, a medical professional freezes the wart with a special chemical. Afterward, a scab develops as the skin heals. Plantar warts can be difficult to treat, however, because most of the wart is located beneath the surface of the skin. Medical professionals may use electrosurgery to burn plantar warts—and also sometimes common warts—with a tool that uses an electric current. Sometimes, a doctor will recommend an acid-containing chemical peel to treat flat warts, which grow in such large bunches that the other types of treatments usually are not efficient. These chemicals, which are applied to the skin, eventually peel away the warts. Doctors also may use laser treatment to destroy any type of wart that proves difficult to remove. In some cases, doctors may use a cream called imiquimod, which is applied to the site of the wart and stimulates the body's immune system to fight the HPV.

Genital warts require treatment from a doctor. To remove them, doctors may use cryotherapy, lasers, medicines that can be applied directly to the warts, or surgery. If a woman has had genital warts, doctors may advise her to have Pap smears more often. In some cases, certain types of HPV infection can lead to cancer of the cervix, and a Pap smear allows the doctor to find and treat the disease in its early stages.

Can Warts Be Prevented?

It can be very difficult for people to protect themselves from common, flat, and plantar warts, because they are so common, and the virus spreads so easily. In addition, individuals can come into contact with HPV many months or even a year before a wart grows big enough to see, so it is often impossible to know for sure where and how they got the virus. If people have a wart, it is best for other people not to touch it. It is also advisable to avoid sharing towels and washcloths with someone who has a wart and to wear sandals at public showers or pools or in locker rooms, to avoid infection. The prevention of genital warts can be difficult, because skin-to-skin contact spreads them. Condoms may limit the spread of genital warts, but because some warts grow on the skin around the genitals and on the buttocks, a condom may not cover every one of them, making it still possible for the HPV to pass between sexual partners. Abstaining from sex with a person who has genital warts is the safest choice.

In 2006, the Food and Drug Administration licensed a vaccine to fight HPV infection. Medical professionals recommend the vaccine, called Gardasil, for all girls and young women. Studies were under way to

* **diabetes** (dye-uh-BEE-teez) is a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.

* **flavivirus family** (FLAY-vih-vy-rus) is a group of viruses that includes those that cause dengue fever and yellow fever.

* **hosts** are organisms that provide another organism (such as a parasite or virus) with a place to live and grow.

determine if it can also protect others groups of people, including boys and men, from HPV infections.

▶ See also **Skin and Soft Tissue Infections**

Resources

Books and Articles

Royston, Angela. *Warts*. Chicago: Heinemann Library, 2002.

Organizations

American Academy of Dermatology. PO Box 4014, Schaumburg, IL, 60168-4014. Toll free: 866-503-SKIN. Web site: http://www.aad.org/public/publications/pamphlets/common_warts.html.

American Academy of Family Physicians. P.O. Box 11210, Shawnee Mission, KS, 66207-1210. Toll free: 800-274-2237. Web site: <http://familydoctor.org/online/famdocen/home/common/skin/disorders/209.html>.

West Nile Fever

West Nile fever is a viral infection that can result in inflammation of the brain, called encephalitis (en-seh-fuh-LYE-tis). The virus that causes it spreads to humans by way of infected mosquitoes.

What Is West Nile Fever?

West Nile fever (WNF) is caused by West Nile virus (WNV), which is part of the flavivirus family*. First discovered in Africa, WNV can infect animals and humans, although animals (mainly birds, but also horses, cats, and bats) are the primary hosts* for the virus.

Most of the time, people with WNF become only mildly ill. In some cases, however, WNF can develop into a life-threatening disease. If the virus passes into the brain, the infection can cause serious inflammation and complications affecting the nervous system. Of those infected, people 50 years of age or older have the greatest risk of developing severe disease.

Do Many People Contract West Nile Fever?

WNF is found most frequently in Africa, the Middle East, Western Europe, and Asia. It was not found in the Western Hemisphere until 1999, when the first case appeared in the United States. Between 1999 and 2008, presence of the virus was documented in 39 states and the

District of Columbia. In 2007, the Centers for Disease Control (CDC) reported a total of 3,630 WNF cases in the United States. WNF tends to occur more often in the summer and early fall, but the vast majority of cases likely go unreported because they cause only mild illness, if any. Of the 3,630 total in 2007, 124 (3 percent) resulted in death from the disease. Those numbers represented a decrease compared with 2006, when the CDC reported 4,269 cases and 177 deaths. Some experts believed that the U.S. population was starting to develop immunity to the virus.

Is West Nile fever Contagious?

Generally, a person cannot contract WNF from another infected person or from an infected animal, although transmission of the virus through a blood transfusion* has been confirmed in some cases. Likewise, infected people cannot spread the virus to animals. Scientists think that the virus is transmitted almost exclusively by the bite of an infected mosquito. The chances of becoming ill with WNF actually are very small. Of all the mosquitoes in any area where infected mosquitoes have been found, less than 1 percent carry the virus.

The transmission cycle begins when a mosquito bites an infected bird and takes in blood that contains WNV. If the mosquito then bites a human, it can transmit the virus to that person. Scientists have found no evidence that humans can contract the disease by handling live or dead birds or any other animal that has been infected with the virus. Still, experts recommend that people never handle a dead animal with bare hands, instead always using disposable gloves and placing the dead animal in a plastic bag when discarding it.

How Do People Know They Have West Nile Fever?

The first symptoms of WNV infection are usually fever, headache, and body aches, sometimes accompanied by a rash and swollen lymph nodes*. Serious cases of the disease may cause more severe symptoms, including high fever, stiff neck, muscle weakness, convulsions*, confusion, paralysis*, and coma*. Very severe cases can result in death, but this is rare. Symptoms usually begin 3 to 15 days after infection.

How Is West Nile fever Diagnosed and Treated?

If WNF is suspected, the first step for the physician is take a history, which means asking a person about prior health, when symptoms began, and recent travels and activities. This may help determine if the person might have been exposed to an infected mosquito. A blood test can confirm the presence of the virus.

For mild cases of WNF, no specific treatment exists. A doctor usually recommends rest and over-the-counter medications, such as acetaminophen*, to ease fever and aches. Severe cases of WNF may require hospitalization and more specialized care, such as intravenous (in-tra-VEE-nus) fluids (fluids given directly into a vein) to prevent or treat

* **blood transfusion** is the process of giving blood (or certain cells or chemicals found in the blood) to a person who needs it due to illness or blood loss.

* **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.

* **convulsions** (kon-VUL-shuns), also called seizures, are involuntary muscle contractions caused by electrical discharges within the brain and are usually accompanied by changes in consciousness.

* **paralysis** (pah-RAH-luh-sis) is the loss or impairment of the ability to move some part of the body.

* **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

* **acetaminophen** (uh-see-teh-MIH-noh-fen) is a medication commonly used to reduce fever and relieve pain.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **ventilator** (VEN-tuh-lay-ter) is a machine used to support or control a person's breathing.

WEST NILE INVADES NEW YORK

In the summer of 1999, dead birds began appearing all over the New York City metropolitan area. Public health officials were called in to find out why. They soon learned that the deaths were linked to the virus that causes West Nile fever, an infection that is spread by mosquitoes. Before 1999, West Nile fever had never been seen in the Western Hemisphere.

dehydration* in someone who is too sick to drink or who is vomiting. A person who is having trouble breathing may be put on a ventilator*.

How long WNV illness lasts depends on the severity of the infection. If a person has a mild infection, symptoms often go away in about a week. Recovery from serious infection may take several weeks to months. Most people who are infected with WNV do not become very sick. Only about 1 percent of all infected people become severely ill. Of these severe cases, up to 15 percent are fatal. Elderly people have the highest risk of developing serious complications from the disease.

Can West Nile Fever Be Prevented?

No vaccine is available for WNF, so the best way to prevent the spread of the virus is to prevent mosquito bites. To do so, experts recommend that people avoid being outside at times when mosquitoes are most active (dawn, dusk, and early evening), that they wear long sleeves and long pants, and that they use insect repellent when outside. When using repellent, everyone, especially children, should carefully follow the instructions on the package.

In the United States, health officials have often traced WNV to areas where dead birds have been found. By tracking the disease and looking for patterns of infection, public health officials are better able to prevent future outbreaks. Experts advise people to contact the local or state health department if a dead bird is found in an area where WNV has been reported; a representative will collect the bird for testing.

▶ See also **Encephalitis • Zoonoses**

Resources

Books and Articles

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Sfakianos, Jeffrey N. *West Nile Virus*. Philadelphia, PA: Chelsea House, 2005.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov/ncidod/dvbid/westnile>.

National Biological Information Infrastructure, USGS Biological Informatics Office. 302 National Center, Reston, VA, 20192. Telephone: 703-648-4216. Web site: <http://westnilevirus.nbii.gov>.

* **gastrointestinal** (gas-tro-in-TESS-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.

Whiteheads *See Acne.*

Whooping Cough *See Pertussis (Whooping Cough).*

Williams Syndrome *See Intellectual Disability.*

Wisdom Teeth *See Impacted Teeth.*

Worms

Disease-causing worms are parasitic organisms that must live on or inside another organism to survive.

What Are Worms?

Worms that cause human disease are parasitic organisms that must live on or inside another organism to survive. An animal or human harboring a worm is called its host. Worms live at the expense of the host and may cause illness. Worms live part of their life cycle within the gastrointestinal* tract and the organs of the digestive system. Worms may cause diarrhea or malnutrition despite a healthy diet.

What Are Types of Worms?

In humans, there are three major types of worm parasites: flukes (trematodes), tapeworms (cestodes), and roundworms (nematodes). While worms complete a part of their life cycle within the gastrointestinal tract, some may also travel to other parts of the body and invade other organs. Worms enter the body through different routes and at various life cycle stages. For example, tapeworms may enter the human body through ingestion of both

* **endemic** (en-DEH-mik) describes a disease or condition that is present in a population or geographic area at all times.

the egg and larval forms. There are some types of worm parasites that can enter the body directly through the skin.

While typically worm infestation is not fatal, it is still a serious health and economic problem. Parasitic worms create a lot of sickness in the tropics and subtropics, especially among rural, poor people. They are a common problem in areas with poor sanitation. Worms may interfere with the normal growth and development of children and cause chronic illness in adults. In the United States, cases of worms occur among people who were infected during travels to endemic* countries.

Flukes (Trematodes) After malaria, the most prevalent tropical disease in the world is schistosomiasis, which is caused by a fluke of the genus *Schistosoma*. The fluke that causes schistosomiasis lives on a type of freshwater snail. Humans may be infected by contaminated water carrying the fluke. Schistosomiasis affects large populations in developing countries, especially among children who become infested while playing in water containing the snail host. Although it is usually not fatal, schistosomiasis causes chronic illness that may damage internal organs and impair both physical and mental development. One form of schistosomiasis involves a type of fluke that enters the urinary tract and is associated with increased risk for bladder cancer in adults. Individuals from the United States traveling to tropical areas may become infested while abroad.

Tapeworms (Cestodes) Human tapeworm infestations usually are caused by eating meat or fish contaminated with worm larvae, but it may also be caused by eating soil or water contaminated with human fecal matter containing the eggs. Meat contaminated with tapeworm larvae has larvae enclosed in cyst form within the meat. Like other types of worms, tapeworms frequently cause infestations in areas with poor sanitation, where livestock animals are exposed to contaminated soil or fish to contaminated water, and these have parasites in their body tissues. After humans ingest contaminated tapeworm encysted meat or fish, the larvae travel to the intestines, where they latch onto the lining of the intestines and gradually grow into adults. The worms shed their eggs into the feces, from which they contaminate soil and water, are ingested by animals or fish, and reenter the cycle. Tapeworms cause the most health problems in areas of Latin America and Asia. Tapeworm infestation is rare in the United States. Fish tapeworm infestations in the United States tend to occur among Eskimos of western Alaska and in individuals from the west coast.

Ascariasis (Nematode) Ascariasis is caused by *Ascaris lumbricoides*, an intestinal roundworm. It is one of the most common intestinal parasites in areas with poor sanitation, affecting people in all parts of the world. In the United States, ascariasis is extremely common in rural parts of the Southeast. Exposure to pigs and pig manure increases the risk of infestation. An estimated 4 million individuals may be infected in the United States. Approximately 1.4 billion people may be infected worldwide. Indonesia

has an especially high rate of infestation with Ascariasis, with 90 percent of the people in some regions being affected. The life cycle of this worm begins when an adult worm lays its eggs in the intestines of an infected person. The eggs leave the body through the feces and can live in soil for up to two years. When people eat raw food containing this contaminated soil, they may ingest the eggs, which hatch in the stomach as larvae. Part of the life cycle of the larvae is to migrate outside the gastrointestinal tract. The larvae invade the walls of the gastrointestinal tract, migrate through the blood to the lungs and then to the throat, where they are swallowed. Eventually, they pass into the intestines, where adult worms form and begin the cycle again.

Strongyloidiasis/Threadworm (Nematode) Strongyloidiasis is caused by a type of roundworm commonly referred to as the threadworm, *Strongyloides stercoralis*. Strongyloidiasis is common in the tropics and is especially prevalent in West Africa, the Caribbean, and Southeast Asia. Strongyloidiasis is rare in the United States, except in some areas of the Southeast and Appalachia. It is more common among military veterans who served in Southeast Asia. Worldwide approximately 35 million cases occurred in 2008. Although the route of infestation can be fecal-oral, this infestation most commonly comes from contact with contaminated soil where the larvae of the parasite can burrow directly through the skin. The larvae travel to the lungs, are coughed up into the mouth, swallowed, and enter the intestines. In the intestines the worm matures to adulthood and begins laying eggs. The eggs can hatch inside the intestines and the worm can continue to cycle through many generations without leaving the body. Such an infestation can last for decades. Some larvae may invade the lungs and other organs. This infestation can be fatal.

Hookworm (Nematode) Hookworms are a type of roundworm and a common intestinal parasite. The Centers for Disease Control and Prevention (CDC) estimates that one-fourth of the population worldwide has hookworm infestations, although improved sanitation has reduced the number of cases in the United States. Two species can infest humans. The hookworm eggs hatch into larvae in the soil. Hookworms can directly penetrate human skin. Humans may be infested by walking barefoot in or touching contaminated soil, as well as ingesting food with contaminated soil on it. The hookworm larvae travel to the lungs via the bloodstream. The larvae then travel to the throat and are swallowed, in a similar fashion to the ascaris worm. When they reach the small intestine, the larvae latch onto the intestinal walls and suck blood. There they mature and eventually lay eggs, which pass out of the body in the feces. Hookworms can live for one to two years in the human body.

Enterobiasis/Pinworm (Nematode) Enterobiasis, also known as pinworm infestation, is caused by a staple-size worm known as *Enterobius vermicularis*. Pinworm tends to occur in temperate regions, rather than

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **endoscope** (EN-doh-skope) is a tool for looking inside parts of the body. It consists of a lighted tube and optical fibers and/or lenses.

the tropics. It is the most common worm infestation in the United States and is found primarily in children. Crowded living conditions are often associated with pinworm infestation. Outbreaks of pinworm often occur among individuals who are grouped together in institutions, such as schools and daycare centers. From there, infested children may spread the worms to their family members. In the United States, in some small regions pinworm infestation has affected 12 percent of the population. School-aged children and adults from 30 to 39 years of age who have children are most commonly infested.

Trichinosis (Nematode) Trichinosis arises from several varieties of roundworms of the genus *Trichinella*. Although once very common, trichinosis was as of 2009 relatively rare in the United States, with the CDC reporting an average of just 38 cases per year. Trichinosis is more common in developing countries. *Trichinella* larvae live encysted in the tissues of pigs and wild animals. When people eat their meat raw or undercooked, the larval cysts travel to the stomach, where acid dissolves the walls of the cysts and releases the immature, larval worms. These migrate to the small intestine, mature to adults, and lay eggs. Once the eggs hatch, the worms travel through the bloodstream to muscles, where they burrow in, forming new cysts. This ends the cycle in humans.

How Is Worm Infestation Diagnosed?

Physicians may use fecal samples, sometimes taken a day or two apart, to diagnose intestinal parasitic diseases. The feces are examined for evidence of parasites, such as eggs, larvae, or adult forms. Blood samples may also be taken to check for antibodies* made by the body against specific parasites. Physicians may also use an endoscope* that allows them to view the internal structures of the gastrointestinal tract and to examine the intestines for infection. To detect pinworms, physicians often request that patients take a “tape test”. For this test, patients briefly apply a piece of transparent tape to the skin around the anus in the early morning, the time right after the worm has laid its eggs. The tape is removed and examined at the doctor's office for any eggs that might be sticking to it.

How Is Worm Infestation Treated?

Some cases of intestinal parasites require little or no treatment, and the parasites eventually disappear on their own. Other cases require antibiotics or anthelmintics, a type of drug used to fight worm infections. Different types of infestation are treated with different medicines. It is critical that the type of worm be identified so that the correct medication can be prescribed. Some anthelmintics work by inhibiting the development of the worm from egg to larvae. Others may inhibit an enzyme specific to worms, not present in human cells, and necessary for worm bodily function. Anthelmintics can also paralyze the worm so that it can no longer remain attached to the human body and is either digested or simply expelled. Anthelmintics may kill the worm by preventing its absorption of nutrients.

In most cases, patients can remain at home and maintain a normal schedule. However, many side effects are associated with anthelmintics for the duration of treatment, including nausea, vomiting, abdominal pain, dizziness, and headache. Patients experiencing diarrhea are usually advised to drink plenty of fluids to avoid dehydration*. Infants and young children are particularly vulnerable to dehydration and nutrition problems when they become infested. Antidiarrheal medicine is usually not recommended because it may keep the parasites in the body longer. More severe cases of infestations may require treatment in the hospital.

Prevention of Worm Infestation

Intestinal parasite infestation is best prevented through careful personal hygiene, which includes frequent and thorough hand washing, especially after changing diapers, after going to the bathroom, and before handling food. In areas known for parasites that live in the soil and burrow directly through the skin, wearing shoes may prevent parasites from entering the body. Individuals who travel to foreign countries known to have parasite problems should drink bottled water only and brush their teeth with bottled water. They should avoid eating raw fruits and vegetables, food from street vendors, and unpasteurized dairy products. In addition, cooking all food until it is steaming hot kills parasites. Avoiding swimming in bodies of fresh water such as ponds, rivers, and lakes in these areas can reduce possible exposure to contaminated water.

▶ See also **Ascariasis • Hookworm • Parasitic Diseases: Overview • Pinworm Infestation • Tapeworm • Trichinosis**

Resources

Books and Articles

Tilden, Thomasine E. Lewis. *Belly-Busting Worm Invasions! Parasites That Love Your Insides!* New York: Franklin Watts, 2008.

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-311-3435. Web site: <http://www.cdc.gov>.

Food and Drug Administration, Center for Food Safety and Applied Nutrition. 5100 Paint Branch Parkway, College Park, MD, 20740. Toll free: 888-SAFEFOOD. Web site: <http://www.cfsan.fda.gov>.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

Y-Z

Yeast Infection, Vaginal

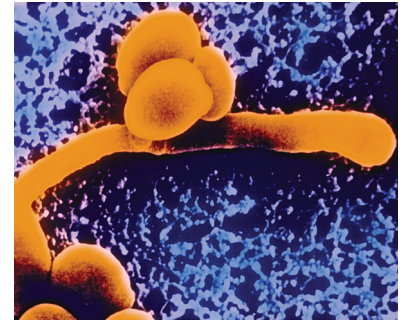
The vaginal yeast infection candidiasis (kan-di-DY-a-sis) results from an overabundance of a certain kind of fungus in the genital area. Its symptoms include an itching or burning sensation in the genital area and often a white discharge from the vagina. Genital candidiasis occurs much more frequently in women, but it also occurs in men.*

What Is Candidiasis?

The fungus that causes most vaginal yeast* infection is usually *Candida albicans* (KAN-di-da AL-bi-kanz). It is naturally present in the vagina (va-JY-na), the gastrointestinal* tract, and the mouth. It is part of the vaginal and gastrointestinal flora. In the vagina and in the gastrointestinal tract, the *Candida* organisms usually remains in balance with various bacteria* that are also found in these naturally moist areas (meaning that the presence of bacteria and other components of the flora helps to keep *Candida* growth in check). All of these microorganisms are competitors for the same resources, and a reduction in the level of one becomes an opportunity for another to flourish. When this ecological balance is disrupted, *Candida* growth may become *Candida* overgrowth (candidiasis). Vaginal candidiasis will develop quickly when this excessive growth occurs in the vaginal area. (When *Candida* infection involves the mouth, it is called thrush. When it involves babies' diaper area, it is called candidal diaper rash.)

Candida fungus cells can multiply too much when a person is taking an antibiotic*, which may destroy too many of the bacteria that usually keep the fungus in check. Other situations that may cause the fungus to grow out of control are the use of birth control pills, pregnancy, and the use of drugs that suppress the immune system*. When a woman becomes immunocompromised (has an immunodeficiency disease such as AIDS, or is taking an immunosuppressant medication—for example, in preparation for organ transplantation) she will also be more likely to develop a vaginal yeast infection. Sugar causes yeasts to multiply. Women with diabetes have higher blood sugar levels, and their vaginal secretions contain more glucose. Thus, a woman with diabetes is more likely to develop a vaginal yeast infection.

Estimates indicate that about 75 percent of women have a yeast infection at least once in their lifetime. Half of them have the infection more than once.



▲
Candida albicans magnified 3000 times.
© PHOTOTAKE Inc./Alamy.

- * **fungus** (FUN-gus) is any organism belonging to the kingdom Fungi (FUN-ji), which includes mushrooms, yeasts, and molds.
- * **yeast** (YEEST) is a general term describing single-celled fungi that reproduce by budding.
- * **gastrointestinal** (gas-tro-IN-TES-tih-nuhl) means having to do with the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.
- * **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.
- * **antibiotics** (an-tie-by-AH-tiks) are drugs that kill or slow the growth of bacteria.

Antibiotics and Yogurt

Antibiotics prescribed to treat bacterial infections also kill beneficial bacteria. When the beneficial bacteria found normally in the mucous membranes of the vagina and other mucous membranes die, yeast cells can grow unchecked, which leads to a yeast infection.

Eating active-culture yogurt daily while taking an antibiotic may help replenish the supply of beneficial bacteria. Besides yogurt, most pharmacies and health stores carry a capsule or powder form of the same beneficial bacteria that are in active-culture yogurt. These beneficial bacteria, also known as probiotics, include *Lactobacillus acidophilus* and *Lactobacillus bifidus* species. Another probiotic that shows promise in treatment and prevention of yeast infections is a beneficial yeast called *Saccharomyces boulardii*, which is marketed in the United States as Florastor.

* **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.

* **antifungal drugs** (an-ty-FUNG-al drugs) are medications that kill fungi.

What Are the Symptoms of Candidiasis?

The most common symptom of vaginal yeast infection is an itching sensation in and around the vagina and/or vulva. The itching may be accompanied by a burning sensation and sharp, or even severe, pain. A vaginal discharge is not always present, but when it occurs it typically has a whitish appearance and a texture like that of cottage cheese. The area around the vagina also may itch or feel irritated. In yeast infections in men, the head of the penis becomes inflamed or shows a rash.

How Is Candidiasis Diagnosed and Treated?

The diagnosis of vaginal yeast infection is usually a simple matter of microscopic examination. A scraping or swab of the infected area, or a small sample of the vaginal discharge, is placed on a microscope slide. The treatment is antifungal drugs* that are applied to the affected area or taken by mouth.

An individual who notices a vaginal yeast infection for the first time should see her doctor, who can then diagnose it properly before she begins treatment. Health professionals recommend that anyone with a vaginal yeast infection should also have her partner examined for infection. Women who have had previous vaginal yeast infections are often familiar enough with the infection to diagnose it themselves and begin treatment with over-the-counter creams.

How Can Candidiasis Be Prevented?

The following measures can help prevent a vaginal yeast infection:

- Wearing cotton underwear
- Avoiding tight-fitting underwear made of synthetic fiber such as nylon
- Avoiding the daily use of panty hose
- Using white, non-perfumed toilet paper
- Keeping the genital area clean
- Using a towel (not a blow dryer) to dry the genital area
- Removing a wet bathing suit as soon as possible after swimming
- Avoiding douches and feminine hygiene sprays
- Using sanitary pads or tampons that are free of perfume

▶ See also **Fungal Infections** • **Sexually Transmitted Diseases (STDs)** • **Thrush**

Resources

Organizations

Centers for Disease Control and Prevention. 1600 Clifton Road, Atlanta, GA, 30333. Toll free: 800-232-4636. Web site:http://www.cdc.gov/nczved/dfbmd/disease_listing/candidiasis_gi.html.

Mayo Clinic. 200 First Street SW, Rochester, MN, 55905. Web site: <http://www.mayoclinic.com/health/male-yeast-infection/HO00172>.

National Women's Health Information Center. 8270 Willow Oaks Corporate Drive, Fairfax, VA, 22031. Toll free: 800-994-9662. Web site: <http://www.4woman.gov/faq/vaginal-yeast-infections.cfm>.

Yellow Fever

Yellow fever is an infectious disease caused by a virus that is transmitted to humans by mosquitoes.

What Is Yellow Fever?

Yellow fever is a disease caused by yellow fever virus, a member of the flavivirus (FLAY-vih-vy-rus) group of viruses. The disease gets its name because it often causes jaundice*, which tints the skin yellow, and a high fever. Yellow fever also can cause kidney failure and uncontrolled bleeding, or hemorrhaging (HEM-rij-ing). Many cases produce only mild illness, but severe cases of yellow fever can be fatal. Once someone has survived the disease, the person has lifetime immunity* against it.

Yellow fever afflicts both humans and monkeys and has been known since at least the 1600s. The disease is not spread by person-to-person contact. It is transmitted by several different species of mosquitoes; a person can contract yellow fever only from the bite of a mosquito that has bitten an infected person or monkey.

The disease once caused epidemics* in the Americas, Europe, and the Caribbean, but at the beginning of the 21st century the disease occurred almost exclusively in South America and Africa. Each year, outbreaks lead to an estimated 200,000 cases and 30,000 deaths worldwide. Vaccines against the virus were developed in 1928 and 1937, and mosquito-eradication programs made great progress in controlling the disease. The last recorded outbreak of yellow fever in the United States was in New Orleans in 1905. However, lapses in prevention programs in Africa and South America allowed yellow fever to once again become a serious public health issue on those continents.

Are There Different Kinds of Yellow Fever?

Yellow fever occurs as three subtypes: epidemic (urban), intermediate, and jungle-acquired. Epidemic yellow fever spreads in densely populated areas of Africa and South America via the bite of *Aedes aegypti* (a-E-deez eh-JIP-tie) mosquitoes. Intermediate yellow fever occurs in Africa as the result of

* **jaundice** (JON-dis) is a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

* **immunity** (ih-MYOON-uh-tee) is the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.

* **epidemics** (eh-pih-DEH-miks) are outbreaks of diseases, especially infectious diseases, in which the number of cases suddenly becomes far greater than usual. Usually, epidemics that involve worldwide outbreaks are called pandemics.

WALTER REED AND THE U.S. YELLOW FEVER COMMISSION

Walter Reed (1851–1902), American military surgeon and head of the U.S. Army Yellow Fever Commission, is widely known as the man who conquered yellow fever by tracing its origin to a particular mosquito species.

Walter Reed was born in Belroi, Virginia, the son of a Methodist minister. After attending private schools, Reed entered the University of Virginia, where he received his medical degree in 1869, after completing only two years. He then went to New York, where he received a second medical degree from the Bellevue Hospital Medical College in 1870. In June 1875, after working for the Board of Health of New York and Brooklyn, Reed was commissioned an assistant surgeon in the U.S. Army with the rank of first lieutenant. Then followed 11 years of frontier garrison duty, further study at Johns Hopkins Hospital while on duty in Baltimore, and an assignment as professor of bacteriology and clinical microscopy at the newly organized Army Medical School in Washington in 1893.

When yellow fever made its appearance among U.S. troops in Havana, Cuba, in 1900, Reed was appointed head of the commission of Army medical officers to investigate the cause and mode of transmission. After some months of fruitless work in searching for the cause of the disease, Reed and his associates decided to concentrate upon determining the mode of transmission. Carlos Juan Finlay first advanced the theory that yellow fever was transmitted

by mosquitoes (he blamed it on the *Stegomyia fasciata*, later known as the *Aedes aegypti*) and proved it by experiments, but physicians generally did not credit the possibility. Walter Reed confirmed Finlay's findings by using human subjects. Reed and his associates argued that there was no alternative to experimentation with humans and that their results would justify the practice. Mosquitoes that had been fed on yellow fever-infected blood were applied to several of Reed's associates, including Dr. James Carroll, who developed the first experimental case of the disease.

There followed a series of controlled experiments with soldier volunteers. In all, 22 cases of experimental yellow fever were produced: 14 by mosquito bites, 6 by injections of blood, and 2 by injections of filtered blood serum. At the same time, in order to disprove the theory that the disease could be transmitted by mere physical contact, Dr. Robert P. Cook and a group of soldiers slept in a detached building with the clothing and bedding of yellow fever patients from the camp hospital. No cases of the illness resulted, the theory was conclusively falsified.

The value of the commission's work quickly became evident. In 1900 there had been 1,400 cases of yellow fever in Havana; by 1902, after more than a year of mosquito eradication prompted by the Reed Commission's report, there was not a single case. Once its mode of transmission was known, there was no danger of yellow fever in any country with adequate control facilities.

* **incubation** (ing-kyoo-BAY-shun) is the period of time between infection by a germ and when symptoms first appear. Depending on the germ, this period can be from hours to months.

mosquitoes breeding in humid flat grasslands (savannahs) during rainy seasons, then infecting both monkeys and humans. In dry seasons, the virus can remain alive in unhatched mosquito eggs that are resistant to the heat.

Jungle-acquired yellow fever occurs mainly in South America when mosquitoes pick up the virus from infected forest monkeys and then transmit the disease to humans in jungles and rainforests. People who are regional settlers, soldiers, or agricultural or forestry workers are at greater risk for this less common form of the disease.

How Do People Know They Have Yellow Fever?

After an incubation* period of three to six days, the yellow fever virus begins to produce symptoms. An early phase of disease occurs, which includes fever, headache, muscle aches, and vomiting. The infected person may have a slower heartbeat than that expected with a high fever. After a few days,

most of the symptoms disappear. Many people recover from yellow fever at this point without complications. However, about 15 percent of patients develop a second, toxic phase of the disease, in which fever reappears and the disease becomes more severe. Inflammation* of the liver occurs, along with jaundice, stomach pains, and vomiting. The mouth, nose, eyes, and stomach can bleed uncontrollably, with blood present in vomited material and bowel movements. The kidneys may begin to fail, and patients may go into a coma (an unconscious state in which a person cannot be awakened).

How Do Doctors Diagnose and Treat Yellow Fever?

Early stages of yellow fever can be easily confused with other diseases such as malaria*, typhoid fever*, and other hemorrhagic (heh-muh-RAH-jik) fevers and types of viral hepatitis*. Blood tests can detect whether a patient's body has produced yellow fever antibodies* to fight the infection. Doctors also will take a travel history to see if a patient recently has visited a country where yellow fever occurs.

No specific treatment exists for yellow fever. Care is geared toward treating complications of the disease. In serious cases, intensive care in the hospital usually is needed. Patients may be given fluids to prevent dehydration*, and blood transfusions* may be necessary if bleeding is severe.

Most people who contract yellow fever recover from the early phase of the disease within a week; those who progress to the toxic phase may take several weeks or longer to recover. About half of those who develop toxic phase symptoms die within two weeks; the other half may recover without significant long-term problems.

How Can Yellow Fever Be Prevented?

Vaccination* against yellow fever is the single most important prevention measure, and it is a must for people traveling to countries where the disease is common. Most countries in which yellow fever occurs require a certificate proving that travelers have been vaccinated before they are allowed into the country. One dose of vaccine provides at least 10 years of immunity.

Doctors recommend that infants under six months of age, pregnant women, people allergic to eggs (eggs are used in producing the vaccine), and people with a weakened immune system* (such as people who have AIDS* or certain cancers) not receive the vaccine; these people are advised to delay visits to countries where yellow fever is endemic*.

Avoiding mosquito bites when traveling abroad reduces the risk of contracting yellow fever. To help prevent infection, experts suggest that travelers do the following:

- Wear long sleeves and pants
- Avoid going outside when mosquitoes are active—at dawn, dusk, and early evening
- Use mosquito repellent
- Sleep beneath a mosquito net

* **inflammation** (in-fla-MAY-shun) is the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

* **malaria** (mah-LAIR-e-uh) is a disease spread to humans by the bite of an infected mosquito.

* **typhoid fever** (TIE-foyd FEE-ver) is an infection with the bacterium *Salmonella typhi* that causes fever, headache, confusion, and muscle aches.

* **hepatitis** (heh-puh-TIE-tis) is an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.

* **antibodies** (AN-tih-bah-deez) are protein molecules produced by the body's immune system to help fight specific infections caused by microorganisms, such as bacteria and viruses.

* **dehydration** (dee-hi-DRAY-shun) is a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.

* **transfusions** (trans-FYOO-zhunz) are procedures in which blood or certain parts of blood, such as specific cells, are given to a person who needs them due to illness or blood loss.

* **vaccination** (vak-sih-NAY-shun), also called immunization, is giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ.

- * **immune system** (im-YOON SIS-tem) is the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).
- * **endemic** (en-DEH-mik) describes a disease or condition that is present in a population or geographic area at all times.
- * **parasites** (PAIR-uh-sites) are organisms such as protozoa (one-celled animals), worms, or insects that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. Parasites live at the expense of the host and may cause illness.
- * **bacteria** (bak-TEER-ee-a) are single-celled microorganisms, which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.
- * **viruses** (VY-rus-sez) are tiny infectious agents that can cause infectious diseases. Viruses can only reproduce within the cells they infect.

▶ See also **Dengue Fever • Hepatitis • Malaria • West Nile Fever**

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Yersinia See *Plague*.








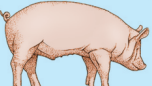
Zoonoses

Zoonoses (zoh-ah-NO-seez) are infections that humans contract from animals.

What Are Zoonoses?

Zoonoses are infections caused by parasites*, bacteria*, or viruses* that pass from animals to humans. Most people contract zoonotic (zoh-uh-NAH-tik) infections from pets, farm animals, and animals with which they are in contact. Alternatively, there may be an intermediate between the animal and the human, such as food or water. Wild animals and insects can be the source of disease, too, particularly for diseases spread by the bite of a tick, mosquito, or fly. Animals such as wild rodents, raccoons, and bats also can carry diseases that may be harmful to humans.

Zoonoses can either cause minor or serious illness. In some cases, the organisms involved infected humans, but the people do not become ill.

Disease-causing Organism	Animal or Insect Carrier	Human Disease
<i>Bartonella hensalae</i> bacteria	 Cats	Cat scratch disease
<i>Chlamydia psittaci</i> bacteria	 Birds	Psittacosis
Mononegavirales virus	 Mammals, including bats, raccoons, skunks, foxes, and coyotes	Rabies
<i>Yersinia pestis</i> bacteria	 Fleas and rodents, including rats, chipmunks, prairie dogs, ground squirrels, and mice	Plague
Hantavirus	 Rodents, including rats and mice	Hantavirus pulmonary syndrome
<i>Borrelia burgdorferi</i> bacteria	 Ticks, deer, and mice	Lyme disease
<i>Toxoplasma gondii</i> bacteria	 Cats and farm animals	Toxoplasmosis
<i>Trichinella</i> larvae	 Bears, foxes, and other wild game; pigs and horses	Trichinosis

Other zoonoses can be very dangerous to people, some of which to especially anyone with an immune system weakened by age or illness.

Are Zoonoses Contagious?

Most of these infections do not spread from person to person or do so only in rare instances. Usually they spread from animals to humans in the following ways:

- Bite of an infected insect
- Contact with an animal's feces* or urine, either through the mouth (perhaps by touching a contaminated object and then touching the mouth) or by breathing in dust from dried feces
- Bite or scratch of an infected animal
- Consumption of the meat of an infected animal



A sampling of infections contracted from animals. *Illustration by Frank Forney. Reproduced by permission of Gale, a part of Cengage Learning.*

* **feces** (FEE-seez) is the excreted waste from the gastrointestinal tract.

- * **lymph nodes** (LIMF) are small, bean-shaped masses of tissue containing immune system cells that fight harmful microorganisms. Lymph nodes may swell during infections.
- * **delirium** (dih-LEER-e-um) is a condition in which a person is confused, is unable to think clearly, and has a reduced level of consciousness.
- * **seizures** (SEE-zhurs) are sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness.
- * **coma** (KO-ma) is an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.
- * **vaccinations** (vak-sih-NAY-shunz), also called immunizations, are the giving of doses of vaccines, which are preparations of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself.
- * **epidemics** (eh-pih-DEH-miks) are outbreaks of diseases, especially infectious diseases, in which the number of cases suddenly becomes far greater than usual. Usually, epidemics that involve worldwide outbreaks are called pandemics.

What Are Examples of Zoonoses?

Cat scratch disease A cat carrying *Bartonella henselae* (bar-tuh-NEH-luh HEN-suh-lay), the bacterium responsible for cat scratch disease, usually does not have symptoms, but if the bacteria are passed to a human through a scratch or bite, the person may experience skin sores, swollen and sore lymph nodes*, extreme tiredness, headaches, and fever. Doctors may prescribe antibiotics to treat the infection.

Psittacosis People who have contact with birds may be at risk for psittacosis (sih-tuh-KO-sis), also known as parrot fever. If a person inhales bird feces or urine particles while cleaning a bird's cage, the person may develop symptoms of pneumonia (nu-MO-nyah, inflammation of the lung), such as fever, coughing, or chest pain. Medical professionals use antibiotics to treat psittacosis.

Rabies A virus that is carried in the saliva of infected animals can cause rabies when transmitted through a bite or, less commonly, through contact with saliva. Rabies in the United States is most often associated with raccoons, followed by bats and skunks, but any bite produced by an animal, whether domestic, stray, or wild, should be reported immediately to a local animal control agency. Symptoms include fever, difficulty swallowing, delirium*, seizures*, and coma*. If treatment does not begin very soon after the bite, death can result. Treatment includes intensive care in a hospital. A series of vaccinations* started at the time of a bite from a possibly infected animal can prevent the person from developing the disease.

In 2006, the Centers for Disease Control and Prevention (CDC) reported that tests of more than 113,000 animals in 49 states, the District of Columbia, and Puerto Rico resulted in 6,940 cases of rabies in animals and three human cases. Only one state, Hawaii, was free of rabies. Rabies is much more common in many other countries, especially developing ones.

Plague Plague (PLAYG) is a bacterial infection caused by *Yersinia pestis* (yer-SIN-e-uh PES-tis). People can contract plague through the bite of a flea that has become infected through contact with an infected rodent, such as a rat. The disease causes such symptoms as fever and swollen lymph nodes. In some cases the infection spreads through the blood and can infect the lungs. If this happens, plague can spread from person to person through coughing or sneezing. Plague was the cause of epidemics* in Europe and Asia during the Middle Ages, and it is still seen in the 21st century in many developing countries. It occurs in many developed countries too, including the United States, although not as many cases occur. The disease can be fatal if it is not treated with antibiotics.

Hantavirus Rodents, such as mice and rats, may carry hantavirus (HAN-tuh-vy-rus), which can spread to humans when they inhale

particles from rodent feces, saliva, or urine. People infected with hantavirus can develop hantavirus pulmonary (PUL-mo-nar-ee) syndrome (HPS), which causes such symptoms as fever, headaches, muscle aches, nausea (NAW-zee-uh), vomiting, diarrhea (dye-uh-REE-uh), abdominal* pain, and chills. In severe cases a person may experience shortness of breath and the lungs may fill with fluid. No cure is available for hantavirus infection, but people who have HPS typically are hospitalized in an intensive care unit, where they receive oxygen and other types of supportive care.

Lyme disease *Borrelia burgdorferi* (buh-REEL-e-uh burg-DOR-fee) bacteria inside an infected tick can cause Lyme (LIME) disease in humans after a tick attaches to the skin and feeds on a person's blood. Ticks pick up the bacterium by feeding on the blood of infected deer and mice, which serve as reservoirs for the organism. Lyme disease can produce a number of symptoms, such as extreme tiredness, muscle aches, and swollen painful joints. Patients often describe the symptoms as being flu-like and pay a visit to the doctor's office because no one else they know has the flu. At the site of the tick bite, some (but not all) people develop a bull's-eye rash, a red rash surrounded by rings that resembles a bull's-eye target. A person with Lyme disease usually is treated with antibiotics.

Toxoplasmosis Eating contaminated meat or having contact with the feces of an infected cat can put a person at risk for toxoplasmosis (tox-o-plaz-MO-sis). This zoonosis is caused by a parasite and can produce such symptoms as swollen lymph nodes, muscle aches, headaches, and sore throat in a healthy person, and life-threatening brain infections in people with weakened immune systems, especially those who have HIV*/AIDS*. If a pregnant woman becomes infected with the parasite, she can transmit the infection to her unborn baby, which can lead to a number of health problems in the child. Doctors treat those people who have severe forms of the disease, as well as pregnant women, with antibiotics.

Trichinosis If people eat meat (especially pork products, such as sausage or ham, or the meat of wild carnivorous animals) infected with the eggs of *Trichinella* (trih-kih-NEH-luh) worms, the people can contract trichinosis (trih-kih-NO-sis), also known as trichinellosis. Trichinosis is a disease that produces such symptoms as diarrhea, vomiting, and abdominal pain. It can cause nerve and muscle damage and heart and lung problems. Medication treats this condition.

How Are Zoonoses Treated?

The treatment of a zoonotic infection depends on the specific disease, but many are treated with prescription medications, such as antibiotics.

How Are Zoonoses Prevented?

Because household pets may carry zoonotic organisms, pet owners should keep their animals healthy and vaccinated to avoid infection. Some other ways people can protect against zoonoses include the following:

- * **abdominal** (ab-DAH-mih-nul) refers to the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.
- * **HIV** or human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see), is the virus that causes AIDS (acquired immunodeficiency syndrome).
- * **AIDS** or acquired immunodeficiency (ih-myoo-no-dih-FIH-shen-see) syndrome, is an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

- Have pets regularly examined by a veterinarian
- Avoid contact with stray, unfamiliar, or wild animals
- Clean litter boxes daily and animal cages frequently to prevent the growth of bacteria and parasites
- Have someone who does not have a weakened immune system and is not pregnant empty pet litter boxes, bathe pets, clean pet cages, and pick up pet feces
- Cook meat until it is no longer pink inside and the juices run clear
- Wash hands with soap and warm water after handling animals and before eating
- Clear brush and other areas around the house where rodents might live
- Avoid storing food or trash in an area where it could attract animals
- Wear long sleeves and long pants when outdoors, especially in wooded areas, to discourage tick and mosquito bites
- Use insect and mosquito repellent
- Examine the body and pets for ticks after spending time outside in areas where ticks are found

▶ *See also* **Cat Scratch Disease • Chlamydial Infections • Hantavirus Pulmonary Syndrome • Lyme Disease • Plague • Rabies • Toxoplasmosis • Trichinosis**

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Glossary

The following is an alphabetical compilation of the terms and definitions that appear in the main body entries. Although the list is comprehensive, it is by no means exhaustive and is intended to serve as a starting point for further research.

abdomen (AB-do-men) the portion of the body between the thorax (THOR-aks) and the pelvis. Also called the belly.

abdominal (ab-DAH-mih-nul) the area of the body below the ribs and above the hips that contains the stomach, intestines, and other organs.

abscess (AB-ses) a localized or walled off accumulation of pus caused by infection that can occur anywhere in the body.

acetaminophen (uh-see-teh-MIH-noh-fen) a medication commonly used to reduce fever and relieve pain.

acid reflux a condition in which stomach acid flows upward into the esophagus, often causing a burning sensation (so-called heartburn) in the upper abdomen or chest.

acne (AK-nee) a condition in which pimples, blackheads, whiteheads, and sometimes deeper lumps occur on the skin.

Acquired Immunodeficiency Syndrome (or AIDS) an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

acromegaly (akro-MEG-al-ee) a disease in which the pituitary gland secretes too much growth hormone with the effect of gradual and permanent enlargement of flat bones, the hands and feet, abdominal organs, and some facial features.

acute an infection or other illness that comes on suddenly and usually does not last very long.

addiction (a-DIK-shun) a strong physical or psychological dependence on a physical substance.

adenoids (AH-din-oyds) the fleshy lumps of tissue behind the nose that contain collections of infection-fighting cells of the immune system.

adenovirus (ah-deh-no-VY-rus) a type of virus that can produce a variety of symptoms, including upper respiratory disease, when it infects humans.

ADHD (or Attention Deficit Hyperactivity Disorder) a condition that makes it hard for a person to pay attention, sit still, or think before acting.

adrenal glands (a-DREEN-al glands) the pair of endocrine organs located near the kidneys.

adrenaline (a-DREN-a-lin) a hormone, or chemical messenger, that is released in response to fear, anger, panic, and other emotions. It readies the body to respond to threat by increasing heart rate, breathing rate, and blood flow to the arms and legs. These and other effects prepare the body to run away or fight. Also called epinephrine (ep-e-NEF-rin).

aerobic exercise (air-O-bik) exercise designed to increase oxygen consumption by the body; it helps keep the heart and lungs in shape.

aerosolize (AIR-o-suh-lize) to put something, such as a medication, in the form of small particles or droplets that can be sprayed or released into the air.

AIDS (or Acquired Immunodeficiency (ih-myoo-no-dih-FIH-shen-see) Syndrome) an infection that severely weakens the immune system; it is caused by the human immunodeficiency virus (HIV).

- allergens** substances that provoke a response by the body's immune system or cause a hypersensitive reaction.
- allergy** (AL-uhr-jee) an immune system-related sensitivity to certain substances, for example, cat dander or the pollen of certain plants, that cause various reactions, such as sneezing, runny nose, wheezing, or swollen, itchy patches on the skin, called hives.
- alopecia areata** (al-o-PEA-shah a-ree-AH-ta) a condition that leads to sudden hair loss, often in small, round patches on the scalp. The cause is not known.
- alpha-fetoprotein** (AL-fah-FEE-toe-PRO-teen) a substance produced by a fetus and present in maternal blood and amniotic fluid, measured to determine likelihood of neural tube defects.
- Alzheimer's disease** (ALTS-hy-merz) a condition that leads to gradually worsening loss of mental abilities, including memory, judgment, and abstract thinking, as well as changes in personality.
- amebas** (a-MEE-buz) small, one-celled animals that live in fresh and salt water. Amebas can be seen only with a microscope. Also spelled amoebas.
- amino acids** (a-MEE-no acids) the chief building blocks of proteins. In humans, certain amino acids are required to sustain life.
- amnesia** (am-NEE-zha) the loss of memory about one or more past experiences that is more than normal forgetfulness.
- amniocentesis** (am-nee-o-sen-TEE-sis) a test in which a long, thin needle is inserted in the mother's uterus to obtain a sample of the amniotic fluid from the sac that surrounds the fetus. The fetal cells in the fluid are then examined for genetic defects.
- amniotic sac** (am-nee-AH-tik SAK) the sac formed by the amnion, the thin but tough membrane that lines the outside of the embryo in the uterus and is filled with fluid to cushion and protect the embryo as it grows.
- amoebas** (a-MEE-buz) small, one-celled animals that live in fresh and salt water. Amoebas can be seen only with a microscope. Also spelled amebas.
- amphetamines** (am-FET-a-meenz) drugs that produce a temporary feeling of alertness, energy, and euphoria.
- amputation** (am-pyoo-TAY-shun) the removal of a limb or other appendage or outgrowth of the body.
- amygdala** (a-MIG-da-la) a small almond-shaped structure in the brain that plays a part in processing emotions.
- amyloidosis** a condition in which excessive amounts of a protein known as amyloid are created by the body and deposited in tissues causing damage.
- anal** of or referring to the anus, the opening at the end of the digestive system through which waste leaves the body.
- androgen deficiency** (AN-dro-gen de-FISH-ens-see) reduced male hormones in men. Also called male menopause.
- androgynous** (an-DRAW-gin-us) having characteristics of both sexes.
- anemia** (uh-NEE-me-uh) a blood condition in which there is a decreased hemoglobin in the blood and, usually, fewer than normal numbers of red blood cells.
- anencephaly** (an-en-SEF-uh-lee) a condition present at birth in which most of the brain is missing.

- anesthesia** (an-es-THEE-zha) a state in which a person is temporarily unable to feel pain while under the influence of a medication.
- anesthetic** (an-es-THET-ik) a medicine that decreases the sensation of pain.
- angiogram** (AN-jee-o-gram) a test in which x-rays are taken as dye is injected into the body, showing the flow of blood through the heart and blood vessels.
- anorexia nervosa** (an-o-REK-se-a ner-VO-sa) an emotional disorder characterized by dread of gaining weight, leading to self-starvation and dangerous loss of weight and malnutrition.
- antagonist** (an-TAG-oh-nist) a chemical that acts within the body to reduce or oppose the effects of another chemical.
- anthrax** (AN-thraks) a rare infectious disease caused by the bacterium *Bacillus anthracis*.
- antibiotic** (an-tie-by-AH-tik) a drug that kills or slows the growth of bacteria.
- antibiotic resistance** occurs when bacteria evolve to withstand attack by antibiotics.
- antibody** (AN-tih-bah-dee) a protein molecule produced by the body's immune system to help fight a specific infection caused by a microorganism, such as a bacterium or virus.
- anticholinergics** (AN-ti-koll-in-ER-giks) medications given to counteract a chemical in the central nervous system that controls muscles, sweat glands, and some glands that secrete mucus.
- anticonvulsants** (an-tie-kon-VUL-sents) medications that affect the electrical activity in the brain and are given to prevent or stop seizures.
- antidepressant medications** medications used for the treatment and prevention of depression.
- antifungal drugs** (an-ty-FUN-gal) medications that kill fungi.
- antigen** (AN-tih-jen) a substance that is recognized as a threat by the body's immune system, which triggers the formation of specific antibodies against the substance.
- antihistamines** (an-tie-HIS-tuh-meens) drugs used to combat allergic reactions and relieve itching.
- antimony** (AN-tih-mo-nee) an element that has properties of both metals and nonmetals and can kill or inhibit the growth of certain bacteria.
- antipsychotic drugs** medications that counteract or reduce the symptoms of a severe mental disorder such as schizophrenia.
- antisocial** behaving in ways that purposefully disregard the rights of others and break society's rules or laws.
- antisocial behavior** behavior that differs significantly from the norms of society and is considered harmful to society.
- antitoxin** (an-tih-TOK-sin) counteracts the effects of toxins, or poisons, on the body. It is produced to act against specific toxins, such as those made by the bacteria that cause botulism or diphtheria.
- antivenin** an antibody (protein) capable of neutralizing a specific venom.
- anus** (A-nus) the opening at the end of the digestive system, through which waste leaves the body.
- anxiety** (ang-ZY-e-tee) can be experienced as a troubled feeling, a sense of dread, fear of the future, or distress over a possible threat to a person's physical or mental well-being.
- anxiety disorders** (ang-ZY-e-tee dis-OR-derz) a group of conditions that cause people to feel extreme fear or worry that sometimes is accompanied by symptoms such as dizziness, chest pain, or difficulty sleeping or concentrating.

- aorta** (ay-OR-ta) the major large artery that carries blood from the heart to the rest of the body.
- aortic aneurysm** (ay-OR-tik AN-yoo-rizm) a weak spot in the aorta, the body's largest blood vessel. The weak spot can rupture or break, causing massive internal bleeding.
- apnea** (AP-nee-uh) the temporary stopping of breathing.
- appendectomy** (ah-pen-DEK-toe-me) a surgical procedure in which the appendix is removed.
- appendicitis** (ah-pen-dih-SY-tis) an inflammation of the appendix.
- appendix** (ah-PEN-diks) the narrow, finger-shaped organ that branches off the part of the large intestine in the lower right side of the abdomen. Although the organ is not known to have any vital function, the tissue of the appendix is populated by cells of the immune system.
- arbovirus** (ar-buh-VY-rus) a member of a family of viruses that multiply in blood-sucking organisms, such as mosquitoes and ticks, and spread through their bites.
- arteriosclerosis** (ar-teer-e-o-sklah-RO-sis) a condition in which arteries of the body become narrowed and hardened from the buildup of calcium, cholesterol, and other substances, causing decreased blood flow through these vessels.
- artery** a vessel that carries blood from the heart to tissues in the body.
- arthritis** (ar-THRY-tis) any of several disorders characterized by inflammation of the joints.
- arthropod** a member of a group of organisms that lack a spinal column and have a segmented body and jointed limbs. This group includes various insects, ticks, spiders, lice, and fleas.
- aseptic meningitis** (a-SEP-tik meh-nin-JY-tis) a milder, non-bacterial form of meningitis that is usually caused by a virus.
- Asperger's syndrome** a pervasive developmental disorder in which a child does not learn to communicate and interact socially with others in a typical way. Children with Asperger's syndrome have normal intelligence and generally good language development.
- aspiration** (as-puh-RAY-shun) the sucking of fluid or other material out of the body, such as the removal of a sample of joint fluid through a needle inserted into the joint.
- asthma** (AZ-mah) a condition in which the airways of the lungs repeatedly become narrowed and inflamed, causing breathing difficulty.
- ataxia** a disorder involving an unsteady gait.
- atopy** (AT-uh-pee) an allergic hypersensitivity that affects parts of the body not in direct contact with the allergen, such as hay fever, asthma, or eczema.
- atrial fibrillation** (AY-tree-al fib-ri-LAY-shun) the arrhythmic or irregular beating of the left upper chamber of the heart. This leads to an irregular flow of blood and to the formation of blood clots that can leave the heart and travel to the brain, causing a stroke.
- Attention Deficit Hyperactivity Disorder** (or ADHD) a condition that makes it hard for a person to pay attention, sit still, or think before acting.
- aura** a warning sensation that precedes a seizure or other neurological event.
- autism** (AW-tih-zum) a developmental disorder in which a person has difficulty interacting and communicating with others and usually has severely limited interest in social activities.

- autoimmune disease** (aw-toh-ih-MYOON) a disease in which the body's immune system attacks some of the body's own normal tissues and cells.
- autonomic nervous system** a branch of the peripheral nervous system that controls various involuntary body activities such as body temperature, metabolism, heart rate, blood pressure, breathing, and digestion. The autonomic nervous system has two parts—the sympathetic and parasympathetic branches.
- autopsy** (AW-top-see) an examination of a body after death to look for the cause of death or the effects of a disease.
- autosomal dominant** a mode of inheritance in which only one copy of an abnormal gene is necessary to cause disease.
- bacteremia** (bak-tuh-REE-me-uh) the presence of bacteria in the blood.
- bacteria** (bak-TEER-ee-a) single-celled microorganisms which typically reproduce by cell division. Some, but not all, types of bacteria can cause disease in humans. Many types can live in the body without causing harm.
- bacterial vaginosis** (back-TER-i-all vag-in-OH-sis) a condition of the vagina caused by an overgrowth of normal bacteria. Symptoms include an abnormal discharge and fishy odor. This condition is treated with oral antibiotics and vaginal gels.
- Bartholin glands** (BAR-tha-lin) two very small glands, inside the vagina, that are important for vaginal lubrication during sexual intercourse.
- battery** a group of related tests that are given together.
- bedsores** skin sores caused by prolonged pressure on the skin and typically are seen in people who are confined by illness or paralysis to beds or wheelchairs. Also called pressure sores.
- behavior therapy** a type of counseling that works to help people change their actions.
- behavioral** related to the way a person acts.
- Bell's palsy** (PAWL-zee) a condition in which there is weakness or loss of function of muscles on one side of the face.
- benign** (be-NINE) a condition that is not cancerous or serious and will probably improve, go away, or not get worse.
- bifocals** prescription eyeglasses that have lenses divided into two or more sections. The bottom section allows a person to see things clearly that are close, and the top section allows a person to see things clearly that are far away. Also called multifocal (progressive) lenses.
- bile** a greenish-brown fluid manufactured in the liver that is essential for digesting food. Bile is stored in the gallbladder, which contracts and discharges bile into the intestine to aid digestion of fats after a person eats.
- bile duct** a passageway that carries bile, a substance that aids the digestion of fat, from the liver to the gallbladder (a small pouch-like organ where the bile is temporarily stored) and from the gallbladder to the small intestine.
- biliary tract** (BIH-lee-ah-ree) the organs and ducts, including the liver and gallbladder, that produce, store, and transport bile, a substance which aids in digestion.
- bilirubin** (bih-lih-ROO-bin) a substance that the body produces when hemoglobin, an iron-containing component of the blood, is broken down.
- binge drinking** having five or more drinks in a row within a few hours.
- biochemical** relating to the chemistry of living organisms.

- biofeedback** a technique that helps people gain some voluntary control over normally involuntary body functions.
- biohazard** a biological agent or condition that causes a threat to humans.
- biological warfare** a method of waging war by using harmful microorganisms to purposely spread disease to many people.
- biopsy** (BI-op-see) a test in which a small sample of skin or other body tissue is removed and examined for signs of disease.
- bipolar disorder** a group of mood disorders that are characterized by alternating episodes of depression and mania.
- bisexual** (bi-SEK-shoo-al) sexually attracted to both sexes.
- bladder** (BLAD-er) the sac that stores urine produced by the kidneys prior to discharge from the body.
- blood clot** a thickening of the blood into a jelly-like substance that helps stop bleeding. Clotting of the blood within a blood vessel can lead to blockage of blood flow.
- blood transfusion** the process of giving blood (or certain cells or chemicals found in the blood) to a person who needs it due to illness or blood loss.
- blood-brain barrier** a biological shield in the body that helps prevent germs or other potentially harmful materials in the blood from entering the brain and spinal cord.
- body dysmorphic disorder** (dis-MORE-fik) (or BDD) an extremely distressing, obsessive preoccupation with perceived flaws in one's appearance.
- body image** a person's impressions, thoughts, feelings, and opinions about his or her body.
- boils** skin abscesses or collections of pus in the skin.
- bone marrow** the soft tissue inside bones where blood cells are made.
- brain stem** the part of the brain that connects to the spinal cord. The brain stem controls the basic functions of life, such as breathing and blood pressure.
- bronchi** (BRONG-kye) the larger tube-like airways that carry air in and out of the lungs.
- bronchitis** (brong-KYE-tis) a disease that involves inflammation of the larger airways in the respiratory tract, which can result from infection or other causes.
- bronchodilator** (brong-ko-DYE-lay-tor) a medication that helps improve air flow through the lungs by widening narrowed airways.
- bronchoscopy** (brong-KOS-ko-pee) a procedure used to examine the bronchi with an instrument called a bronchoscope, which is a tool for looking inside the lungs that is made up of a lighted tube with viewing lenses. A bronchoscope has channels through which samples of material can be taken from the lungs for study in the laboratory.
- bulimia** (bu-LEE-me-a) an eating disorder in which a person has episodes of out-of-control overeating, or binges, and then tries to make up for them by making themselves vomit, by taking laxatives, or by exercising to excess to avoid gaining weight.
- bullying** when a person repeatedly intimidates or acts aggressively toward those with less power or ability to defend themselves.
- caisson** (KAY-son) a watertight container that divers or construction workers use under water.
- calorie** (KAL-or-ee) a unit of energy used to describe both the amount of energy in food and the amount of energy the body uses.

- cancer** a condition characterized by abnormal overgrowth of certain cells, which may be fatal.
- candidiasis** (kan-dih-DYE-uh-sis) an overgrowth of *Candida*, a type of yeast, in or on the body.
- carbohydrates** the nutrients in food that help provide energy to the body.
- carbon dioxide** (CAR-bon dy-OK-side) an odorless, colorless gas that is formed in the tissues and breathed out through the lungs.
- carcinogens** (kar-SIH-no-jenz) substances or agents that can cause cancer.
- carcinoma** (kar-sih-NO-muh) a cancerous tumor that arises in the epithelium (eh-puh-THÉE-lee-um), the sheets of cells that line body surfaces, such as the insides of hollow organs and cavities.
- cardiovascular system** (kar-dee-o-VAS-ku-lur) the heart and blood vessels.
- carrier** a person who has in his body a bacterium or virus or gene for a disease that he can transmit to other people without getting sick himself.
- cataracts** (KAH-tuh-rakts) areas of cloudiness of the lens of the eye that can interfere with vision.
- catatonic** (kat-a-TON-ik) an extreme disturbance in movement that has a psychological cause. Catatonic people can develop a wide range of symptoms, including: becoming very inactive and withdrawn, displaying excessive activity with no purpose, refusing to talk or follow instructions, becoming rigid if others try to move them, adopting strange gestures and facial expressions, and repeating the words or copying the movements of others.
- catecholamines** (kat-e-KO-la-meens) hormones and neurotransmitters such as epinephrine, norepinephrine, and dopamine.
- catheter** (KAH-thuh-ter) a small plastic tube placed through a body opening into an organ (such as the bladder) or through the skin directly into a blood vessel. It is used to give fluids to or drain fluids from a person.
- cecum** (SEE-kum) the pouch-like start of the large intestine that connects it to the small intestine.
- cell division** the process by which a cell divides to form new cells, each of which contains the same genetic material as the original cell.
- cellular** (cell-U-lar) relating to or consisting of cells, cell-mandated, as in cellular immunity.
- cellulitis** (sel-yoo-LYE-tis) an infection of the skin and the tissues beneath it.
- centenarians** people who are at least 100 years old.
- central nervous system** (SEN-trul NER-vus SIS-tem) the part of the nervous system that includes the brain and spinal cord.
- cerebellum** (se-re-BEL-um) the portion of the brain that is responsible for muscle coordination and balance.
- cerebral cortex** (suh-REE-brul KOR-teks) the part of the brain that controls functions such as conscious thought, listening, and speaking.
- cerebral palsy** (se-RE-bral PAL-zee) a group of conditions, all of which affect a person's ability to move. They are caused by injury to the brain before or during the birth process.
- cerebrum** (se-RE-brum) the largest, front and upper part of the brain that is responsible for mental processes.
- cerebrospinal fluid** (seh-ree-bro-SPY-nuhl) the fluid that surrounds the brain and spinal cord.
- cervical** referring to the cervix.

- cervix** (SIR-viks) the lower, narrow end of the uterus that opens into the vagina.
- cesarean section** (si-ZAR-ee-an SEK-shun) the surgical incision of the walls of the abdomen and uterus to deliver offspring in cases where the mother cannot deliver through the vagina.
- chancere** (SHANG-ker) a usually painless sore or ulcer that forms where a disease-causing germ enters the body, such as with syphilis.
- chancroid** (SHANG-kroid) a bacterial infection that causes painful sores in the genital region. Relatively rare in the United States, it mostly occurs in tropical and subtropical areas.
- chelation therapy** (kee-LAY-shun) a technique used to treat patients with lead or mercury poisoning by administering medications that combine with the metal to keep the body from absorbing it.
- chemotherapy** (KEE-mo-THER-a-pee) the treatment of cancer with powerful drugs that kill cancer cells.
- chlamydia** (kla-MIH-dee-uh) microorganisms that can infect the urinary tract, genitals, eye, and respiratory tract, including the lungs.
- chlamydial infection** (kla-MIH-dee-ul) occurs in various forms in which the bacteria can invade the urinary and genital systems of the body, as well as the eyes and lungs. One of its most common forms is a sexually transmitted disease (STD), usually passed from one person to another through unprotected sexual intercourse.
- cholera** (KAH-luh-ruh) an infection of the small intestine that can cause severe diarrhea.
- cholesterol** (ko-LES-ter-ol) a fatlike substance found in the blood and body tissues.
- chorionic villus sampling** (KOR-ee-on-ik VIL-lus) a test in which a small tube is inserted through the cervix and a small piece of the placenta supporting the fetus is removed for genetic testing.
- chromosome** (KRO-mo-zom) a unit or strand of DNA, the chemical substance that contains the genetic code to build and maintain a living being. Humans have 23 pairs of chromosomes, for a total of 46.
- chromosomes** (KRO-mo-somz) threadlike chemical structures inside cells on which the genes are located. There are 46 (23 pairs) of chromosomes in normal human cells. Genes on the X and Y chromosomes (known as the sex chromosomes) help determine whether a person is male or female. Females have two X chromosomes; males have one X and one Y chromosome.
- chondrodystrophy** (kon-dro-DIS-trof-ee) abnormal growth at the ends of the bones.
- chronic** (KRAH-nik) lasting a long time or recurring frequently.
- chronic fatigue syndrome** (KRON-ik fat-TEEG) a debilitating and complicated disorder in which individuals feel intense fatigue that lasts six months or longer. Symptoms may include insomnia, muscle pain, and impaired concentration. Because other illnesses have these symptoms, doctors must rule out a number of conditions in order to make a diagnosis.
- chronic illness** (KRAH-nik) an illness with symptoms that last a long time or that recur frequently.
- circulatory system** (SIR-kyoo-luh-tor-e) the system composed of the heart and blood vessels that moves blood throughout the body.
- circumcision** a surgical procedure in which the fold of skin covering the end of the penis is removed.
- cirrhosis** (sir-O-sis) a condition that affects the liver, involving long-term inflammation and scarring, which can lead to problems with liver function.

cleft palate a gap or split in the roof of the mouth (the palate). It occurs when the palate of a fetus does not develop properly during the first months of pregnancy.

clinical psychologist a mental health professional who has earned a non-medical doctoral degree. Clinical psychologists can do psychological evaluation and provide mental health counseling and therapy.

cloning (KLOH-ning) a process in which a group of cells or even an entire organism is grown from a single stem cell and is genetically identical to it.

clot as a verb: the process by which the body forms a thickened mass of blood cells and protein to stop bleeding; as a noun: the result of that process.

cocaine (ko-KAYN) a drug that produces a temporary feeling of alertness, energy, and euphoria.

cognitive associated with thinking, learning, perception, awareness, and judgment.

cognitive behavioral therapy (KOG-nih-tiv be-HAY-vyuh-rul THAIR-uh-pee) treatment that helps people identify negative ways of thinking and behaving and change them to more positive approaches.

cognitive therapy a form of counseling that helps people work to change distorted attitudes and ways of thinking.

colitis, ulcerative (ko-LIE-tis, UL-sir-ah-tiv) a common form of inflammatory bowel disease that causes inflammation with sore spots or breaks in the inner lining of the large intestine (colon). Symptoms include cramping, bleeding from the rectum, and diarrhea.

colon (KO-lin) the muscular tube through which food passes as it is digested, just before it moves into the rectum and out of the body through the anus. Also called the large intestine.

colonized means that a group of organisms, particularly bacteria, are living on or inside the body without causing symptoms of infection.

colostomy (ko-LOS-to-mee) a surgical procedure in which a part of the large intestine is removed, and the end of the intestine is attached to an opening made in the abdomen. The stool is passed through this opening into a special bag.

coma (KO-ma) an unconscious state, like a very deep sleep. A person in a coma cannot be awakened, and cannot move, see, speak, or hear.

comedo (KOM-e-do) an acne pimple. A blackhead is an open comedo. A whitehead is a closed comedo. Cosmetics that are labeled non-comedogenic (non-kom-e-do-JEN-ik) are less likely to cause pimples.

communication disorder a condition affecting a person's ability to use or understand speech and language.

complement proteins proteins that circulate in the blood and play a role in the immune system's response to infections. More than 20 complement proteins have been identified.

computerized tomography (kom-PYOO-ter-ized toe-MAH-gruh-fee), or CT, a technique in which a machine takes many x-rays of the body to create a three-dimensional picture. Also called computerized axial tomography (CAT).

concussion (kon-KUH-shun) an injury to the brain, produced by a blow to the head or violent shaking.

conduct disorder is diagnosed in children and adolescents who have had serious problems with lying, stealing, and aggressive behavior for at least six months.

confabulation filling in gaps in memory by making up or fabricating facts. The gaps occur because the memory function is impaired.

congenital (kon-JEH-nih-tul) present at birth.

- congestive** (kon-JES-tiv) characterized by accumulation of too much fluid.
- congestive heart failure** (kon-JES-tiv) a condition in which a damaged or overworked heart cannot pump enough blood to meet the oxygen and nutrient needs of the body. People with heart failure may find it hard to exercise due to the insufficient blood flow, but many people live a long time with this condition. Also called heart failure.
- conjunctivitis** (kon-jung-tih-VY-tis) an inflammation of the thin membrane that lines the inside of the eyelids and covers the surface of the eyeball. Conjunctivitis can be caused by viruses, bacteria, allergies, chemical irritation, and other conditions or diseases that cause inflammation. Also called pinkeye
- connective tissue** helps hold the body together, is found in skin, joints and bones.
- consensual sex** sexual activity in which both people freely agree to participate.
- constipation** the sluggish movement of the bowels, usually resulting in infrequent, hard stools.
- contagious** (kon-TAY-jus) transmittable from one person to another, usually referring to an infection.
- contraception** (kon-tra-SEP-shun) the deliberate prevention of conception or impregnation.
- controversy** discussions with many different and opposing points of view.
- conversion disorder** a mental disorder in which psychological symptoms are converted to physical symptoms, such as blindness, paralysis, or seizures. A person with conversion disorder does not intentionally produce symptoms.
- convulsions** (kon-VUL-shuns) sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness. Also called seizures.
- cornea** (KOR-nee-uh) the transparent circular layer of cells over the central colored part of the eyeball (the iris) through which light enters the eye.
- coronary aneurysm** (KOR-uh-nair-e AN-yuh-rih-zum) an abnormal stretching and weakening of a blood vessel that supplies blood to the heart. If it breaks open, it may cause serious damage to the heart, sometimes leading to death.
- coronary arteries** (KOR-uh-nair-e AR-tuh-reez) the blood vessels that directly supply blood to the heart.
- correlated** linked in a way that can be measured and predicted.
- cortex** (KOR-teks) the top outer layer of the brain. It controls the brain's higher functions, such as thinking, learning, and personality.
- corticosteroids** (kor-tih-ko-STIR-oyds) chemical substances made by the adrenal glands that have several functions in the body, including maintaining blood pressure during stress and controlling inflammation. They can also be given to people as medication to treat certain illnesses.
- cortisol** (KOR-ti-sol) a hormone that helps control blood pressure and metabolism, the process of converting food into energy and waste products. It plays a part in the stress response.
- cortisone** (KOR-ti-zone) a medication used to relieve inflammation.
- Crohn's disease** (KRONZ) an often inherited, chronic inflammatory disease that typically affects the small and/or large intestine but which can affect any part of the digestive system. The disease causes crater-like ulcers or sores in the inner surface of the bowel. Mild cases may be treated with medication; serious cases may be treated with surgery.

- cri du chat** (kree-doo-SHA), French for *cat's cry*, a genetic disorder that can cause mental retardation, a small head, and a cat-like whine.
- croup** (KROOP) an infection involving the trachea (windpipe) and larynx (voice box) that typically occurs in childhood. It causes inflammation and narrowing of the upper airway, sometimes making it difficult to breathe. The characteristic symptom is a barking cough.
- CT scan** the shortened name for computerized axial tomography (to-MOG-ra-fee), which uses computers to view structures inside the body. Also called CAT scan.
- culture** (KUL-chur) a test in which a sample of fluid or tissue from the body is placed in a dish containing material that supports the growth of certain organisms. Typically, within days the organisms will grow and can be identified.
- cutaneous** (kyoo-TAY-nee-us) related to or affecting the skin.
- cyanosis** (syeh-uh-NO-sis) a bluish or purplish discoloration of the skin and mucous membranes due to a lack of oxygen in the blood.
- cystic fibrosis** (SIS-tik fy-BRO-sis) a disease that causes the body to produce thick mucus that clogs passages in many of the body's organs, including the lungs.
- cysts** (SISTS) shell-like enclosures that contain small organisms in a resting stage.
- cytomegalovirus infection** (sy-tuh-MEH-guh-lo-vy-rus) (CMV) a common infection usually causing no symptoms. It poses little risk for healthy people, but it can lead to serious illness in people with weak immune systems.
- debilitating** (de-BI-li-tay-ting) making weak or sapping strength.
- DEET** (abbreviation for N,N-Diethyl-metoluamide) the active ingredient in many insect repellants.
- defiant** (dee-FY-ent) an attitude of challenging the rules in a hostile way or of being disobedient on purpose.
- degenerative** (dee-JEN-er-uh-tiv) progressively worsening or becoming more impaired.
- dehydration** (dee-hi-DRAY-shun) a condition in which the body is depleted of water, usually caused by excessive and unreplaced loss of body fluids, such as through sweating, vomiting, or diarrhea.
- delinquent** a legal term that refers to a juvenile (someone under the age of 18) who has committed an illegal act. Delinquent behavior includes any behavior that would be considered a crime if committed by an adult as well as specific behaviors that are illegal for youth, such as school truancy, violating curfew, or running away.
- delirious** (dee-LEER-ee-us) an acute mental syndrome characterized by confusion, disordered thinking, and hallucinations (ha-loo-si-NAY-shunz).
- delirium** (dih-LEER-e-um) a condition in which a person is confused, is unable to think clearly, and has a reduced level of consciousness.
- delirium tremens** also called the DTs or Alcohol Withdrawal Delirium. The DTs may occur two to three days after a person with long-term alcoholism stops drinking. Symptoms include rapid heartbeat, sweating, abnormally high blood pressure, an irregular tremor, delusions, hallucinations, and agitated or wild behavior. The delirium and other withdrawal symptoms usually subside in three or four days.
- delusion** (de-LOO-zhun) a false belief or judgment that remains even in the face of proof that it is not true.
- dementia** (dih-MEN-sha) a loss of mental abilities, including memory, understanding, and judgment.

- depersonalization** (de-per-son-al-i-ZAY-shun) a mental condition in which people feel that they are living in a dream or are removed from their body and are watching themselves live.
- depression** (de-PRESH-un) a mental state characterized by feelings of sadness, despair, and discouragement.
- depressive disorders** a collection of mental disorders that involve long periods of excessive sadness and affect a person's feelings, thoughts, and behavior.
- derealization** (de-reel-i-ZAY-shun) a mental condition in which people feel that the external world is strange or unreal.
- dermatitis** a skin condition characterized by a red, itchy rash. It may occur when the skin comes in contact with something to which it is sensitive.
- desensitization** (de-sens-ih-tih-ZAY-shun) a method for reducing a person's reaction to an allergen.
- detoxification** (de-tox-i-fi-KAY-shun) the process of breaking dependence on an addictive substance.
- deviated septum** a condition in which the wall of tissue between the passages, the septum, divides the passage-ways unevenly, sometimes causing breathing difficulties and blockage of sinus drainage.
- dextrocardia** mirror image rotation that is confined to the heart.
- diabetes** (dye-uh-BEE-teez) a condition in which the body's pancreas does not produce enough insulin or the body cannot use the insulin it makes effectively, resulting in increased levels of sugar in the blood. This can lead to increased urination, dehydration, weight loss, weakness, and a number of other symptoms and complications related to chemical imbalances within the body.
- dialysis** (dye-AL-uh-sis) a process that removes waste, toxins (poisons), and extra fluid from the blood. Usually dialysis is done when a person's kidneys are unable to perform these functions normally.
- diaphragm** (DY-a-fram) the muscle that separates the chest and abdominal cavities. It is the chief muscle used in breathing.
- diarrhea** (di-ah-RE-a) frequent, watery stools (bowel movements).
- differentiation** (dif-feh-rent-see-AY-shun) the process in which embryonic or adult stem cells give rise to more specialized cells.
- digestive system** the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, rectum, and other organs involved in digestion, including the liver and pancreas.
- dilate** (DY-late) to become enlarged or stretched beyond the usual boundaries.
- diphtheria** (dif-THEER-e-uh) an infection of the lining of the upper respiratory tract (the nose and throat). It can cause breathing difficulty and other complications, including death.
- disseminated** a disease that has spread widely in the body.
- dissociative identity disorder** (DID) a severe psychiatric condition in which a person has two or more distinct sub-personalities that periodically take control of his or her behavior. The sub-personalities are thought to be caused by repeated episodes of an extreme form of dissociation. Formerly known as multiple personality disorder (MPD).
- diuretics** (dye-yoor-EH-tiks) medications that increase the body's output of urine.
- dizygotic** (dye-zye-GOT-ik) derived from two different fertilized eggs.

- DNA** or deoxyribonucleic acid (dee-OX-see-ry-bo-nyoo-KLAY-ik AH-sid), the specialized chemical substance that contains the genetic code necessary to build and maintain the structures and functions of living organisms.
- dopamine** (DOE-puh-meen) a neurotransmitter in the brain that is involved in the brain structures that control motor activity (movement).
- double vision** a vision problem in which a person sees two images of a single object.
- Down syndrome** a genetic disorder that can cause mental retardation, shortness, and distinctive facial characteristics, as well as many other features.
- DSM-IV** The *Diagnostic and Statistical Manual of Mental Disorders*, 4th revision, published by the American Psychiatric Association. This is the system of classification and diagnosis of mental conditions used in the United States.
- duodenal** (do-uh-DEE-nul) the upper part of the small intestine.
- duodenum** (dew-eh-DEE-num) the first part of the small intestine that connects to the stomach.
- dura mater** (DUR-uh MAY-ter) the outermost of three membranes covering the brain and spinal cord.
- dust mites** tiny insects that live in dust and in materials such as carpets, pillows, mattresses and furniture.
- dysplasia** (dis-PLAY-zha) abnormal growth or development.
- ear wax** the wax-like substance in the ear that traps dust and other particles to prevent them from damaging the inner ear. Also known as cerumen (se-ROO-men).
- eating disorder** a condition in which a person's eating behaviors and food habits are so unbalanced that they cause physical and emotional problems.
- echocardiogram** (eh-ko-KAR-dee-uh-gram) a diagnostic test that uses sound waves to produce images of the heart's chambers and valves and blood flow through the heart.
- echoviruses** a group of viruses found in the intestinal tract. The word echo in the name is acronym for enteric cytopathic human orphan viruses. When these viruses were named, they were not associated with any disease, hence the use of the word orphan. However, later these viruses were associated with various diseases, including meningitis and encephalitis.
- ectopic pregnancy** (ek-TAH-pik) an abnormal pregnancy in which the fertilized egg develops outside the uterus, usually within one of the fallopian tubes.
- eczema** (EG-ze-mah) an inflammatory skin condition characterized by redness, itchiness, and oozing blisters that become crusty and hard.
- edema** (e-DEE-ma) swelling in the body's tissues caused by excess fluids.
- effusion** (ih-FYOO-zhun) an excessive accumulation of body fluid in a body space or cavity, such as the middle ear.
- ejaculate** (e-JAH-kyoo-late) to discharge semen from the penis.
- elasticity** the ability to be stretched and to return to original shape.
- electrocardiogram** (e-lek-tro-KAR-dee-o-gram) a test that records and displays the electrical activity of the heart. Also known as an EKG.
- electroconvulsive therapy** involves sending small, carefully controlled pulses of electric current to the brain, which leads to brief seizures. It is a fast treatment for severe depression. Popularly known as shock therapy.

- electroencephalogram** an instrument that records the electrical activity of the brain.
- electrolysis** (ee-lek-TRAW-li-sis) a method of destroying hair roots by passing an electric current through them.
- electromyogram** (ee-lek-tro-MY-eh-gram) (EMG) a visual record made by an electromyograph, which measures the electrical activity associated with functioning muscle.
- elephantiasis** (eh-luh-fan-TIE-uh-sis) the significant enlargement and thickening of body tissues caused by an infestation of parasites known as filaria.
- embolism** a blockage in a blood vessel caused by a blood clot, air bubble, fatty tissue, or other substance that traveled through the bloodstream from another part of the body.
- embryo** (EM-bree-o), in humans, the developing organism from the end of the second week after fertilization to the end of the eighth week.
- empathy** the action of being aware or understanding the feelings of others without having those feelings explained.
- emphysema** (em-fuh-ZEE-mah) a lung disease in which the tiny air sacs in the lungs become permanently damaged and are unable to maintain the normal exchange of oxygen and other respiratory gases with the blood, often causing breathing difficulty.
- encephalitis** (en-seh-fuh-LYE-tis) an inflammation of the brain, usually caused by a viral infection.
- endemic** (en-DEH-mik) a disease or condition that is present in a population or geographic area at all times.
- endocarditis** (en-do-kar-DYE-tis) an inflammation of the valves and internal lining of the heart, known as the endocardium (en-doh-KAR-dee-um), usually caused by an infection.
- endocrine** (EN-do-krin) a group of glands, such as the thyroid, adrenal, and pituitary glands, and the hormones they produce. The endocrine glands secrete their hormones into the bloodstream, and the hormones travel to the cells that have receptors for them. Certain hormones have effects on mood and sometimes cause emotional swings.
- endocrine system** a system of ductless glands, including the thyroid and pituitary among others, that secrete hormones and control many bodily functions.
- endocrinologist** (en-do-krin-OL-o-jist) a doctor who specializes in treating patients with hormone-related disorders.
- endoscope** (EN-doh-skope) a tool for looking inside parts of the body. It consists of a lighted tube and optical fibers and/or lenses.
- endoscopy** (en-DOS-ko-pee) a type of diagnostic test in which a lighted tube-like instrument is inserted into a part of the body.
- enema** (EH-nuh-muh) a procedure in which liquid is injected through the anus into the intestine, usually to flush out the intestines.
- enterovirus** (en-tuh-ro-VY-rus) a group of viruses that can infect the human gastrointestinal tract and spread through the body causing a number of symptoms.
- enzyme** (EN-zime) a protein that helps speed up a chemical reaction in cells or organisms.
- epidemic** (eh-pih-DEH-mik) an outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual. Usually epidemics are outbreaks of diseases in specific regions, whereas widespread epidemics are called pandemics.
- epididymitis** (eh-pih-dih-duh-MY-tis) a painful inflammation of the epididymitis, a structure attached to the testicles.

- epidural** (ep-I-DOO-ral) above or outside the dura, the covering of the brain.
- epiglottis** (eh-pih-GLAH-tis) the soft flap of tissue that covers the opening of the trachea (windpipe) when a person swallows to prevent food or fluid from entering the airway and lungs.
- epiglottitis** (eh-pih-glah-TIE-tis) a condition involving life-threatening swelling of the epiglottis, which is usually caused by a bacterial infection of the epiglottis. The condition can result in a blockage of the trachea and severe breathing difficulty.
- epilepsy** (EP-i-lep-see) a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Seizures occur when powerful, rapid bursts of electrical energy interrupt the normal electrical patterns of the brain.
- epinephrine** (eh-pih-NEH-frin) a chemical substance produced by the body that can also be given as a medication to constrict, or narrow, small blood vessels, stimulate the heart, and cause other effects, such as helping to open narrowed airways in conditions such as asthma and croup.
- Epstein-Barr virus** (EP-stine-BAHR VI-rus) a common virus that causes infectious mononucleosis.
- ergonomics** (er-go-NOM-iks) a science that helps people to know the best postures and movements to use while working, in order to avoid injury and discomfort.
- esophagus** (eh-SAH-fuh-gus) the soft tube that, with swallowing, carries food from the throat to the stomach.
- osteomyelitis** (ah-stee-o-my-uh-LYE-tis) a bone infection that is usually caused by bacteria. It can involve any bone in the body, but it most commonly affects the long bones in the arms and legs.
- estrogen** (ES-tro-jen) a steroid hormone that stimulates the development of female sexual characteristics and maintenance of the female reproductive system.
- ethical** having to do with questions of what is right and wrong, or with moral values.
- ethics** a guiding set of principles for conduct, a system of moral values.
- euphoria** (yoo-FOR-ee-uh) an abnormally high mood with the tendency to be overactive and overly talkative, and to have racing thoughts and overinflated self-confidence.
- eustachian tube** (yoo-STAY-she-un) the tiny channel that connects and allows air to flow between the middle ear and the throat.
- exotoxin** (ek-so-TOK-sin) a substance produced by bacteria that has harmful effects on the infected person.
- factitious** false.
- failure to thrive** a condition in which an infant fails to gain weight and grow at the expected rate.
- fallopian tubes** (fa-LO-pee-an tubes) the two slender tubes that connect the ovaries and the uterus in females. They carry the ova, or eggs, from the ovaries to the uterus.
- feces** (FEE-seez) the excreted waste from the gastrointestinal tract.
- fetal alcohol syndrome** occurs if the fetus is exposed to alcohol and is a condition that can be associated with mental, physical, and behavioral differences. Oppositional behavioral problems, learning difficulties, intellectual disability, and retarded growth can occur in the children of women who drink alcohol while they are pregnant.

- fetus** (FEE-tus) an unborn human after it is an embryo, from 9 weeks after fertilization until childbirth.
- fibromyalgia** (fi-bro-my-AL-ja) a group of disorders that are characterized by achy, tender, and stiff muscles.
- fistulas** (FIS-tu-las) abnormal connections between two organs or leading from an internal organ to the surface of the body.
- flashbacks** intensely vivid, recurring mental images of a past traumatic event. People may feel or act as if they were reliving the experience.
- flavivirus family** (FLAY-vih-vy-rus) a group of viruses that includes those that cause dengue fever and yellow fever.
- fluoridation** the process of adding fluoride to drinking water to help prevent tooth decay.
- follicles** tiny pits in the skin from which hair grows.
- food chain** the eating relationships between different organisms in a specific environment.
- foreign** coming from outside a person's body.
- formula** a prepared, nutritious drink or a dry drink mix designed specifically for infants.
- fragile X syndrome** a disorder associated with a faulty X chromosome (a chromosome is a structure inside the body's cells that contains DNA, which is the genetic material that helps determine characteristics such as hair and eye color; females have two X chromosomes whereas males have only one). Fragile X syndrome is associated with mental retardation, especially in males.
- fraternal twins** twins who are born at the same time but develop from two separate fertilized eggs. Unlike identical twins, who develop from only one fertilized egg that splits into two and who look exactly alike, fraternal twins may not look the same at all or be the same gender. Identical twins have the same genes, but fraternal twins are no more likely to share genes than non-twin siblings.
- frostbite** damage to tissues resulting from exposure to low environmental temperatures. It is also called congelation (kon-jeh-LAY-shun).
- fugue** (FYOOG) a psychiatric condition in which people wander or travel and may appear to be functioning normally, but they are unable to remember their identity or details about their past.
- fulminant** (FUL-mi-nant) occurring suddenly and with great severity.
- fungus** (FUN-gus) a microorganism that can grow in or on the body, causing infections of internal organs or of the skin, hair, and nails. The plural form is fungi (FUNG-eye).
- gall bladder** a small pear-shaped organ on the right side of the abdomen that stores bile, a liquid that helps the body digest fat.
- gallstones** (GAWL-stonz) hard masses that form in the gallbladder or bile duct.
- gamma globulin** (GAH-muh GLAH-byoo-lin) a type of protein in the blood that contains the antibodies produced by the cells of the body's immune system that help defend the body against infection-causing germs, such as bacteria and viruses.
- gangrene** (GANG-green) the decay or death of living tissue caused by a lack of oxygen supply to the tissue and/or bacterial infection of the tissue.
- gastrointestinal** (gas-tro-in-TES-tih-nuhl) pertaining to the organs of the digestive system, the system that processes food. It includes the mouth, esophagus, stomach, intestines, colon, and rectum and other organs involved in digestion, including the liver and pancreas.
- gene therapy** a treatment that works by altering genes.

- general anesthesia** (an-es-THE-zha) using drugs or inhaled gases to create a state of unconsciousness and muscle relaxation throughout the body to block pain during surgery. Local anesthesia blocks or numbs pain in one part of the body while patients remain awake.
- genes** (JEENS) chemical structures composed of deoxyribonucleic acid (DNA) that help determine a person's body structure and physical characteristics such as hair or eye color. Inherited from a person's parents, genes are contained in the chromosomes found in the body's cells.
- genetic** (juh-NEH-tik) refers to heredity and the ways in which genes control the development and maintenance of organisms.
- genetic predisposition** the tendency to get a certain disease that is inherited from a person's parents.
- genetics** (juh-NEH-tiks) the branch of science that deals with heredity and the ways in which genes control the development and maintenance of organisms.
- genital** (JEH-nih-tul) the external sexual organs.
- genital herpes** (GEN-eh-tal her-PEES) a viral infection transmitted by intimate contact with an infected person. The herpes simplex type 2 virus enters the mucous membrane and settles in nerves near the spinal column. When an infected person has an outbreak, the virus causes blisters at the infection site.
- gestational** (jes-TAY-shun-al) relating to pregnancy.
- gestational age** the length of time a fetus has remained developing within the womb.
- gland** an organ that produces substances such as hormones and chemicals that regulate body functions.
- glaucoma** a group of disorders that cause pressure to build in the eye, which may result in vision loss.
- glomerulus** (glom-ER-you-lus) a knot of blood vessels that have the job of filtering the blood. From a Greek word meaning filter.
- gonorrhea** (gah-nuh-REE-uh) a sexually transmitted disease (STD) spread through all forms of sexual intercourse. The bacteria can also be passed from an infected mother to her baby during childbirth. Gonorrhea can affect the genitals, urethra, rectum, eyes, throat, joints, and other tissues of the body.
- Goodpasture's syndrome** an autoimmune disorder of unknown cause, characterized by circulating antibodies in the blood that attack the membrane of the kidney's glomeruli and the lung's alveoli.
- gout** occurs when deposits of uric acid in the joints cause inflammation and pain.
- grafts** tissue or organ transplants.
- granuloma** (gran-yoo-LO-muh) chronically inflamed and swollen tissue that often develops as the result of an infection.
- growth hormone** a chemical substance produced by the pituitary gland that regulates growth and other body functions.
- gum disease** an infection caused by bacteria that affect the tissues surrounding and supporting the teeth.
- gynecologist** (gy-ne-KOL-o-jist) a doctor who specializes in the reproductive system of women.
- Haemophilus influenzae type B** bacteria that can cause serious illnesses, including meningitis, pneumonia, and other infections.
- hantavirus** a group of viruses transmitted to humans through the saliva or excrement of rodents, such as field mice, and which causes hemorrhagic fever and pneumonia.
- hair follicle** (FAH-lih-kul) the skin structure from which hair develops and grows.

- hallucinate** (ha-LOO-sin-ate) to hear, see, or otherwise sense things that are not real.
- hallucinations** (ha-LOO-sin-AY-shuns) occur when a person sees or hears things that are not really there. Hallucinations can result from nervous system abnormalities, mental disorders, or the use of certain drugs.
- hallucinogenic drugs** substances that cause a person to have hallucinations.
- heart attack** a general term that usually refers to a sudden, intense episode of heart injury. It is usually caused by a blockage of a coronary artery, which stops blood from supplying the heart muscle with oxygen.
- heart disease** a broad term that covers many conditions that prevent the heart from working properly to pump blood throughout the body.
- heart failure** a condition in which a damaged heart cannot pump enough blood to meet the oxygen and nutrient demands of the body. People with heart failure may find it hard to exercise due to the insufficient blood flow, but many people live a long time with heart failure. Also called congestive heart failure.
- heart murmur** an abnormal sound from the heart, heard with a stethoscope, that is usually related to the flow of blood through the heart. Some murmurs indicate a problem with a heart valve or other part of the heart's structures, but many murmurs do not indicate any problem.
- heel spur** a bony growth under the heel that causes pain when a person walks.
- Helicobacter pylori** (HEEL-ih-ko-bak-ter pie-LOR-eye) a bacterium that causes inflammation and ulcers, or sores, in the lining of the stomach and the upper part of the small intestine.
- hemodialysis** (HEE-mo-dye-AL-is-is) a method for removing waste products from the blood in patients with kidney failure.
- hemoglobin** (HE-muh-glo-bin) the oxygen-carrying pigment of the red blood cells.
- hemolytic** (he-mo-LIT-ik) destruction of red blood cells with the release of hemoglobin into the bloodstream.
- hemophilia** (hee-mo-FIL-e-a) a hereditary disease that results in abnormal bleeding because the blood fails to clot. It occurs almost exclusively in males.
- hemorrhage** (HEH-muh-rij) uncontrolled or abnormal bleeding.
- hemorrhoids** (HEM-o-roidz) a mass of dilated veins in swollen tissue at the margin of the anus or nearby within the rectum.
- hepatitis** (heh-puh-TIE-tis) an inflammation of the liver. Hepatitis can be caused by viruses, bacteria, and a number of other noninfectious medical conditions.
- hepatitis A** (heh-puh-TIE-tis A) an inflammation of the liver that is caused by an infection with the hepatitis A virus.
- hepatocellular** (hep-a-to-SEL-ular) the cells of the liver.
- hernia** (HER-nee-ah) a protrusion of an organ through connective tissue or a cavity wall.
- heroin** a narcotic, an addictive painkiller that produces a high, or a euphoric effect. Euphoria (yoo-FOR-ee-a) is an abnormal, exaggerated feeling of well-being.
- herpes** (HER-pee-z) a viral infection that can produce painful, recurring skin blisters around the mouth or the genitals, and sometimes symptoms of infection elsewhere in the body.
- herpes simplex** (HER-pee-z SIM-plex) a virus that can cause infections of the skin, mouth, genitals, and other parts of the body.

- herpesvirus family** (her-pee-z-VY-rus) a group of viruses that can store themselves permanently in the body. The family includes varicella zoster virus, Epstein-Barr virus, and herpes simplex virus.
- heterosexual** (he-te-ro-SEK-shoo-al) a tendency to be sexually attracted to the opposite sex.
- high blood pressure** a condition in which the pressure of the blood in the arteries is above normal. Also called hypertension.
- hippocampus** (hip-o-KAM-pus) the part of the brain that is involved in learning and memory.
- histamine** (HIS-tuh-meen) a substance released by the body during inflammation. It causes blood vessels to expand and makes it easier for fluid and other substances to pass through vessel walls.
- HIV** human immunodeficiency virus (HYOO-mun ih-myoo-no-dih-FIH-shen-see) the virus that causes AIDS (acquired immunodeficiency syndrome), an infection that severely weakens the immune system.
- hives** swollen, itchy patches on the skin.
- hormone** a chemical substance that is produced by a gland and sent into the bloodstream carrying messages that have certain effects on other parts of the body.
- host** an organism that provides another organism (such as a parasite or virus) with a place to live and grow.
- HTLV-1** (short for human T-cell lymphotropic virus type 1) a virus that is associated with certain kinds of adult leukemia and lymphoma.
- human immunodeficiency virus** (HYOO-mun ih-myoo-no-dih-FIH-shen-see), or HIV, the virus that causes AIDS (acquired immunodeficiency syndrome), an infection that severely weakens the immune system.
- humoral** (HUM-eh-ral) relating to a hormone, relating to or part of an immune response that involves antibodies secreted by B cells and circulating in bodily fluids.
- Huntington's disease** a genetic condition that leads to involuntary twitching or jerking of the muscles in the face, arms, and legs along with a gradual loss of mental abilities.
- hydrocephalus** (hy-droe-SEF-uh-lus) a condition, sometimes present at birth, in which there is an abnormal buildup of fluid within the skull, leading to enlargement of the skull and pressure on the brain.
- hydrocephaly** (hi-dro-SEH-fah-lee) having an abnormally large amount of cerebrospinal fluid in the brain, resulting in an enlarged skull and brain atrophy.
- hyperactivity** (hy-per-ak-TI-vi-tee) overly active behavior, which makes it hard for a person to sit still.
- hyperglycemia** (hi-per-gly-SEE-mee-uh) an excess of blood sugar.
- hypersensitivity** excessively sensitive or abnormally susceptible physically to a specific agent such as a drug.
- hypertension** (HI-per-ten-chen) abnormally high arterial blood pressure.
- hyperthermia** (hi-per-THER-me-ah) a state in which the body either produces or absorbs more heat than it can dissipate resulting in a significantly raised body temperature.
- hyperthyroidism** (hi-per-THY-royd-ih-zum) excessive activity of the thyroid gland, characterized by an enlarged thyroid gland, increased metabolic rate, rapid heartbeat, and high blood pressure.
- hypnosis** a trance-like state, usually induced by another person. The person under hypnosis may recall forgotten or suppressed memories and be unusually responsive to suggestions.

- hypochondria** (hy-po-KON-dree-a) a mental disorder in which people believe that they are sick, but their symptoms are not related to any physical illness.
- hypoglycemia** (hi-po-gly-SEE-mee-uh) a condition that occurs when the amount of glucose, or sugar, in the blood becomes too low. Symptoms can include dizziness, trembling, sweating, and confusion.
- hypothalamus** (hy-po-THAL-uh-mus) a brain structure located deep within the brain that regulates automatic body functions such as heart rate, blood pressure, temperature, respiration, and the release of hormones.
- hypothyroidism** (hi-po-THY-royd-ih-zum) an impairment of the functioning of the thyroid gland that causes too little thyroid hormone to be produced by the body. Symptoms of hypothyroidism can include tiredness, paleness, dry skin, and in children, delayed growth and mental and sexual development.
- hypoxia** (hip-AK-see-ah) occurs when insufficient oxygen reaches the tissues of the body.
- ibuprofen** (eye-bew-PRO-fin) a nonsteroidal anti-inflammatory drug (NISAD) used to reduce fever and relieve pain or inflammation.
- identical twins** twins produced when a single egg from the mother is fertilized and divides to form two separate embryos of the same sex with nearly identical DNA.
- immune** (ih-MYOON) resistant to or not susceptible to a disease.
- immune globulin** (ih-MYOON GLAH-byoo-lin) the protein material that contains antibodies. Also called gamma globulin.
- immune system** (im-YOON SIS-tem) the system of the body composed of specialized cells and the substances they produce that helps protect the body against disease-causing germs.
- immunity** (ih-MYOON-uh-tee) the condition of being protected against an infectious disease. Immunity often develops after a germ has entered the body. One type of immunity occurs when the body makes special protein molecules called antibodies to fight the disease-causing germ. The next time that germ enters the body, the antibodies quickly attack it, usually preventing the germ from causing disease.
- immunoglobulins** (im-mune-o-GLOB-uh-linz) types of antibodies.
- immunology** (ih-myoo-NOL-uh-jee) the science of the system of the body composed of specialized cells and the substances they produce that help protect the body against disease-causing germs.
- immunosuppressants** (im-yoo-no-su-PRES-ants) substances that weaken the body's immune system.
- impetigo** (im-pih-TEE-go) a bacterial skin infection that usually occurs around the nose and mouth and causes itching and fluid-filled blisters that often burst and form yellowish crusts.
- impotence** (IM-po-tens) the failure of a man to achieve or to maintain an erection.
- impulsive** acting quickly before thinking about the effect of a certain action or behavior.
- in vitro** in the laboratory or other artificial environment rather than in the living body.
- inborn** present from birth, or inherited.
- incidence** rate of occurrence.
- incontinence** (in-KON-ti-nens) loss of control of urination or bowel movement.
- incontinent** unable to control urination or bowel movements.
- incubation** (ing-kyoo-BAY-shun) the period of time between infection by a germ and when

symptoms first appear. Depending on the germ, this period can be from hours to months.

infectious able to spread to others.

infertility (in-fer-TIH-lih-tee) the inability of females to become pregnant or of males to cause pregnancy.

infestations illnesses caused by multi-celled parasitic organisms, such as tapeworms, roundworms, or protozoa living on or in the body tissues of a human or other host.

inflammation (in-fla-MAY-shun) the body's reaction to irritation, infection, or injury that often involves swelling, pain, redness, and warmth.

influenza (in-floo-EN-zuh) a contagious viral infection that attacks the respiratory tract, including the nose, throat, and lungs. Also known as the flu.

influenza A (in-floo-EN-zuh A) one member of a family of viruses that attack the respiratory tract.

inhalants (in-HAY-lunts) substances that a person can sniff, or inhale, to get high.

inhaler (in-HAY-ler) a hand-held device that produces a mist that is breathed in through the mouth.

insecticides chemicals used to kill insects and prevent infestation.

insomnia abnormal inability to get adequate sleep.

insulin a hormone, or chemical produced in the body, that is crucial in controlling the level of glucose (sugar) in the blood and in helping the body use glucose to produce energy. When the body cannot produce or use insulin properly, a person must take insulin or other medications.

intelligence quotient test a test designed to estimate a person's intellectual potential. Also known as an IQ test.

intestines the muscular tubes that food passes through during digestion after it exits the stomach.

intolerance lacking an ability to endure exposure to some environmental feature, such as sunlight, or an exceptional sensitivity, for example to milk, so that the food cannot be properly metabolized, as in glucose intolerance.

intravenous (in-tra-VEE-nus) or IV, means within or through a vein. For example, medications, fluid, or other substances can be given through a needle or soft tube inserted through the skin's surface directly into a vein.

intubation (in-too-BAY-shun) the insertion of a tube into the windpipe to allow air and gases to flow into and out of the lungs in a person who needs help breathing.

ions positively or negatively charged elements or compounds, such as hydrogen, sodium, potassium, and phosphate, which are necessary for cellular metabolism.

ischemic stroke events that occur when a blood vessel bringing oxygen and nutrients to the brain becomes clogged by a blood clot or other particle. As a result, nerve cells in the affected area of the brain cannot function properly.

jaundice (JON-dis) a yellowing of the skin, and sometimes the whites of the eyes, caused by a buildup in the body of bilirubin, a chemical produced in and released by the liver. An increase in bilirubin may indicate disease of the liver or certain blood disorders.

joint the structure where two or more bones come together, allowing flexibility and motion of the skeleton.

juvenile rheumatoid arthritis a joint disease in children with symptoms of high fever, rash, swollen lymph glands, enlarged spleen and liver, and inflammation around the heart and of the lungs. Arthritis in the joints appears later. This disease is also known as systemic-onset chronic arthritis or Still's disease.

- ketones** (KEE-tones) the chemicals produced when the body breaks down fat for energy.
- kidney stone** a hard structure that forms in the urinary tract. This structure is composed of crystallized chemicals that have separated from the urine. It can obstruct the flow of urine and cause tissue damage and pain as the body attempts to pass the stone through the urinary tract and out of the body.
- kidneys** the pair of organs that filter blood and remove waste products and excess water from the body in the form of urine.
- kuru** (KUR-ew) a progressive, fatal brain disease characterized by tremors and loss of muscle coordination that is caused by eating contaminated brain tissue from other humans who had the disease.
- laparoscope** (LAP-a-ro-scope) a fiber-optic instrument inserted into an incision in the abdominal wall to perform a visual examination.
- laparoscopy** (lap-uh-ROS-kuh-pee) a type of surgery in which a small fiberoptic instrument is inserted through a very small incision to examine the inside of the abdomen or remove small amounts of tissue. Also called minimally invasive surgery.
- large intestine** the part of the intestine that contains the colon and rectum.
- larva** (LAR-vuh) the immature form of an insect or worm that hatches from an egg. The plural form is larvae (LAR-vee).
- laryngitis** (lair-in-JY-tis) an inflammation of the vocal cords that causes hoarseness or a temporary loss of voice.
- larynx** (LAIR-inks) the voice box (which contains the vocal cords) and is located between the base of the tongue and the top of the windpipe.
- laser surgery** uses a very narrow and intense beam of light that can destroy body tissue.
- latent** dormant illnesses that may or may not show the signs and symptoms of active diseases.
- latex** (LAY-tex) a substance made from a rubber tree and is used in such things as medical equipment (especially gloves), toys, and other household products.
- learning disability** a disorder in the basic mental processes used for language or math. The disorder occurs in people of normal or above-normal intelligence. It is not the result of an emotional disturbance or of an impairment in sight or hearing.
- lesion** (LEE-zhun) a general term referring to a sore or a damaged or irregular area of tissue.
- leukemia** (loo-KEE-me-uh) a form of cancer characterized by the body's uncontrolled production of abnormal white blood cells.
- leukocytes** (LOO-ko-sites) white blood cells sent by the body's immune system to fight infection.
- ligaments** (LIG-a-ments) bands of fibrous tissue that connect bones or cartilage, supporting and strengthening the joints. Ligaments in the mouth hold the roots of teeth in the tooth sockets.
- listeriosis** (lis-teer-e-O-sis) a bacterial infection that can cause a form of meningitis in infants and other symptoms in children and adults.
- liver** a large organ located beneath the ribs on the right side of the body. The liver performs numerous digestive and chemical functions essential for health.
- local anesthesia** (an-es-THÉE-zha) using medicine to block or numb pain in one part of the body while the patient remains awake. General anesthesia blocks pain over the entire body while the patient sleeps.

- low birth weight** born weighing less than normal. In humans, it refers to a full-term (pregnancy lasting 37 weeks or longer) baby weighing less than 5 pounds.
- LSD** short for lysergic acid diethylamide (ly-SER-jik A-sid dy-e-thel-AM-eyed), a hallucinogen, a drug that distorts a person's view of reality and causes hallucinations.
- lupus** (LOO-pus) a chronic, or long-lasting, disease that causes inflammation of connective tissue, the material that holds together the various structures of the body.
- Lyme disease** (LIME) a bacterial infection that is spread to humans by the bite of an infected tick. It begins with a distinctive rash and/or flulike symptoms and, in some cases, can progress to a more serious disease with complications affecting other body organs.
- lymph node** (LIMF) a small, bean-shaped mass of tissue containing immune system cells that fight harmful microorganisms. The lymph node may swell during infections.
- lymphadenitis** (lim-fah-den-EYE-tis) inflammation of the lymph nodes and channels of the lymphatic system.
- lymphangitis** (lim-fan-JIE-tis) inflammation of the lymphatic system, the system that carries lymph through the body. Lymph is a clear fluid that contains white blood cells.
- lymphatic system** (lim-FAH-tik) the system that contains lymph nodes and a network of channels that carry fluid and cells of the immune system through the body.
- lymphatic tissue** the tissue where white blood cells fight invading germs.
- lymphocytes** (LIM-fo-sites) white blood cells, which play a part in the body's immune system, particularly the production of antibodies and other substances to fight infection.
- lymphoma** (lim-FO-muh) a cancerous tumor of the lymphocytes, cells that normally help the body fight infection.
- macrocephaly** (ma-kro-SEH-fah-lee) having an abnormally large head.
- magnetic resonance imaging** (or MRI) uses magnetic waves, instead of x-rays, to scan the body and produce detailed pictures of the body's structures.
- malaria** (mah-LAIR-e-uh) a disease spread to humans by the bite of an infected mosquito.
- malformation** (mal-for-MAY-shun) an abnormal formation of a body part.
- malignant** (ma-LIG-nant) a condition that is severe and progressively worsening.
- malinger** (ma-LING-er-ing) intentionally pretending to be sick or injured to avoid work or responsibility.
- mammals** warm-blooded animals with backbones, who usually have fur or hair. Female mammals secrete milk from mammary glands to feed their young. Humans are mammals.
- mammography** (mam-MOG-ra-fee) an x-ray examination of the breasts. A mammogram is used in the diagnosis of breast cancer. It may show changes that indicate a possibility of cancer, and medical professionals will then run other tests to check for other signs of the disease.
- mapping** locates the positions of all the genes on a chromosome.
- marijuana** (mar-a-WA-na) a mixture of dried, shredded flowers and leaves from the hemp plant that a person can smoke or eat to get high.
- marrow** (MAR-o) the soft tissue that fills the cavities of the bones.
- mastectomy** (mas-TEK-to-mee) the surgical removal of the breast.

- mastoiditis** (mas-toy-DYE-tis) an infection of the mastoid bone, located behind the ear.
- measles** (ME-zuls) a viral respiratory infection that is best known for the rash of large, flat, red blotches that appear on the arms, face, neck, and body.
- meiosis** (my-OH-sis) the process of reduction division in which the number of chromosomes per cell is cut in half.
- membrane** (MEM-brain) a thin layer of tissue that covers a surface, lines a cavity, or divides a space or organ.
- meninges** (meh-NIN-jeez) the membranes that enclose and protect the brain and the spinal cord.
- meningitis** (meh-nin-JY-tis) an inflammation of the meninges, the membranes that surround the brain and the spinal cord. Meningitis is most often caused by infection with a virus or a bacterium.
- menopause** (MEN-o-pawz) the end of menstruation.
- mesothelium** (me-zo-THÉE-le-um) epithelium derived from embryonic mesoderm that lines the body cavities.
- menstrual** (MEN-stroo-al) refers to menstruation (men-stroo-AY-shun).
- menstrual cycle** (MEN-stroo-al SYkul) culminates in menstruation (men-stroo-AY-shun), the discharging through the vagina of blood, secretions, and tissue debris from the uterus that recurs at approximately monthly intervals in females of reproductive age.
- menstrual period** (MEN-stroo-al PE-re-od) the discharging through the vagina (va-JY-na) of blood, secretions, and tissue debris from the uterus (YOO-ter-us) that recurs at approximately monthly intervals in females of breeding age.
- menstruation** (men-stroo-AY-shun) is the discharge of the blood-enriched lining of the uterus. Menstruation normally occurs in females who are physically mature enough to bear children. Most girls have their first period between the age of 9 and 16. Menstruation ceases during pregnancy and with the onset of menopause. Because it usually occurs at about four-week intervals, it is often called the monthly period.
- mental health counseling** involves talking about feelings with a trained professional. The counselor can help the person change thoughts, actions, or relationships that play a part in the illness. Also known as psychotherapy.
- mental retardation** a condition in which people have below average intelligence that limits their ability to function normally. Also known as intellectual disability.
- metabolic** (meh-tuh-BALL-ik) the process in the body (metabolism) that converts food into energy and waste products.
- metabolism** (meh-TAB-o-liz-um) the process in the body that converts foods into the energy necessary for body functions.
- metastases** (me-TAS-ta-seez) tumors formed when cancer cells from a tumor spread to other parts of the body.
- microbes** (MY-krobes) microscopic living organisms, such as bacteria, viruses and fungi.
- microcephaly** (my-kro-SEH-fah-lee) the condition of having an abnormally small head, which typically results from having an underdeveloped or malformed brain.
- microorganism** a tiny organism that can be seen only by using a microscope. Types of microorganisms include fungi, bacteria, and viruses.
- miscarriage** (MIS-kare-ij) the end of a pregnancy through the death of the embryo or fetus before birth.

- mittelschmerz** (MITT-el-shmairts) cramping pain that some women experience at the midpoint in their menstrual cycle when one of their ovaries releases an egg.
- mononucleosis** (mah-no-nu-klee-O-sis) an infectious illness caused by a virus with symptoms that typically include fever, sore throat, swollen glands, and tiredness.
- monozygotic** (mah-no-zye-GOT-ik) derived from a single fertilized egg.
- mood disorder** a mental disorder that involves a disturbance in the person's internal emotional state. Depressive disorders, bipolar disorders, and mood disorders are associated with the use of drugs or medical illnesses.
- morbidly obese** weighing two or more times a person's ideal body weight.
- morphine** (MOR-feen) a narcotic, an addictive painkiller that produces a high.
- motor skills** muscular movements or actions.
- MRI** (short for magnetic resonance imaging) produces computerized images of internal body tissues based on the magnetic properties of atoms within the body.
- mucosa** (mu-KOH-sa) the moist tissue that lines some organs and body cavities. It makes mucus, a thick, slippery fluid.
- mucous membranes** the thin layers of tissue found inside the nose, ears, cervix (SER-viks) and uterus, stomach, colon and rectum, on the vocal cords, and in other parts of the body.
- mucus** (MYOO-kus) a thick, slippery substance that lines the insides of many body parts.
- multiple personality disorder** (MUL-ti-pul per-so-NAL-i-tee dis-OR-der) a mental disorder in which a person displays two or more distinct identities that take control of behavior in turn. Also known as dissociative identity disorder.
- multiple sclerosis** (skluh-RO-sis) (or MS) an inflammatory disease of the nervous system that disrupts communication between the brain and other parts of the body. MS can result in paralysis, loss of vision, and other symptoms.
- mumps** a contagious viral infection that causes inflammation and swelling in the glands of the mouth that produce saliva.
- Munchausen syndrome** (MOON-chowzen SIN-drome) a mental disorder in which a person pretends to have symptoms or causes symptoms of a disease in order to be hospitalized or receive tests, medication, or surgery.
- muscular dystrophy** (DIS-tro-fee) a group of inherited disorders that causes muscle weakening that worsens over time.
- mutation** (myoo-TAY-shun) is a change in an organism's gene or genes.
- mycobacteria** (my-ko-bak-TEER-e-uh) a family of bacteria called fungus bacteria because they are found in wet environments.
- myocarditis** (my-oh-kar-DYE-tis) an inflammation of the muscular walls of the heart.
- myositis** (my-oh-SY-tis) an inflammation of the muscles.
- nasal** (NA-zal) of or relating to the nose.
- nasopharyngeal** (nay-zo-fair-in-JEE-ul) the nose and pharynx (FAIR-inks), or throat.
- nausea** (NAW-zha) a feeling of being sick to one's stomach or needing to vomit.
- neonatal** (ne-o-NAY-tal) pertaining to the first 4 weeks after birth.
- nervous system** a network of specialized tissue made of nerve cells, or neurons, that processes messages to and from different parts of the human body.
- neuritis** (nuh-RYE-tis) an inflammation of the nerves that disrupts their function.

- neurocutaneous** (nur-o-kyoo-TAY-nee-us) affecting the skin and nerves.
- neurologic exam** a battery of systematic tests to determine how well various parts of the nervous system are functioning.
- neurological** (nur-a-LAH-je-kal) referring to the nervous system, which includes the brain, spinal cord, and the nerves that control the senses, movement, and organ functions throughout the body.
- neurologist** (new-RHAL-eh-jist) a physician who specializes in diagnosing and treating diseases of the nervous system.
- neurons** nerve cells. Most neurons have extensions called axons and dendrites through which they send and receive signals from other neurons.
- neuroscientists** scientists who study the nerves and nervous system, especially their relationship to learning and behavior.
- neurotransmitter** (NUR-o-tranz-mit-er) a chemical substance that transmits nerve impulses, or messages, throughout the brain and nervous system and is involved in the control of thought, movement, and other body functions.
- night terrors** occur during deep (stage 4) sleep, usually within an hour after a person goes to bed. People experiencing night terrors may sit up in bed, scream, cry, sweat, and appear to be extremely frightened, but they are still asleep and are unaware of their environment. Night terrors most commonly affect young children, although anyone can experience them.
- nipah virus** a virus that infects pigs and humans, and in people it can cause a sometimes fatal form of viral encephalitis. The transmission is not understood, but it may be transmitted from pigs to humans by infected mosquitoes.
- nitrates** (NYE-trayts) chemical substances that can be produced by the breakdown of proteins by certain bacteria.
- norepinephrine** (NOR-e-pi-ne-frin) a body chemical that can increase the arousal response, heart rate, and blood pressure.
- nucleic acids** the cell structures that transfer genetic information DNA (deoxyribonucleic acid) transfers information to RNA (ribonucleic acid), which leads to the production of body proteins.
- nucleus** the part of the cell that contains its genetic information.
- nutrients** the components of food (protein, carbohydrate, fat, vitamins, and minerals) needed for growth and maintenance of the body.
- obesity** (o-BEE-si-tee) an excess of body fat. People are considered obese if they weigh more than 30 percent above what is healthy for their height.
- obsessions** (ob-SESH-unz) repeated disturbing thoughts or urges that a person cannot ignore and that will not go away.
- obsessive-compulsive disorder** a condition that causes people to become trapped in a pattern of repeated, unwanted thoughts, called obsessions (ob-SESH-unz), and a pattern of repetitive behaviors, called compulsions (kom-PUL-shunz).
- oncotic pressure** the pressure difference of blood plasma and tissue fluid.
- ophthalmologic** (off-thal-MOLL-o-jik) related to the function, structure, and diseases of the eye.
- ophthalmologist** (off-thal-MOLL-o-jist) a medical doctor who specializes in treating diseases of the eye.
- opiates** (O-pea-atz) painkilling chemicals that can cause sleepiness and loss of sensation.
- opportunistic infections** infections caused by infectious agents that usually do not produce

disease in people with healthy immune systems but can cause widespread and severe illness in patients with weak or faulty immune systems.

oppositional (op-po-ZI-shun-al) an attitude of going against something or refusing in a combative way.

oppositional defiant disorder (op-uh-ZIH-shun-ul de-FY-unt dis-OR-der) a disruptive behavior disorder that can be diagnosed in children as young as preschoolers who demonstrate hostile or aggressive behavior and who refuse to follow rules.

optic nerve the nerve that sends messages, or conducts impulses, from the eyes to the brain, making it possible to see. The optic nerve is also referred to as the second cranial nerve.

optometrist a licensed specialist who practices optometry, a healthcare profession that specializes in eye examinations and prescribing corrective lenses.

oral by mouth or referring to the mouth.

orthotic a support or brace for weak or ineffective joints or muscles.

osteoarthritis (os-tee-o-ar-THRY-tis) a common disease that involves inflammation and pain in the joints (places where bones meet), especially those in the knees, hips, and lower back of older people.

osteomyelitis (ah-stee-o-my-uh-LYE-tis) a bone infection that is usually caused by bacteria. It can involve any bone in the body, but it most commonly affects the long bones in the arms and legs.

osteoporosis (os-te-o-por-O-sis) the loss of material from the bone. This makes the bones weak and brittle.

outpatient 1) a medical procedure that is conducted in a doctor's office or hospital for treatment but does not require an overnight stay in

a hospital bed; 2) the patient who is treated in a doctor's office or hospital but does not stay overnight in a hospital bed.

ovaries (O-vuh-reez) the sexual glands from which ova, or eggs, are released in women.

ovulation (ov-yoo-LAY-shun) the release of a mature egg from the ovary.

oxygen (OK-si-jen) an odorless, colorless gas essential for the human body. It is taken in through the lungs and delivered to the body by the bloodstream.

pacemaker a device whose function is to send electrical signals that control the heartbeat. The heart's natural pacemaker is the sinoatrial node, a special group of cells. Sometimes it is necessary to implant a battery-powered pacemaker that sends small electrical charges through an electrode placed next to the wall of the heart.

palate (PAL-it) the structure at the roof of the mouth. Damage or poor functioning of the palate can affect swallowing, the voice, and breathing.

palliative (PAL-ee-at-iv) to ease or relieve without curing.

palpitation the sensation of a rapid or irregular heartbeat.

pancreas (PAN-kree-us) the gland located behind the stomach that produces enzymes and hormones necessary for digestion and metabolism.

pandemic (pan-DEHM-ik) a worldwide outbreak of disease, especially infectious disease, in which the number of cases suddenly becomes far greater than usual.

panic attack a period of intense fear or discomfort with a feeling of doom and a desire to escape. The person may shake, sweat, be short of breath, and experience chest pain.

- Pap smear** a common diagnostic test used to look for cancerous cells in the tissue of the cervix.
- parainfluenza** (pair-uh-in-floo-EN-zuh) a family of viruses that cause respiratory infections.
- paralysis** (pah-RAHL-uh-sis) the loss or impairment of the ability to move some part of the body.
- paranoia** (pair-a-NOY-a) either an unreasonable fear of harm by others (delusions of persecution) or an unrealistic sense of self-importance (delusions of grandeur).
- paranoid** (PARE-a-noyd) behavior that is based on delusions of persecution or grandeur. People with persecution delusions falsely believe that other people are out to get them. People with delusions of grandeur falsely believe that they have great importance, power, wealth, intelligence, or ability.
- parasite** (PAIR-uh-site) an organism such as protozoa (one-celled animals), worms, or insects that must live on or inside a human or other organism to survive. An animal or plant harboring a parasite is called its host. Parasites live at the expense of the host and may cause illness. The adjectival form is parasitic.
- Parkinson's disease** a disorder of the nervous system that causes shaking, rigid muscles, slow movements, and poor balance.
- parkinsonism** a neurological condition with various causes with symptoms similar to those seen in Parkinson's disease.
- parotid gland** (puh-RAH-tid) the salivary gland located in the jaw just beneath and in front of each ear.
- pasteurize** (PAS-cha-rise) to sterilize a substance, generally a liquid such as milk, by bringing it to high temperature and keeping it at that temperature long enough to destroy unhealthy organisms in it without changing its other characteristics.
- pathogens** (PAH-tho-jens) microorganisms that can cause disease in another living organism.
- PCP** short for phencyclidine (fen-SY-kle-deen), a hallucinogen, a drug that distorts a person's view of reality.
- pelvic exam** an internal examination of a woman's reproductive organs.
- pelvic inflammatory disease** an infection of a woman's internal reproductive organs, including the fallopian tubes, uterus, cervix, and ovaries.
- penile** (PEE-nile) refers to the penis, the external male sexual organ.
- perianal** (pair-e-A-nul) the area of skin surrounding the anus.
- pericarditis** (per-ih-kar-DYE-tis) an inflammation of the sac surrounding the heart.
- perinatal** (per-ee-NAY-tal) existing or occurring around the time of birth, with reference to the fetus.
- period** the monthly flow, or discharge, of the blood-enriched lining of the uterus that normally occurs in women who are physically mature enough to bear children. Most girls have their first period between the ages of 9 and 16. Because it usually occurs at four-week intervals, it is often called the monthly period. Also called menstruation (men-stroo-AY-shun).
- periodontal** (pare-e-o-DON-tul) located around a tooth.
- peripheral nerves** (puh-RIH-fer-ul) a network of nerve fibers throughout the body that send and receive messages to and from the central nervous system (the brain and spinal cord).
- perishable** able to spoil or decay, as in perishable foods.

- peritoneum** the membrane that lines the abdominal cavity.
- peritonitis** (per-i-to-NI-tis) an inflammation of the peritoneum.
- personality disorders** a group of mental disorders characterized by long-term patterns of behavior that differ from those expected by society. People with personality disorders have patterns of emotional response, impulse control, and perception that differ from those of most people.
- pertussis** (per-TUH-sis) a bacterial infection of the respiratory tract that causes severe coughing. Also called whooping cough.
- pet dander** microscopic parts of the pet's skin that flake off and get into the air people breathe.
- pharyngitis** (far-in-JI-tis) inflammation of the pharynx, part of the throat.
- phenylketonuria** (fen-ul-ke-ton-U-ree-a) (or PKU) a genetic disorder of body chemistry that, if left untreated, causes mental retardation.
- phlebitis** (fle-BY-tis) inflammation of a vein.
- phobia** an intense, persistent, unreasonable fear of (and avoidance of) a particular thing or situation.
- phonemes** (FO-neemz) the smallest units of spoken language, such as the puh' sound at the start of the word pat.
- photosensitive** responsive to light.
- physical and occupational therapists** professionals who are trained to treat injured people by means of activities designed to help them recover or relearn specific functions or movements and restore their abilities to perform the tasks of daily living.
- physiologic** (fiz-ee-o-LOJ-ik) an organism's healthy and normal functioning.
- pigment** (PIG-ment) a substance that imparts color to another substance.
- pituitary** (pih-TOO-ih-tare-e) a small oval-shaped gland at the base of the skull that produces several hormones—substances that affect various body functions, including growth.
- placenta** (pluh-SEN-ta) an organ that provides nutrients and oxygen to a developing baby; it is located within the womb during pregnancy.
- plague** (PLAYG) a serious bacterial infection that is spread to humans by infected rodents and their fleas.
- plaque** (PLAK) a raised patch or swelling on a body surface. Arterial plaque occurs on the inner surface of an artery and is produced by fatty deposits.
- plastic surgery** the surgical repair, restoration, or improvement in the shape and appearance of body parts.
- platelets** (PLATE-lets) tiny disk-shaped particles within the blood that play an important role in clotting.
- pneumonia** (nu-MO-nyah) inflammation of the lungs.
- podiatrist** (po-DIE-uh-trist) a specialist in the medical care of the foot, ankle, and lower leg.
- poliomyelitis** (po-lee-o-my-uh-LYE-tis) a condition caused by the polio virus that involves damage of nerve cells. It may lead to weakness and deterioration of the muscles and sometimes paralysis.
- polyps** (PAH-lips) bumps or growths usually on the lining or surface of a body part (such as the nose or intestine). Their size can range from tiny to large enough to cause pain or obstruction. They may be harmless, but they also may be cancerous.
- pornography** (por-NAH-gra-fee) any material, such as magazines or videos, that shows sexual behavior and is meant to cause sexual excitement.

- positron emission tomography** (POZ-i-tron i-MISH-en toe-MAH-gruh-fee) uses a radiotracer that accumulates in an area of the body and emits gamma rays that are detected as diagnostic images. Also called PET imaging or PET scanning.
- post-traumatic stress disorder** (post-traw-MAT-ik STRES dis-OR-der) a mental disorder that interferes with everyday living and occurs in people who survive a terrifying event, such as school violence, military combat, or a natural disaster.
- pre-malignant** a disease or condition considered highly associated with future cancer.
- premature birth** (pre-ma-CHUR) born too early. In humans, it means being born after a pregnancy term lasting less than 37 weeks.
- premature labor** labor (the birth process) that begins too early, before the fetus has developed fully in the womb.
- prenatal** (pre-NAY-tal) existing or occurring before birth, with reference to the fetus.
- prevalence** (of a disease or condition) how common it is in a population of people.
- progesterone** (pro-JES-teh-ron) a female steroid sex hormone that prepares for and supports pregnancy.
- pronation** the rotation of the foot inward and downward so that, in walking, the foot comes down on its inner edge.
- prophylactic** (pro-fih-LAK-tik) something that is used to prevent an illness or other condition, such as an infection or pregnancy.
- prophylaxis** (pro-fih-LAK-sis) taking specific measures, such as using medication or a device (such as a condom), to help prevent infection, illness, or pregnancy.
- prostate** (PRAH-state) a male reproductive gland located near where the bladder joins the urethra. The prostate produces the fluid part of semen.
- prosthesis** (pros-THEE-sis) an artificial substitute for a missing body part. It can be used for appearance only or to replace the function of the missing part (as with a prosthetic leg).
- protooncogene** (pro-toe-AN-keh-gene) a gene that is used to divide normal cells for specialized uses.
- protozoa** (pro-tuh-ZOH-uh) single-celled microorganisms (tiny organisms), some of which are capable of causing disease in humans.
- psychiatrist** (sy-KY-uh-trist) a medical doctor who has completed specialized training in the diagnosis and treatment of mental illness. Psychiatrists can diagnose mental illnesses, provide mental health counseling, and prescribe medications.
- psychoactive** (sy-ko-AK-tiv) affecting a person's mood, behavior, perceptions, or consciousness.
- psychoanalysis** (sy-ko-a-NAL-i-sis) a method of treating a person with psychological problems, based on the theories of Sigmund Freud. It involves sessions in which a therapist encourages a person to talk freely about personal experiences, and the psychoanalyst interprets the patient's ideas and dreams.
- psychogenic** (SIGH-ko-JEN-ik) originating in the mind as a result of emotional conflict.
- psychological** (SI-ko-LOJ-i-kal) mental processes, including thoughts, feelings, and emotions.
- psychologist** (sy-KOL-o-jist) a mental health professional who treats mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth. Psychologists also study the brain, behavior, emotions, and learning.
- psychosis** (sy-KO-sis) a mental disorder in which the sense of reality is so impaired that a patient can not function normally. People with psychotic disorders may experience delusions

(exaggerated beliefs that are contrary to fact), hallucinations (something that a person perceives as real but that is not actually caused by an outside event), incoherent speech, and agitated behavior, but they usually are not aware of their altered mental state.

psychotherapist (sy-ko-THER-a-pist) any mental health professional who works with people to help them change thoughts, actions, or relationships that play a part in their emotional or behavioral problems.

psychotherapy (sy-ko-THER-a-pea) the treatment of mental and behavioral disorders by support and insight to encourage healthy behavior patterns and personality growth.

psychotic disorders (sy-KOT-ik) mental disorders, such as schizophrenia, in which the sense of reality is so impaired that a person can not function normally. People with psychotic disorders may experience delusions, hallucinations, incoherent speech, and agitated behavior, but they usually are not aware of their altered mental state.

puberty (PU-ber-tee) the period during which sexual maturity is attained.

pulmonary refers to the lungs.

pulmonary embolism a blockage of the pulmonary artery or one of its branches that is frequently caused by thrombosis, or formation of a blood clot, in the lower extremities.

pulp the sensitive area deep inside the central part of the tooth, where the nerves and blood vessels are located.

pus a thick, creamy fluid, usually yellow or ivory in color, that forms at the site of an infection. Pus contains infection-fighting white cells and other substances.

quarantine the enforced isolation (for a fixed period) of apparently well persons or animals

who may have been exposed to infectious disease.

rabies (RAY-beez) a viral infection of the central nervous system that usually is transmitted to humans by the bite of an infected animal.

radiation energy that is transmitted in the form of rays, waves, or particles. Only high-energy radiation, such as that found in x-rays and the sun's ultraviolet rays, has been proven to cause human cancer.

radiation therapy a treatment that uses high-energy radiation from x-rays and other sources to kill cancer cells and shrink cancerous growths.

radiculitis (ruh-dih-kyoo-LYE-tis) numbness, tingling, or burning sensation along the course of a nerve due to irritation or inflammation of the nerve.

radionuclide scans (ray-dee-o-NU-klide) tests that begin by giving a patient a small amount of a radioactive substance. The radioactive substance shows up on a scan, producing a view of the structure or function of the part of the body being studied.

radiotracer a substance that contains radioactive material.

rape when a person forces another person to have sexual intercourse, or engage in other unwanted sexual activities.

Raynaud's disease (ray-NOZE) a condition in which discoloration of the skin typically on the fingers and/or toes occurs when individuals experience changes in temperature or emotional events. An abnormal spasm of blood vessels causes the reduced supply of blood to the affected areas of the body.

reaction speed the time it takes to respond to a stimulus.

reaction time the time it takes a muscle or some other living tissue to respond to a stimulus.

- receptors** cell structures that form a chemical bond with specific substances, such as neurotransmitters. This leads to a specific effect.
- recessive** a gene that is not dominant, one that requires a second identical recessive gene in order for the trait to show in the individual. When a recessive gene is paired with a dominant one, the individual is said to be a carrier of the trait.
- rectum** the final portion of the large intestine, connecting the colon to the outside opening of the anus.
- rehabilitative therapy** helps people return to more normal physical, mental, or emotional function following an illness or injury. Rehabilitative therapy also helps people find ways to better cope with conditions that interfere with their lives.
- relaxation techniques** exercises such as meditation that help people reduce the physical symptoms of stress.
- remission** an easing of a disease or its symptoms for a prolonged period.
- replicate** (REP-li-kate) to create an identical copy.
- respirator** a machine that helps people breathe when they are unable to breathe adequately on their own.
- respiratory** (RES-pi-ra-tor-ee) the breathing passages and lungs.
- respiratory failure** a condition in which breathing and oxygen delivery to the body are dangerously altered. This may result from infection, nerve or muscle damage, poisoning, or other causes.
- respiratory syncytial virus** (RES-puh-ruh-tor-e sin-SIH-she-ul) (or RSV) a virus that infects the respiratory tract and typically causes minor symptoms in adults but can lead to more serious respiratory illnesses in children.
- respiratory system** includes the nose, mouth, throat, and lungs. It is the pathway through which air and gases are transported down into the lungs and back out of the body. Also called the respiratory tract.
- retina** (RET-i-na) the tissue that forms the inner surface of the back of the eyeballs; it receives the light that enters the eye and transmits it through the optic nerves to the brain to produce visual images.
- retinitis** (reh-tin-EYE-tis) an inflammation of the retina, the nerve-rich membrane at the back of the eye on which visual images form.
- retrovirus** viruses whose genetic information is found in ribonucleic acid (RNA), a nucleic acid that is found in all living cells.
- Reye's syndrome** (RYES SIN-drome) a rare condition that involves inflammation of the liver and brain, and sometimes appears after illnesses such as chicken pox or influenza. It has also been associated with taking aspirin during certain viral infections.
- rheumatic fever** (roo-MAH-tik) a condition associated with fever, joint pain, and inflammation affecting many parts of the body, including the heart. It occurs following infection with certain types of strep bacteria.
- rheumatoid arthritis** (ROO-mah-toyd ar-THRY-tis) a chronic disease characterized by painful swelling, stiffness, and deformity of the joints.
- rheumatologist** (roo-ma-TOL-o-jist) a doctor who specializes in disorders involving the connective tissue structures of the body.
- rickets** (RICK-kets) a condition of bones that causes them to soften and bend creating deformity. In the early twentieth century, rickets was caused by lack of sunlight, and the lack of vitamin D, calcium, and phosphorus. As enriched foods and improved diets became

more widespread, rickets practically disappeared in industrialized countries.

ringworm a fungal infection of the skin or scalp that appears as a round, red rash.

risk factor any factor that increases the chance of developing a disease.

RNA or ribonucleic acid (ry-bo-nyoo-KLAY-ik AH-sid), the chemical substance through which DNA sends genetic information to build new cells.

root canal a procedure in which a dentist cleans out the pulp of an infected tooth, removes the nerve, and then fills the cavity with a protective substance.

roundworm one of several types of cylinder-shaped worms that live in people. Roundworms are also known as nematodes (NEE-muh-todes).

rubella (roo-BEH-luh) a viral infection that usually causes a rash and mild fever.

salivary glands (SAL-i-var-ee) the three pairs of glands that produce the liquid called saliva, which aids in the digestion of food.

sarcoma (sar-COHM-ah) one of a group of tumors that occur in connective tissue and are mostly malignant.

scarlet fever an infection that causes a sore throat and a rash.

schizophrenia (skit-so-FREE-nee-ah) a serious mental disorder that causes people to experience hallucinations, delusions, and other confusing thoughts and behaviors, which distort their view of reality.

sciatica (sy-AT-i-ka) pain along the course of either of the sciatic (sy-AT-ik) nerves, which run through the pelvis and down the backs of the thighs.

scrapie (SKRAY-pee) a fatal brain disorder of sheep that is characterized by itching of the skin and difficulty walking.

scrotum (SKRO-tum) the pouch on a male body that contains the testicles.

secondhand smoke smoke that is inhaled passively or involuntarily by someone who is not smoking. It is a mixture of gases and particles from a burning cigarette, cigar, or pipe and the smoke exhaled by smokers. Also called environmental tobacco smoke or passive smoke.

sedatives (SAID-uh-tivs) drugs that produce a calming effect or sleepiness.

seizures (SEE-zhurs) sudden bursts of disorganized electrical activity that interrupt the normal functioning of the brain, often leading to uncontrolled movements in the body and sometimes a temporary change in consciousness. Also called convulsions.

self-esteem the value that people put on the mental image that they have of themselves.

semen (SEE-men) the sperm-containing whitish fluid produced by the male reproductive tract.

separation anxiety the normal fear that babies and young children feel when they are separated from their parents or approached by strangers.

sepsis a potentially serious spreading of infection, usually bacterial, through the bloodstream and body.

septic shock shock due to overwhelming infection and is characterized by decreased blood pressure, internal bleeding, heart failure, and, in some cases, death.

septicemia (sep-ti-SE-me-a) a bacterial infection in the blood that spreads throughout the body, with potentially fatal results.

serotonin (ser-o-TO-nin) a neurotransmitter, a substance that helps transmit information from one nerve cell to another in the brain. It is associated with feelings of well-being.

- sex-linked** genetic traits involve the chromosomes that determine whether a person is male or female. They usually affect boys, who have only one X chromosome.
- sexually transmitted disease** (STD) an infection, such as the human immunodeficiency virus (HIV) or herpes, that can be passed from person to person by sexual contact.
- shin splint** an inflammation in the front part of the tibia (the big bone below the knee), due to overuse, as in running too much on hard surfaces.
- shock** a serious condition in which blood pressure is very low and not enough blood flows to the body's organs and tissues. Untreated, shock may result in death.
- sickle-cell anemia** a hereditary condition in which the red blood cells, which are usually round, take on an abnormal crescent shape and have a decreased ability to carry oxygen throughout the body. Also called sickle-cell disease.
- side effects** unwanted symptoms that may be caused by vaccines or medications.
- sinuses** (SY-nuh-ses) hollow, air-filled cavities in the facial bones.
- sinusitis** (sy-nyoo-SY-tis) an infection in the sinuses.
- small intestine** the part of the intestines—the system of muscular tubes that food passes through during digestion—that directly receives the food when it passes through the stomach.
- sonogram** (SON-o-gram) an image or record made on a computer using sound waves passing through the body.
- spasms** (SPAH-zumz) involuntary muscular tightenings or contractions.
- speech therapist** a health professional who assesses and treats voice, speech, and language disorders.
- speech-language pathologist** (pa-THAH-lo-jist) a professional who is specially trained to test and treat people with speech, language, and voice disorders.
- sperm** the tiny, tadpole-like cells males produce in their testicles. Sperm can unite with a female's egg to result eventually in conception.
- spina bifida** (SPY-nuh BIF-ih-duh) a condition present at birth in which the spinal column is imperfectly closed, leaving part of the spinal cord exposed and often leading to neurological and other problems.
- spinal stenosis** (SPY-nal ste-NO-sis) the narrowing of the spinal canal.
- spinal tap** a medical procedure in which a needle is used to withdraw a sample of the fluid surrounding the spinal cord and brain. The fluid is then tested, usually to detect signs of infection, such as meningitis, or other diseases. Also called a lumbar puncture.
- spleen** an organ in the upper left part of the abdomen that stores and filters blood. As part of the immune system, the spleen also plays a role in fighting infection.
- spondylolisthesis** (spon-di-lo-lis-THEE-sis) a condition in which one vertebra slips over the other.
- spore** a temporarily inactive form of a germ enclosed in a protective shell.
- sputum** (SPYOO-tum) a substance that contains mucus and other matter coughed out from the lungs, bronchi, and trachea.
- St. John's wort** the common name for hypericum, an herb that is being studied as a possible treatment for depression.
- stem cell** an unspecialized cell that gives rise to differentiated cells.
- sterilize** (STAIR-uh-lyze) to eliminate all live bacteria or microorganisms from something,

usually through the use of heat, pressure, chemicals, or other antimicrobial agents.

stethoscope (STETH-o-skope) a medical instrument used for listening for sounds produced in the chest, abdomen, and other areas of the body.

stigma a mark of shame.

stillbirth the birth of a dead fetus.

stimulant (STIM-yoo-lunt) a drug that produces a temporary feeling of alertness, energy, and euphoria.

stimulus (STIM-yoo-lus) an agent in the environment that excites a response or reaction. A stimulus might cause a person to function, become active, or respond. The plural form is stimuli.

strabismus a condition that causes the eyes to cross or not work together correctly, which may lead to permanent loss of vision in one eye.

strain 1) a subtype of an organism, such as a virus or bacterium; 2) to injure by overuse, misuse, or excessive pressure.

strep throat a contagious sore throat caused by a strain of bacteria known as *Streptococcus*.

stress test a test to measure the health of a person's heart while the heart is intentionally stressed by exercise or medication.

stretch marks stripes or lines on the skin (such as on the hips, abdomen, and breasts) from excessive stretching and rupture of elastic fibers, especially due to pregnancy or obesity.

stridor (STRY-dor) a high-pitched, squeaking noise that occurs while breathing in, present usually only if there is narrowing or blockage of the upper airway.

stroke a brain-damaging event usually caused by interference with blood flow to the brain. A stroke may occur when a blood vessel supplying

the brain becomes clogged or bursts, depriving brain tissue of oxygen. As a result, nerve cells in the affected area of the brain, and the specific body parts they control, do not properly function.

stupor a state of sluggishness or impaired consciousness.

subacute sclerosing panencephalitis (sub-uh-KYOOT skluh-RO-sing pan-en-seh-fuh-LYE-tis) (SSPE) a chronic brain disease of children and adolescents that occurs months or years after having had measles; it causes convulsions, movement problems, and mental retardation and is usually fatal.

subdural (sub-DOO-ral) under the dura, the covering of the brain.

submucosa (sub-mu-KOH-sa) the layer of tissue under the mucosa.

substance abuse the misuse of alcohol, tobacco, illegal drugs, prescription drugs, and other substances such as paint thinners or aerosol gases that change how the mind and body work.

sudden infant death syndrome (SIDS) the sudden death of an infant less than a year old that is not explained even after an autopsy or examination of the death scene. Most cases occur while the otherwise well baby is asleep on its stomach.

susceptibility (su-sep-ti-BIL-i-tee) having less resistance to and higher risk for infection or disease.

sympathetic nervous system the system of nerves that prepares the body for action by speeding up the heart and breathing rates and raising the blood pressure.

syndrome a group or pattern of symptoms or signs that occur together.

synovial fluid (sih-NO-vee-ul) the fluid produced in the synovium, the inner lining of the flexible capsule that encloses the joint space

between two bones. This fluid lubricates and nourishes the joint.

synovitis (sin-o-VY-tis) inflammation of the membrane surrounding a joint.

synthetic produced artificially or chemically rather than grown naturally.

syphilis (SIH-fih-lis) a sexually transmitted disease that, if untreated, can lead to serious life-long problems throughout the body, including blindness and paralysis.

systemic (sis-TEM-ik) a problem affecting the whole system or whole body, as opposed to a localized problem that affects only one place on the body.

systemic lupus erythematosus (sis-TEM-ik LOO-pus er-i-them-a-TO-sus) (sometimes just called lupus) a chronic inflammatory disease that can affect the skin, joints, kidneys, nervous system, membranes lining body cavities, and other organs.

temperament (TEM-per-uh-ment) the genetically or biologically based part of an individual's personality.

temporal lobe epilepsy a form of epilepsy that affects the part of the brain that is located underneath the sides of the head, near the ears. Epilepsy is a condition of the nervous system characterized by recurrent seizures that temporarily affect a person's awareness, movements, or sensations. Also called complex partial epilepsy.

temporal lobes (TEM-por-al) the side portions of the cortex. They contain the sensory center for hearing and are centers for language function.

tendon (TEN-don) a fibrous cord of connective tissue that attaches a muscle to a bone or other structure.

tertiary (TER-she-air-ee) third stage.

testicles (TES-tih-kulz) the paired male reproductive glands that produce sperm.

tetanus (TET-nus) a serious bacterial infection that affects the body's central nervous system.

thalamus (THAL-uh-mus) a pair of large egg-shaped areas located in the middle of the brain just under the cerebral cortex. The plural form is thalami.

thrombosis the formation or development of a blood clot or thrombus.

thyroid gland (THY-roid GLAND) is located in the lower part of the front of the neck. The thyroid produces hormones that regulate the body's metabolism (me-TAB-o-LIZ-um), the processes the body uses to produce energy, to grow, and to maintain body tissues.

tic a sudden, brain-activated involuntary movement (such as eye blinking or shoulder shrugging) or sound, (words or other sounds, such as sniffing, grunting, throat clearing, or even barking) that is repeated over and over in the same way.

tick a small blood-sucking creature that may transmit disease-causing germs from animals to humans through its bite.

tolerance (TALL-uh-runce) a condition in which a person needs more of a drug to feel the original effects of the drug.

tonsils paired clusters of lymphatic tissue in the throat that help protect the body from bacteria and viruses that enter through a person's nose or mouth.

tourniquet a device, often a bandage twisted tight around an arm or a leg, used to stop blood flow or hemorrhage.

toxin a substance that causes harm to the body.

toxoplasmosis (tox-o-plaz-MO-sis) a parasitic infection that usually causes no symptoms in healthy people, but it can cause serious problems in unborn babies and people with weak immune systems.

- trachea** (TRAY-kee-uh) the firm, tubular structure that carries air from the throat to the lungs. Also called the windpipe.
- tracheostomy** (tray-kee-AHS-tuh-me) a small opening through the neck into the trachea, or windpipe, which has been made to allow air to enter the lungs more directly. The surgical procedure to create a tracheostomy is usually performed when a person's upper airway is narrowed or blocked or when there are other problems causing breathing difficulty.
- transfusion** (trans-FYOO-zhun) a procedure in which blood or certain parts of blood, such as specific cells, is given to a person who needs it due to illness or blood loss.
- transgendered** a person who identifies with and expresses a gender identity that differs from the one which corresponds to the person's sex at birth.
- transient** (TRAN-shent) brief or producing effects for a short period of time.
- transient ischemic attack** (TRAN-shent iss-KEE-mik) a temporary loss of blood supply to a particular area of the brain. Also called a TIA.
- transmissible** (trans-MIH-sih-bul) able to be transferred or spread.
- transplants** (TRANS-plantz) organs or tissues from another body used to replace a poorly functioning organ or tissue.
- trauma** a wound or injury, whether psychological or physical. Psychological trauma refers to an emotional shock that leads to lasting psychological damage.
- traumatic** causing mental or emotional stress or physical injury.
- trichomoniasis** (trih-ko-mo-NYE-uh-sis) a common sexually transmitted disease caused by the parasite *Trichomonas vaginalis*.
- triglycerides** (try-GLISS-eh-rides) a type of fatty substances found in the blood.
- trimester** (tri-MES-ter) any of three periods of approximately 3 months each into which a human pregnancy is divided.
- truancy** staying out of school without permission.
- tubal pregnancy** (TOO-bal) a condition in which a fertilized egg implants in the fallopian tube instead of the wall of the uterus.
- tuberculosis** (too-ber-kyoo-LO-sis) a bacterial infection that primarily attacks the lungs but can spread to other parts of the body.
- tularemia** (too-lah-REE-me-uh) an infection caused by bacteria that can be spread to humans by wild animals. Also called rabbit fever.
- tumor** (TOO-mor) an abnormal growth of body tissue that has no known cause or physiologic purpose. A tumor may or may not be cancerous.
- tumor marker** (TOO-mer MARK-er) a substance found in blood, urine, or body tissues whose level rises when a person has cancer. Tumor markers can be used to detect possible cancer.
- Turner syndrome** a genetic disorder that can cause several physical abnormalities, including short stature and lack of sexual development.
- typhoid fever** (TIE-foyd FEE-ver) an infection with the bacterium *Salmonella typhi* that causes fever, headache, confusion, and muscle aches.
- ulcer** an open sore on the skin or the lining of a hollow body organ, such as the stomach or intestine. It may or may not be painful.
- ulcerate** to become eroded by infection, inflammation, or irritation.
- ulcerative colitis** (UL-sir-ah-tiv ko-LIE-tis) a common form of inflammatory bowel disease that causes inflammation with sore spots or

- breaks in the inner lining of the large intestine (colon). Symptoms include cramping, bleeding from the rectum, and diarrhea.
- ulcerations** open sores on the skin or tissue lining a body part.
- ultrasound** a diagnostic test in which sound waves passing through the body create images on a computer screen. Also called a sonogram.
- ultraviolet** a wavelength of light beyond visible light; on the spectrum of light, it falls between the violet end of visible light and x-rays.
- umbilical cord** (um-BIH-lih-kul) the flexible cord that connects a baby to the placenta, the organ that unites the unborn child to the mother's uterus, the organ in which the baby develops.
- unpasteurized** (un-pas-CHUR-ized) foods that have not undergone the process of pasteurization (pas-chu-rih-ZAY-shun), in which food is heated to a certain temperature over a period of time to kill organisms and help make the food safer to consume.
- ureters** (YOOR-eh-ters) the tube-like structures that carry urine from the kidneys to the bladder.
- urethra** (yoo-REE-thra) the tube through which urine passes from the bladder to the outside of the body.
- urethritis** (yoo-ree-THRY-tis) inflammation of the urethra.
- urinary catheters** thin tubes used to drain urine from the body.
- urinary tract** (YOOR-ih-nair-e TRAKT) the system of organs and channels that makes urine and removes it from the body. It consists of the urethra, bladder, ureters, and kidneys.
- urinary tract infection** (YOOR-ih-nair-e) (UTI) an infection that occurs in any part of the urinary tract.
- urine** the liquid waste material secreted by the kidneys and removed from the body through the urinary tract.
- uterus** (YOO-teh-rus) the muscular, pear-shaped internal organ in a woman where a baby develops until birth.
- vaccination** (vak-sih-NAY-shun) giving, usually by an injection, a preparation of killed or weakened germs, or a part of a germ or product it produces, to prevent or lessen the severity of the disease caused by that germ. Also called immunization.
- vaccine** (vak-SEEN) a preparation of killed or weakened germs, or a part of a germ or product it produces, given to prevent or lessen the severity of the disease that can result if a person is exposed to the germ itself. Use of vaccines for this purpose is called immunization.
- vagina** (vah-JY-nah) the canal, or passageway, in a woman that leads from the uterus to the outside of the body.
- vaginitis** (vah-jih-NYE-tis) inflammation of the vagina.
- vaporizer** a device that converts water (or a liquid medication) into a vapor, a suspension of tiny droplets that hang in the air and can be inhaled.
- varicose vein** (VAR-i-kose VAYN) an abnormally swollen or dilated vein.
- varix, varices, varicose** the Latin words that describe veins, arteries, or lymph vessels that have become stretched or enlarged.
- vascular** refers to veins and arteries (the blood vessels).
- vector** (VEK-tor) an animal or insect that carries a disease-causing organism and transfers it from one host to another.
- vegetative state** a state of extreme mental impairment in which only involuntary bodily functions are sustained.

- vein** a vessel that carries blood to the heart. Veins have greater capacity and thinner walls than arteries and contain valves that prevent blood from flowing backward and away from the heart.
- ventilator** (VEN-tuh-lay-ter) a machine used to support or control a person's breathing.
- ventricle** open cavities within the brain that contain the fluid that cushions and protects the central nervous system.
- vertebrae** (VER-tuh-bray) the bones that form a column surrounding the spinal cord; there are 39 vertebrae in the spine.
- vertigo** (VER-ti-go) the feeling that either the environment or one's own body is revolving or spinning, even though they are not.
- viable** means an organism can survive, grow, develop, and function.
- viral infections** cause mouth sores that are called fever blisters or cold sores. These are often caused by the herpesvirus, and they usually appear on the gums or around the mouth and lips. Unlike canker sores, fever blisters and cold sores are contagious.
- virulent** comes from the Latin word for poisonous, and describes a microbe that is especially well suited to countering the immune system.
- virus** (VY-rus) a tiny infectious agent that can cause infectious diseases. A virus can only reproduce within the cells it infects.
- visual cortex** a portion of the brain's cerebrum that processes visual information transmitted from the eyes.
- vocational** (vo-KAY-shun-al) relating to training in a particular job skill.
- voluntary muscle movements** those physical actions, such as moving a hand or blinking an eyelid, over which an individual has conscious muscle control
- vulva** (VUL-vuh) the organs of the female genitals that are located on the outside of the body.
- warts** small, hard growths on the skin or inner linings of the body that are caused by a type of virus.
- weaning** accustoming a child to take food other than by breastfeeding.
- whiplash injuries** general injuries to the spine and spinal cord at the junction of the fourth and fifth vertebrae (VER-te-bray) in the neck occurring as a result of rapid acceleration or deceleration of the body.
- white matter** a group of nerve fibers insulated with a material known as myelin that affects the speed of nerve impulse transmissions and has a white appearance
- windpipe** (or trachea) the tube that carries air from the throat toward the lungs.
- withdrawal** symptoms that occurs when a drug that causes physical or psychological dependence is regularly used for a long time and then suddenly discontinued or decreased in dosage.
- X chromosome** (X KRO-mo-som) a chromosome is a structure inside the body's cells containing DNA, the genetic material that helps determine characteristics, such as whether a person has brown hair or blue eyes. The X chromosome carries many different genes. Females have two X chromosomes, while males have only one.
- yeast** (YEEST) a general term describing single-celled fungi that reproduce by budding.
- yellow fever** an infectious disease caused by a virus that is transmitted to humans by mosquitoes.

Organizations

The following is an alphabetical compilation of organizations listed in the **Resources** section of the main body entries. Although the list is comprehensive, it is by no means exhaustive and is intended to serve as a starting point for further research. Cengage Learning is not responsible for the accuracy of the addresses or the contents of the web sites.

A

Abramson Cancer Center of the University of Pennsylvania

3400 Spruce Street
Philadelphia, PA, 19104
Web site: <http://www.oncolink.upenn.edu>

ADD Warehouse

200 NW 17th Avenue, Suite 102
Plantation, FL, 33317
Toll free: 800-233-9273
Web site: <http://www.addwarehouse.com>

The ADD Warehouse offers a wide selection of books and other products that deal with ADHD.

ADDvance

100I Spring Street, Suite 118
Silver Spring, MD, 20910
Toll free: 888-238-8588
Web site: <http://www.addvance.com>

Agency for Toxic Substances and Disease Registry

1600 Clifton Road
Atlanta, GA, 30333
Toll free: 800-232-4636
Web site: <http://www.atsdr.cdc.gov>

A part of the Centers for Disease Control and Prevention. Its web site aims to provide trusted health information to prevent harmful exposures and diseases related to toxic substances.

Agensis of the Corpus Callosum/ACC Network

University of Maine,
5749 Merrill Hall, Room 118
Orono, ME, 04469-5749
Telephone: 207-581-3119
Web site: <http://www.umaine.edu/edhd/research/accnetwork.htm>

AIDS Education Global Information Service

32234 Paseo Adelanto, Suite B
San Juan Capistrano, CA, 92675
Telephone: 949-248-5843
Web site: <http://www.aegis.com>

An online AIDS bulletin board is run by a nonprofit foundation.

aids.gov

Web site: <http://www.aids.gov>
Managed by the Department of Health & Human Services, aids.gov provides access to federal HIV/AIDS information through a variety of media channels.

Al-Anon/Alateen

1600 Corporate Landing Parkway
Virginia Beach, VA, 23454-5617
Toll free: 888-4AL-ANON
Web site: <http://www.al-anon.alateen.org>

An international self-help group for family members and friends of people with alcoholism. Alateen is a group especially for teenagers affected by someone else's drinking.

Alcoholics Anonymous

Grand Central Station,
P.O. Box 459
New York, NY, 10163
Telephone: 212-870-3400
Web site: <http://www.aa.org>
A worldwide self-help organization for alcoholics.

Allergy and Asthma Network/Mothers of Asthmatics

2751 Prosperity Avenue, Suite 150
Fairfax, VA, 22031
Toll free: 800-878-4403
Web site: <http://www.aanma.org>

A national nonprofit network of families whose desire is to overcome, not cope with, allergies and asthma.

Alliance for the Prudent Use of Antibiotics

75 Kneeland Street
Boston, MA, 02111-1901
Telephone: 617-636-0966
Web site: <http://www.tufts.edu/med/apua>

The Alliance for the Prudent Use of Antibiotics promotes the appropriate use of and access to antimicrobials and the control of antimicrobial resistance on a worldwide basis.

ALS Society of Canada

265 Yorkland Boulevard, Suite 300
Toronto, ON, M2J 1S5, Canada
Toll free: 800-267-4ALS
Web site: <http://www.als.ca>

Alzheimer's Association

225 N. Michigan Avenue,
17th Floor
Chicago, IL, 60601
Toll free: 800-272-3900
Web site: <http://www.alz.org>

Alzheimer's Disease Education and Referral Center, National Institute on Aging, National Institutes of Health

P.O. Box 8250
Silver Spring, MD, 20907-8250
Toll free: 800-438-4380
Web site: <http://www.alzheimers.org>
A service of the federal government providing research updates and referrals.

American Academy of Allergy, Asthma, and Immunology

555 East Wells Street, Suite 1100
Milwaukee, WI, 53202-3823

Organizations

Telephone: 414-272-6071
Web site: <http://www.aaaai.org>

American Academy of Child and Adolescent Psychiatry
3615 Wisconsin Avenue NW
Washington, DC, 20016-3007
Telephone: 202-966-7300
Web site: <http://www.aacap.org>

American Academy of Dermatology
PO Box 4014
Schaumburg, IL, 60168-4014
Toll free: 866-503-SKIN
Web site: <http://www.aad.org>

American Academy of Family Physicians
P.O. Box 11210
Shawnee Mission, KS, 66207-1210
Toll free: 800-274-2237
Web site: <http://www.aafp.org>
Web site: <http://www.familydoctor.org>
The national association of family doctors that supports a web site for patients (familydoctor.org) providing health information for the entire family.

American Academy of Neurology
1080 Montreal Avenue
St. Paul, MN, 55116
Telephone: 612-695-1940
Web site: <http://www.aan.com>

American Academy of Ophthalmology
P.O. Box 7424
San Francisco, CA, 94120
Telephone: 415-561-8500
Web site: <http://aao.org>

American Academy of Orthopedic Surgeons
6300 North River Road
Rosemont, IL, 60018-4262
Toll free: 800-346-2267
Web site: <http://www.aaos.org>

American Academy of Otolaryngology, Head and Neck Surgery
1650 Diagonal Road
Alexandria, VA, 22314-2857

Telephone: 703-836-4444
Web site: <http://www.entnet.org>

American Academy of Pediatrics
141 Northwest Point Boulevard
Elk Grove Village, IL, 60007-1098
Telephone: 847-434-4000
Web site: <http://www.aap.org>

American Academy of Periodontology
737 N. Michigan Avenue, Suite 800
Chicago, IL, 60611-6660
Telephone: 312-787-5518
Web site: <http://www.perio.org>

American Academy of Psychiatry and the Law
P.O. Box 30, One Regency Drive
Bloomfield, CT, 06002-0030
Toll free: 800-331-1389
Web site: <http://www.aapl.org>
The American Academy of Psychiatry and the Law promotes scientific and educational research in how psychiatry is applied to legal issues (forensic psychiatry).

American Association for Clinical Chemistry
1850 K Street NW, Suite 625
Washington, DC, 20006
Toll free: 800-892-1400
Web site: <http://www.labtestsonline.org>

The American Association for Clinical Chemistry's labtestsonline.org web site explains how specific lab tests are done and what the results mean.

American Association for Pediatric Ophthalmology and Strabismus
P.O. Box 193832

San Francisco, CA, 94119-3832
Telephone: 415-561-8505
Web site: <http://www.aapos.org>
The American Association for Pediatric Ophthalmology and Strabismus provides information on both pediatric and adult strabismus.

American Association of Clinical Endocrinologists
245 Riverside Avenue, Suite 200
Jacksonville, FL, 32202

Telephone: 904-353-7878
Web site: <http://www.aace.com>

American Association of Neurological Surgeons
5550 Meadowbrook Drive
Rolling Meadows, IL, 60008
Web site: <http://www.neurosurgerytoday.org>

American Association of Oral and Maxillofacial Surgeons
9700 W. Bryn Mawr Avenue
Rosemont, IL, 60018-570
Telephone: 847-678-6200
Web site: <http://www.aaoms.org>

Members of the American Association of Oral and Maxillofacial Surgeons care for patients with problem wisdom teeth, facial pain, and misaligned jaws. They treat accident victims suffering facial injuries, place dental implants, care for patients with oral cancer, tumors and cysts of the jaws, and perform facial cosmetic surgery.

American Association of Poison Control Centers
515 King Street, Suite 510
Alexandria, VA, 22314
Telephone: 703-894-1858
Web site: <http://www.aapcc.org>

The American Association of Poison Control Centers consists of poison control centers across the United States. Poison centers are open 24 hours a day, seven days a week to help both ordinary citizens and medical professional to care for people who have been poisoned. All of the centers use the same Poison Help Hotline number: 1-800-222-1222.

American Association of Retired Persons
601 E Street NW
Washington, DC, 20049
Toll free: 888-687-2277
Web site: <http://www.aarp.org>

American Association on Intellectual and Developmental Disabilities
444 North Capitol Street
Northwest, Suite 846

Washington, DC, 20001-1512
Toll free: 800-424-3688
Web site: <http://www.aaid.org>

American Autoimmune Related Diseases Association

22100 Gratiot Avenue
Eastpointe, MI, 48021
Telephone: 586-776-3900
Web site: <http://www.aarda.org>

American Brain Tumor Association

2720 River Road
Des Plaines, IL, 60018
Toll free: 800-886-2282
Web site: <http://www.abta.org>

American Burn Association

625 N. Michigan Avenue,
Suite 2550
Chicago, IL, 60611
Telephone: 312-642-9260
Web site: <http://www.ameriburn.org>

American Cancer Society

1599 Clifton Road NE
Atlanta, GA, 30329-4251
Toll free: 800-ACS-2345
Web site: <http://www.cancer.org>

American Celiac Disease Alliance

2504 Duxbury Place
Alexandria, VA, 22308
Telephone: 703-622-3331
Web site: <http://americaneliac.org>

A non-profit advocacy organization that strives to represent all celiac patients, along with involved physicians, health-care providers, researchers, food manufacturers, and service providers.

American Chronic Pain Association

P.O. Box 850
Rocklin, CA, 95677
Toll free: 800-533-3231
Web site: <http://www.theacpa.org>

American College of Allergy, Asthma, and Immunology

85 West Algonquin Road, Suite 550
Arlington Heights, IL, 60005
Telephone: 847-427-1200
Web site: <http://www.acaa.org>

American College of Cardiology

2400 N Street NW
Washington, DC, 20037
Toll free: 800-253-4636
Web site: <http://www.acc.org>

American College of Foot and Ankle Surgeons

8725 West Higgins Road, Suite 555
Chicago, IL, 60631-2724
Toll free: 800-421-2237
Web site: <http://www.acfas.org>

American College of Gastroenterology

P.O. Box 342260
Bethesda, MD, 20827-2260
Telephone: 301-263-9000
Web site: <http://www.acg.gi.org>

American College of Obstetricians and Gynecologists

409 12th Street SW
P.O. Box 96920
Washington, DC, 20090-6920
Telephone: 202-638-5577
Web site: <http://www.acog.org>

American College of Occupational and Environmental Medicine

55 West Seegers Road
Arlington Heights, IL, 60005
Telephone: 708-228-6850
Web site: <http://www.acoem.org>

American College of Physicians

190 N. Independence Mall West
Philadelphia, PA, 19106
Toll free: 800-523-1546
Web site: <http://www.acponline.org>

American College of Rheumatology

1800 Century Place, Suite 250
Atlanta, GA, 30345-4300
Telephone: 404-633-3777
Web site: <http://www.rheumatology.org>

American College of Sports Medicine

P.O. Box 1440
Indianapolis, IN, 46206-1440
Telephone: 317-637-9200
Web site: <http://www.acsm.org>

American Council for Headache Education

19 Mantua Road
Mt. Royal, NJ, 08061
Telephone: 856-423-0258
Web site: <http://www.achenet.org>

American Council of the Blind

1155 15th Street NW, Suite 1004
Washington, DC, 20005
Toll free: 800-424-8666
Web site: <http://www.acb.org>

American Dental Association

211 East Chicago Avenue
Chicago, IL, 60611-2678
Telephone: 312-440-2500
Web site: <http://www.ada.org>

American Diabetes Association

1701 North Beauregard Street
Alexandria, VA, 22311
Toll free: 800-342-2383
Web site: <http://www.diabetes.org>

American Dietetic Association

216 West Jackson Boulevard,
Suite 800
Chicago, IL, 60606-6995
Toll free: 800-366-1655
Web site: <http://www.eatright.org>

American Foundation for the Blind

11 Penn Plaza, Suite 300
New York, NY, 10001
Telephone: 212-502-7600
Web site: <http://www.afb.org>

American Gastroenterological Association

4930 Del Ray Avenue
Bethesda, MD, 20814
Telephone: 301-654-2055
Web site: <http://www.gastro.org>

American Geriatrics Society

Empire State Building
350 5th Avenue, Suite 801
New York, NY, 10118
Telephone: 212-308-1414
Web site: <http://www.americangeriatrics.org>
Web site: <http://www.healthinaging.org>

Organizations

The American Geriatrics Society web site features information on aging. The Society also has a Foundation for Health in Aging which has its own web site.

American Hair Loss Council

30 South Main Street
Shenandoah, PA, 17076
Web site: <http://www.ahlc.org>

American Headache Society

19 Mantua Road
Mount Royal, NJ, 08061
Telephone: 856-423-0043
Web site: <http://www.americanheadachesociety.org>

American Heart Association

7272 Greenville Avenue
Dallas, TX, 75231-4596
Toll free: 800-AHA-USA1
Web site: <http://www.americanheart.org>

American Hemochromatosis Society

4044 W. Lake Mary Boulevard,
Unit #104, PMB 416
Lake Mary, FL, 32746-2012
Toll free: 888-655-IRON
Web site: <http://www.americanhs.org>

American Insomnia Association

One Westbrook Corporate Center,
Suite 920
Westchester, IL, 60154
Telephone: 708-492-0930
Web site: <http://www.americaninsomniaassociation.org>

American Institute of Stress

124 Park Avenue
Yonkers, NY, 10703
Telephone: 914-963-1200
Web site: <http://www.stress.org>

American Liver Foundation

75 Maiden Lane, Suite 603
New York, NY, 10038
Telephone: 212-668-1000
Web site: <http://www.liverfoundation.org>

American Lung Association

1301 Pennsylvania Ave. NW,
Suite 800
Washington, DC, 20004
Toll free: 800-LUNG-USA
Web site: <http://www.lungusa.org>

American Lyme Disease Foundation

P.O. Box 466
Lyme, CT, 06371
Web site: <http://www.aldf.com>

American Optometric Association

243 N. Lindbergh Boulevard
St. Louis, MO, 63141
Web site: <http://www.aoa.org>

American Osteopathic College of Dermatology

1501 East Illinois Street,
P.O. Box 7525
Kirksville, MO, 63501
Toll free: 800-449-2623
Web site: <http://www.aocd.org>

The American Osteopathic College of Dermatology posts information at its web site on many dermatological conditions.

American Parkinson's Disease Association

135 Parkinson Avenue
Staten Island, NY, 10305
Toll free: 800-223-2732
Web site: <http://www.apdaparkinson.org>

American Pediatric Surgical Association

111 Deer Lake Road, Suite 100
Deerfield, IL, 60015
Telephone: 847-480-9576
Web site: <http://www.eapsa.org>

An organization of surgeons who specialize in treating children with complex conditions.

American Physical Therapy Association

1111 North Fairfax Street
Alexandria, VA, 22314-1488
Telephone: 703-684-2782
Web site: <http://www.apta.org>

American Podiatric Medical Association

9312 Old Georgetown Road
Bethesda, MD, 20814-1621
Toll free: 800-366-8227
Web site: <http://www.apma.org>

American Porphyria Foundation

4900 Woodway, Suite 780
Houston, TX, 77056-1837
Toll free: 866-273-3635
Web site: <http://www.porphyrifoundation.com>

American Pregnancy Association

1431 Greenway Drive, Suite 800
Irving, TX, 75038
Telephone: 972-550-0140
Web site: <http://www.americanpregnancy.org>

American Psychiatric Association

1000 Wilson Boulevard, Suite 1825
Arlington, VA, 22209
Toll free: 888-35-PSYCH
Web site: <http://www.psych.org>

American Psychological Association

750 First Street NE
Washington, DC, 20002-4242
Telephone: 202-336-5500
Web site: <http://www.apa.org>

American Red Cross, National Headquarters

2025 E Street NW
Washington, DC, 20006
Telephone: 703-206-6000
Web site: <http://www.redcross.org>

American Rhinologic Society

P.O. Box 495
Warwick, NY, 10990-0495
Telephone: 845-988-1631
Web site: <http://www.american-rhinologic.org>

American Sleep Apnea Association

6856 Eastern Avenue, NW,
Suite 203
Washington, DC, 20012
Telephone: 202-293-3650
Web site: <http://www.sleepapnea.org>

American Social Health Association

P.O. Box 13827
Research Triangle Park, NC, 27709
Telephone: 919-361-8400
Web site: <http://www.ashastd.org>

Dedicated to improving the health of individuals, families, and communities, with a focus on preventing sexually transmitted diseases and infections (STDs/STIs) and their harmful consequences.

American Society for Deaf Children

P.O. Box 1510
Olney, MD, 20830-1510
Toll free: 800-942-ASDC
Web site: <http://www.deafchildren.org>

The American Society for Deaf Children supports parents and families of deaf children and the professionals who work with them, stressing the use of sign language in the home, school, and community.

American Society for Dermatologic Surgery

930 N. Meacham Road
Schaumburg, IL, 60173
Toll free: 800-441-2737
Web site: <http://www.asds-net.org>

American Society for Microbiology

1752 N Street, NW
Washington, DC, 20036-2904
Telephone: 202-737-3600
Web site: <http://www.microbeworld.org>

American Society for Neurochemistry

9037 Ron Den Lane
Windermere, FL, 34786
Telephone: 407-909-9064
Web site: <http://asneurochem.org>

American Society for Reproductive Medicine

1209 Montgomery Highway
Birmingham, AL, 35216-2809

Telephone: 205-978-5000
Web site: <http://www.asrm.org>

American Society of Hypertension

148 Madison Avenue, 5th Floor
New York, NY, 10016
Telephone: 212-696-9099
Web site: <http://www.ash-us.org>

American Speech-Language-Hearing Association

2200 Research Boulevard
Rockville, MD, 20850-3289
Toll free: 800-638-8255
Web site: <http://www.asha.org>

American Stroke Association, National Center

7272 Greenville Avenue
Dallas, TX, 75231
Toll free: 888-478-7653
Web site: <http://strokeassociation.org>

American Thyroid Association

6066 Leesburg Pike, Suite 550
Falls Church, VA, 22041
Telephone: 703-998-8890
Web site: <http://www.thyroid.org>

American Tinnitus Association

P.O. Box 5
Portland, OR, 97207-0005
Toll free: 800-634-8978
Web site: <http://www.ata.org>

American Trauma Society

7611 South Osborne Road, Suite 202
Upper Marlboro, MD, 20772
Toll free: 800-556-7890
Web site: <http://www.amtrauma.org>

American Urological Association

1000 Corporate Boulevard
Linthicum, MD, 21090
Toll free: 866-RING-AUA
Web site: <http://www.urologyhealth.org>

American Veterinary Medical Association

1931 North Meacham Road, Suite 100
Schaumburg, IL, 60173

Telephone: 847-925-8070
Web site: http://www.avma.org/animal_health/brochures/rabies/rabies_brochure.asp

The American Veterinary Medical Association has a brochure on rabies available for download on its web site.

amfAR

120 Wall Street, 13th Floor
New York, NY, 10005-3908
Toll free: 800-39-amfAR
Web site: <http://www.amfar.org>

A nonprofit organization dedicated to the support of HIV/AIDS research, HIV prevention, treatment education, and the advocacy of sound AIDS-related public policy.

Amyotrophic Lateral Sclerosis Association

27001 Agoura Road, Suite 150
Calabasas Hills, CA, 91301
Toll free: 800-782-4747
Web site: <http://www.alsa.org>

Anencephaly Support Foundation

20311 Sienna Pines Court
Spring, TX, 77379
Web site: <http://www.asfhelp.com>

Anosmia Foundation of Canada

Web site: <http://www.anosmiafoundation.org>

This Web-based organization provides extensive information about anosmia along with links to other pages related to smell and smell disorders.

Anxiety Disorders Association of America

8730 Georgia Avenue, Suite 600
Silver Spring, MD, 20910
Telephone: 240-485-1001
Web site: <http://www.adaa.org>

Anxiety Disorders Health Information Program, National Institute of Mental Health

Science Writing, Press, and Dissemination Branch,

Organizations

6001 Executive Boulevard,
Room 8184, MSC 9663
Bethesda, MD, 20892-9663
Toll free: 866-615-6464
Web site: <http://www.nimh.nih.gov/healthinformation/anxietymenu.cfm>

Arc of the United States

1010 Wayne Avenue, Suite 650
Silver Spring, MD, 20910
Telephone: 301-565-3842
Web site: <http://www.thearc.org>

An organization for people with intellectual and developmental disabilities that provides an array of services and support for families and individuals through 850 chapters across the nation.

Arthritis Foundation

P.O. Box 7669
Atlanta, GA, 30357-0669
Toll free: 800-283-7800
Web site: <http://www.arthritis.org>

Arthritis Society

393 University Avenue, Suite 1700
Toronto, ON, M5G 1E6, Canada
Telephone: 416-979-7228
<http://www.arthritis.ca>

Association for Glycogen Storage Diseases

P.O. Box 896
Durant, IA, 52747
Telephone: 563-785-6038
Web site: <http://www.agsdus.org>

Association for Psychological Science

1133 15th Street NW, Suite 1000
Washington, DC, 20005
Telephone: 202-293-9300
Web site: <http://www.psychologicalscience.org>

Association for Repetitive Motion Syndromes

P.O. Box 471973
Aurora, CO, 80047-1973
Telephone: 303-369-0803
Web site: <http://www.certifiedpst.com/arms>

Asthma and Allergy Foundation of America

1233 20th Street NW, Suite 402
Washington, DC, 20036
Toll free: 800-7-ASTHMA
Web site: <http://www.aafa.org>

Autism Research Institute

4182 Adams Avenue
San Diego, CA, 92116
Telephone: 619-281-7165
Web site: <http://www.autism.com>

A non-profit research, resource, and referral organization that conducts and funds research on the causes of autism and on safe, effective treatments for autism.

Autism Society of America

7910 Woodmont Avenue, Suite 300
Bethesda, MD, 20814-3067
Toll free: 800-3AUTISM
Web site: <http://www.autism-society.org>

B

BBC Television Centre

Wood Lane
London, W12 7RJ, UK
Web site: <http://www.bbc.co.uk/health>

Britain's BBC Television offers information on many health issues at the health section of its web site.

Bell's Palsy Research Foundation

9121 East Tanque Verde,
Suite 105-286
Tucson, AZ, 85749
Telephone: 520-749-4614

Binghamton University, State University of New York

PO Box 6000
Binghamton, NY, 13902-6000
Web site: <http://www2.binghamton.edu/news/the-newsroom/ask-a-scientist/archive.html>

SUNY Binghamton posts information various health issues at the "Ask A Scientist" section of its web site.

Bohart Museum of Entomology, University of California

1124 Academic Surge

Davis, CA, 95616

Web site: <http://delusion.ucdavis.edu>

The Bohart Museum of Entomology, founded in 1946, is located on the campus of the University of California, Davis. The museum posts facts about human skin parasites and delusional parasitosis at its web site.

Boomer Esiason Foundation

52 Vanderbilt Avenue, 15th Floor
New York, NY, 10017
Telephone: 646-292-7930
Web site: <http://www.esiason.org>

The Boomer Esiason Foundation provides information on treatment, resources, research, and care centers for Cystic Fibrosis patients and their families.

Brain Injury Association

1608 Spring Hill Road, Suite 110
Vienna, VA, 20036
Toll free: 800-444-6443
Web site: <http://www.biausa.org>

Brain Injury Resource Center

P.O. Box 84151
Seattle, WA, 98104-5451
Telephone: 206-621-8558
Web site: <http://www.headinjury.com>

Breast Cancer and the Environment Research Centers

Web site: <http://www.bcerc.org/pubs.htm>

The Breast Cancer and the Environment Research Centers web site includes a list of scientific publications as well as a link to fact sheets and other materials that describe known and possible connections between breast cancer incidence and environmental factors. In addition, its web site posts abstracts and summaries of various presentations made at the annual network meetings.

Breast Cancer Network of Strength

212 W. Van Buren, Suite 1000
Chicago, IL, 60607-3903
Telephone: 312-986-8338
Web site: <http://www.networkofstrength.org>

British Hernia Centre

87 Watford Way
London, England, NW4 4RS
Web site: <http://www.hernia.org>

C

Campaign for Tobacco-Free Kids

1400 Eye Street NW, Suite 1200
Washington, DC, 20005
Telephone: 202-296-5469
Web site: <http://www.tobaccofreekids.org>

Canadian Cancer Society

Suite 200, 10 Alcorn Avenue
Toronto ON M4V 3B1 Canada
Telephone: 416-961-7223
Web site: <http://www.cancer.ca>

Canadian Paediatric Society

2305 St. Laurent Boulevard
Ottawa ON K1G 4J8 Canada
Telephone: 613-526-9397
Web site: <http://www.cps.ca>

CancerHelp, Cancer Research UK

P.O. Box 123 Lincoln's Inn Fields
London UK
Web site: <http://www.cancerhelp.org.uk>

CancerHelp UK is the patient information web site of Cancer Research UK.

Cedars-Sinai Medical Center

8700 Beverly Boulevard
Los Angeles, CA, 90048
Telephone: 310-4-CEDARS
Web site: <http://www.csmc.edu>

The Cedars-Sinai Medical Center posts information on many medical conditions on its web site.

Celiac Disease Foundation

13251 Ventura Boulevard, Suite 1
Studio City, CA, 91604
Telephone: 818-990-2354
Web site: <http://www.celiac.org>

Celiac Sprue Association/United States of America

P.O. Box 31700
Omaha, NE, 68131-0700

Toll free: 877-272-4272

Web site: <http://www.csaceliacs.org>

Center for Civilian Biodefense Strategies, Johns Hopkins University

111 Market Place, Suite 830
Baltimore, MD, 21202
Telephone: 410-223-1667
Web site: <http://www.hopkins-biodefense.org>

The Center for Civilian Biodefense Strategies carries information about possible bioweapons and posts news updates on the preparedness and response plans of public health agencies and the work of the Department of Homeland Security.

Center For Consciousness Studies

P.O. Box 210068
Tucson, AZ, 85721-0068
Telephone: 520-621-9317
Web site: <http://www.consciousness.arizona.edu>

The aim of the Center for Consciousness Studies at the University of Arizona is to bring together the perspectives of philosophy, the cognitive sciences, neuroscience, the social sciences, medicine, and the physical sciences, the arts and humanities, to move toward an integrated understanding of human consciousness.

Center for Disability Information and Referral

Indiana Institute on Disability and Community, 2853 East 10th Street
Bloomington, IN, 47408-2696
Telephone: 812-855-9396
Web site: <http://www.iidc.indiana.edu>

The Center for Disability Information and Referral, which is associated with Indiana University, provides referrals for all types of disabilities. It also maintains an educational web site for disabled and non-disabled children.

Center for Effective Collaboration and Practice

1000 Thomas Jefferson Street,
Suite 400
Washington, DC, 20007

Toll free: 888-457-1551

Web site: <http://cecp.air.org/resources/schfail/prevsch.asp>

A part of the American Institutes for Research, the Center for Effective Collaboration and Practice posts a collection of articles and fact sheets on strategies to prevent school failure at its web site.

Center for Food Safety and Applied Nutrition, Food and Drug Administration

5100 Paint Branch Parkway
College Park, MD, 20740
Toll free: 888-SAFEFOOD
Web site: <http://www.cfsan.fda.gov>

Center for Human Genetics, Duke University Medical Center

Box 3445
Durham, NC, 27710
Web site: <http://www.chg.duke.edu>

Center for Molecular & Behavioral Neuroscience—Rutgers University, Newark Campus

197 University Avenue
Newark, NJ, 07102
Web site: <http://www.memory.rutgers.edu>

The Memory Disorders Project, housed at Rutgers University, Newark, involves neuroscientists, psychologists, and other researchers who explore how the human brain creates and stores memories. The web site features easy-to-understand information about memory and memory disorders.

Center for Narcolepsy, Sleep, and Health Research, College of Nursing, Suite 208, University of Illinois at Chicago

845 South Damen Avenue (M/C 802)
Chicago, IL, 60612
Telephone: 312-996-5176
Web site: <http://www.uic.edu/nursing/CNSHR>

Center for the Prevention of School Violence

313 Chapanoke Road, Suite 140
Raleigh, NC, 27603

Organizations

Toll free: 800-299-6054

Web site: <http://www.ncsu.edu/cpsv>

Based at North Carolina State University, this center works to inform the public about school violence and ways to prevent it.

Centers for Disease Control and Prevention

1600 Clifton Road

Atlanta, GA, 30333

Toll free: 800-311-3435

Web site: <http://www.cdc.gov>

The CDC is the federal authority for information about infectious and other diseases.

Charcot-Marie-Tooth Association

2700 Chester Street

Philadelphia, PA, 19013

Toll free: 800-606-2682

Web site: <http://www.charcot-marie-tooth.org>

Chicago Center for Jewish Genetic Disorders

Ben Gurion Way,

30 South Wells Street

Chicago, IL, 60606

Telephone: 312-357-4718

Web site: <http://www.jewishgeneticscenter.org>

The Chicago Center for Jewish Genetic Disorders provides education, information, and prevention strategies.

Child and Adolescent Bipolar Foundation (CABF)

1000 Skokie Boulevard, Suite 570

Wilmette, IL, 60091

Telephone: 847-256-8525

Web site: <http://www.bpkids.org>

Children and Adults with Attention-Deficit/Hyperactivity Disorder

8181 Professional Place, Suite 201

Landover, MD, 20785

Web site: <http://www.chadd.org>

Children with Diabetes

8216 Princeton-Glendale Road,

PMB 200

West Chester, OH, 45069-1675

Web site: <http://childrenwithdiabetes.com>

Children with Diabetes provides an online community for children and young adults with Type I diabetes.

Children's Hospital Boston

300 Longwood Avenue

Boston, MA, 02115

Telephone: 617-355-6000

Web site: <http://www.childrenshospital.org>

Boston's Children's Hospital posts information on many children's health issues at its web site.

Children's Neuroblastoma Cancer Foundation

P.O. Box 6635

Bloomington, IL, 60108

Toll free: 866-671-2623

Web site: <http://www.nbhope.org>

The mission of Children's Neuroblastoma Cancer Foundation is to support families living with this disease by listing the most current, reliable information and resources available.

Children's PKU Network

3790 Via De La Valle, Suite 120

Del Mar, CA, 92014

Toll free: 800-377-6677

Web site: <http://www.pkunetwork.org>

Children's Tumor Foundation

95 Pine Street, 16th Floor

New York, NY, 10005

Toll free: 800-323-7938

Web site: <http://www.ctf.org>

Cleft Palate Foundation

1504 E. Franklin Street, Suite 102

Chapel Hill, NC, 27514-2820

Telephone: 919-933-9044

Web site: <http://www.cleftline.org>

Cleveland Clinic

9500 Euclid Avenue

Cleveland, OH, 44195

Toll free: 800-223-2273

Web site: <http://my.clevelandclinic.org>

The Cleveland Clinic's my.clevelandclinic.org web site offers information on many health related topics.

College Drinking: Changing the Culture

Web site: <http://www.collegedrinkingprevention.gov>

This web site sponsored by the National Institute on Alcohol Abuse and Alcoholism is a comprehensive resource for information on drinking prevention in college-age young people.

Compassionate Friends

P.O. Box 3696

Oak Brook, IL, 60522

Toll free: 877-969-0010

Web site: <http://www.compassionatefriends.org>

The mission of Compassionate Friends is to assist families toward the positive resolution of grief following the death of a child of any age and to provide information on how others can be supportive.

Congenital Heart Information Network

600 North Third Street

Philadelphia, PA, 19123

Telephone: 215-627-4034

Web site: <http://www.tchin.org>

Conjoined Twins International

P.O. Box 10895

Prescott, AZ, 86304-0895

Telephone: 928-445-2777

A support group for conjoined twins and their families.

Connecticut Clearinghouse

334 Farmington Avenue

Plainville, CT, 06062

Toll free: 800-232-4424

Web site: <http://www.ctclearinghouse.org/Topics/topicView.asp?TopicID=87>

Connecticut Clearinghouse provides information as well as referrals to people dealing with fetal alcohol syndrome.

Cooley's Anemia Foundation

330 7th Avenue, No. 900

New York, NY, 10001

Toll free: 800-522-7222
 Web site: <http://www.thalassemia.org>

COPD International
 131 DW Highway #627
 Nashua, NH, 03060
 Web site: <http://www.copd-international.com>

Creutzfeldt-Jakob Disease Foundation
 P.O. Box 5312
 Akron, OH, 44334
 Toll free: 800-659-1991
 Web site: <http://cjdfoundation.org>

Crohn's and Colitis Foundation of America
 386 Park Avenue South, 17th Floor
 New York, NY, 10016-8804
 Toll free: 800-932-2423
 Web site: <http://www.ccf.org>

Cushing's Support and Research Foundation
 65 East India Row, Suite 22B
 Boston, MA, 02110
 Telephone: 617-723-3824
 Web site: <http://www.csrf.net>

Cystic Fibrosis Foundation
 6931 Arlington Road
 Bethesda, MD, 20814
 Toll free: 800-FIGHT CF
 Web site: <http://www.cff.org>

D

Department of Health and Human Services
 200 Independence Avenue SW
 Washington, DC, 20201
 Web site: <http://www.hhs.gov>
 Web site: <http://www.pandemicflu.gov/index.html>
 Web site: <http://www.4parents.gov/sexdevt/index.html>
The Department of Health and Human Services (HHS) is the United States government's principal agency for protecting the health of all Americans and providing essential human services, especially for those who are least able to help themselves. They provide information on

various health issues at their specialized web sites.

Department of Health and Mental Hygiene, Community Health Administration
 201 West Preston Street, 3rd Floor
 Baltimore, MD, 21201
 Telephone: 410-767-5300
 Web site: <http://www.cha.state.md.us>
 Web site: <http://www.edcp.org>
Maryland's Department of Health and Mental Hygiene posts information about health and diseases at its web site.

Department of Health Services
 1 West Wilson Street
 Madison, WI, 53703
 Telephone: 608-266-1865
 Web site: <http://dhs.wisconsin.gov>
The Wisconsin Department of Health Services posts information on many diseases and health issues at its web site.

Depression and Bipolar Support Alliance
 730 N. Franklin Street, Suite 501
 Chicago, IL, 60610-7224
 Toll free: 800-826-3632
 Web site: <http://www.dbsalliance.org>
A patient-directed national organization focusing on bipolar disorder, with a network of nearly 1,000 patient-run support groups across the United States.

Directors of Health Promotion and Education
 1015 18th Street NW, 3rd Floor
 Washington, DC, 20036
 Telephone: 202-659-2230
 Web site: <http://www.dhpe.org>
The Directors of Health Promotion and Education work to strengthen, promote, and enhance the professional practice of health promotion and public health education nationally and within State health departments.

Discovery Communications
 One Discovery Place
 Silver Spring, MD, 20910
 Telephone: 240-662-2000

Web site: <http://www.health.discovery.com>

Division of Diabetes Translation, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention
 Mail Stop K-10,
 4770 Buford Highway, NE,
 Atlanta, GA, 30341-3717
 Toll free: 800-232-4636
 Web site: <http://www.cdc.gov/diabetes>
A division of the Centers for Disease Control and Prevention, the Division of Diabetes Translation has the goal of reducing the burden of diabetes in the United States.

Doctors Without Borders
 333 7th Avenue, 2nd Floor
 New York, NY, 10001
 Telephone: 212-679-6800
 Web site: <http://www.doctorswithoutborders.org>
Doctors Without Borders provides treatment for people throughout the world. It is not affiliated with any government.

Dolan DNA Learning Center
 334 Main Street
 Cold Spring Harbor, NY, 11724
 Web site: <http://www.ygyh.org>
The Dolan DNA Learning Center, a part of the Cold Spring Harbor Laboratory, provides a multimedia guide to genetic disorders at its web site.

DrGreene.com
 9000 Crow Canyon Road, Suite S220
 Danville, CA, 94506
 Telephone: 925-964-1793
 Web site: <http://www.drgreene.com>
This web site offers information for parents.

E

Emergency Services and Disaster Relief Branch, Center for Mental Health Services, Substance Abuse and Mental Health Services Administration
 5600 Fishers Lane, Room 17C-20
 Rockville, MD, 20857

Organizations

Telephone: 301-443-4735

Web site: <http://www.mentalhealth.org/cmhs/emergencyservices>

This government agency helps oversee national efforts to provide mental health services to victims of major disasters.

Emory Orthopaedics, Spine Center & Sports Medicine Center

59 Executive Park South

Atlanta, GA, 30329

Web site: <http://www.emoryhealthcare.org>

Part of the Robert W. Woodruff Health Sciences Center of Emory University, Emory Healthcare posts information about various orthopaedic conditions on its web site.

Enabled Online

321 Wilton Circle

Sanford, FL, 32773

Telephone: 407-474-3841

Web site: <http://www.enabledonline.com>

[enabledonline.com](http://www.enabledonline.com)

A web site that provides a list of organizations and information links related to disability. The web site also includes news and event resources for and about people with disabilities.

Endocrine Society

8401 Connecticut Avenue, Suite 900

Chevy Chase, MD, 20815

Toll free: 888-363-6274

Web site: <http://www.endo-society.org>

The Endocrine Society studies and performs research on hormones within the human body in association with the clinical practice of endocrinology.

Endometriosis Association

8585 North Seventy-sixth Place

Milwaukee, WI, 53223-2600

Telephone: 414-355-2200

Web site: <http://www.endometriosisassn.org>

[endometriosisassn.org](http://www.endometriosisassn.org)

Environmental Protection Agency/Office of Radiation and Indoor Air, Indoor Environments Division

1200 Pennsylvania Avenue, NW,

Mail Code 6609J

Washington, DC, 20460

Telephone: 202-343-9370

Web site: <http://www.epa.gov/iedweb00/pubs/coftsht.html>

The U.S. Environmental Protection Agency's Indoor Environments Division posts an informative pamphlet called "Protect Your Family and Yourself from Carbon Monoxide Poisoning" on its web site.

Epilepsy Foundation

8301 Professional Place

Landover, MD, 20785

Toll free: 800-332-1000

Web site: <http://www.epilepsyfoundation.org>

[epilepsyfoundation.org](http://www.epilepsyfoundation.org)

Eunice Kennedy Shriver National Institute of Child Health and Human Development

31 Center Drive, Building 31,

Room 2A32, MSC 2425

Bethesda, MD, 20892-2425

Toll free: 800-370-2943

Web site: <http://www.nichd.nih.gov>

The National Institute of Child Health and Human Development web site has information of all aspects of children's health and development.

F

Family Caregiver Alliance

180 Montgomery Street, Suite 1100

San Francisco, CA, 94104

Toll free: 800-445-8106

Web site: <http://www.caregiver.org>

The Family Caregiver Alliance offers information helpful to people who are caring for loved ones with dementia.

Fanconi Anemia Research Fund

1801 Willamette Street, Suite 200

Eugene, OR, 97401

Toll free: 888-326-2664

Web site: <http://www.fanconi.org>

Federal Emergency Management Agency

500 C Street SW

Washington, DC, 20472

Toll free: 800-621-FEMA

Web site: <http://www.fema.gov/hazard/chemical/index.shtml>

[hazard/chemical/index.shtml](http://www.fema.gov/hazard/chemical/index.shtml)

The web site of the Federal Emergency Management Agency posts a list of common hazardous household items, tips to prevent chemical poisonings, and advice on responding to chemical emergencies.

First Candle

1314 Bedford Avenue, Suite 210

Baltimore, MD, 21208

Toll free: 800-221-7437

Web site: <http://www.sidsalliance.org>

First Candle is a resource for expecting and new parents, and also those who have experienced the death of a baby.

Food and Drug Administration

5600 Fishers Lane

Rockville, MD, 20857

Toll free: 888-INFO-FDA

Web site: <http://www.fda.gov>

Food Safety and Inspection Service

1400 Independence Avenue SW,

Room 2137 South Building

Washington, DC, 20250

Toll free: 800-336-3747

Web site: <http://www.fsis.usda.gov>

The Food Safety and Inspection Service is the public health agency of the Department of Agriculture.

G

Genetic Alliance

4301 Connecticut Avenue NW,

Suite 404

Washington, DC, 20008-2369

Telephone: 202-966-5557

Web site: <http://www.geneticalliance.org>

[geneticalliance.org](http://www.geneticalliance.org)

A national organization of support groups for people who have or who are at risk for genetic disorders.

GLAAD (Gay & Lesbian Alliance Against Defamation)

5455 Wilshire Boulevard, #1500

Los Angeles, CA, 90036

Telephone: 323-933-2240

Web site: <http://www.glaad.org>

GLAAD is dedicated to promoting and ensuring fair, accurate, and inclusive

representation of people and events in the media as a means of eliminating homophobia and discrimination based on gender identity and sexual orientation. They also have offices in New York City.

Glaucoma Research Foundation

251 Post Street, Suite 600
San Francisco, CA, 94108
Toll free: 800-826-6693
Web site: <http://www.glaucoma.org>

Gynecologic Cancer Foundation

230 W. Monroe, Suite 2528
Chicago, IL, 60606
Toll free: 800-444-4441
Web site: <http://www.thegcf.org>

Gynecomastia

2917 McClure Street
Oakland, CA, 94609
Telephone: 510-627-0090
Web site: <http://www.gynecomastia.org>

H

H.E.A.R. (Hearing Education and Awareness for Rockers)

P.O. Box 460847
San Francisco, CA, 94146
Telephone: 415-773-9590
Web site: <http://www.hearnet.com>

H.E.A.R. provides information on safe volume levels for music and on ear plugs for musicians and fans.

Health24

P.O. Box 2434
Cape Town 8000 South Africa
Web site: <http://www.health24.com/medical>

South Africa's leading health and lifestyle web site.

Healthcommunities.com, Inc.

136 West Street
Northampton, MA, 01060
Toll free: 888-950-0808
Web site: <http://www.urologychannel.com>

Healthcommunities.com, Inc., (HC) provides reliable, physician-developed patient education to consumers, medical web site design services for doctors, and online directories of doctors. The Urology Channel site has in-depth information about the parts of the urinary tract, urinary tract infections, and other urological conditions.

HealthInsite

Editorial Team Service Access Programs Branch, Department of Health and Ageing, MD,P 2, GPO Box 9848
Canberra, ACT, 2601, Australia
Telephone: 02 6289 8488
Web site: <http://www.healthinsite.gov.au>

An Australian governmental initiative, funded by the Department of Health and Ageing. It aims to improve the health of Australians by providing easy access to quality information about human health.

Heart and Stroke Foundation of Canada

222 Queen Street, Suite 1402
Ottawa, ON, K1P 5V9, Canada
Telephone: 613-569-4361
Web site: <http://www.hsf.ca>

Helicobacter Research Laboratory

Room 1.11, L Block
QEII Medical Centre
Nedlands, Western Australia
Australia 6009
Telephone: +61 8 9346 4815
Web site: <http://www.hpylori.com.au>

Hepatitis Foundation International

504 Blick Drive
Silver Spring, MD, 20904
Toll free: 800-891-0707
Web site: <http://www.hepfi.org>

Hermansky-Pudlak Syndrome Network

One South Road
Oyster Bay, NY, 11771-1905
Toll free: 800-789-9477
Web site: <http://www.hermansky-pudlak.org>

Human Growth Foundation

997 Glen Cove Avenue
Glen Head, NY, 11545
Toll free: 800-451-6434
Web site: <http://www.hgfound.org>

Huntington's Disease Society of America

505 8th Avenue, Suite 902
New York, NY, 10018
Toll free: 800-345-HDSA (4372)
Web site: <http://www.hdsa.org>

Hydrocephalus Association

870 Market Street, Suite 705
San Francisco, CA, 94102
Toll free: 888-598-3789
Web site: <http://www.hydroassoc.org>

I

Illinois Department of Public Health

535 West Jefferson Street
Springfield, IL, 62761
Telephone: 217-782-4977
Web site: <http://www.idph.state.il.us/public>

The Illinois Department of Public Health posts information on various diseases and their prevention at its web site.

Immune Deficiency Foundation

40 West Chesapeake Avenue,
Suite 308
Towson, MD, 21204
Toll free: 800-296-4433
Web site: <http://www.primaryimmune.org>

The Immune Deficiency Foundation promotes education about primary immunodeficiency diseases, as well as research and patient support.

Immunization Action Coalition

1573 Selby Avenue, Suite 234
St. Paul, MN, 55104
Telephone: 651-647-9009
Web site: <http://www.immunize.org>

The Immunization Action Coalition provides information about infectious diseases and immunization.

Organizations

International AIDS Society

Avenue Louis Casai 71, P.O. Box 20
CH - 1216 Cointrin
Geneva, Switzerland
Telephone: 41-(0)22-7 100 800
Web site: <http://www.iasociety.org>

International Association for CFS/ME

27 N. Wacker Drive, Suite 416
Chicago, IL, 60606
Telephone: 847-258-7248
Web site: <http://www.iacfsme.org>

International Council on Infertility Information Dissemination

P.O. Box 6836
Arlington, VA, 22206
Telephone: 703-379-9178
Web site: <http://www.inciid.org>

International Dyslexia Association

40 York Road, 4th Floor
Baltimore, MD, 21204
Telephone: 410-296-0232
Web site: <http://www.interdys.org>

International Food Information Council

1100 Connecticut Avenue NW,
Suite 430
Washington, DC, 20036
Telephone: 202-296-6540
Web site: <http://www.ific.org>

This web site posts information about nutrition for adults and for children.

International Foundation for Functional Gastrointestinal Disorders

P.O. Box 170864
Milwaukee, WI, 53217-8076
Toll free: 888-964-2001
Web site: <http://www.iffgd.org>

International Hyperhidrosis Society

Kellers Church Road, Suite 6121-A
Pipersville, PA, 18947
Web site: <http://www.sweathelp.org>

International Rett Syndrome Association

4600 Devitt Drive
Cincinnati, OH, 45246

Telephone: 513-874-3020
Web site: <http://www.rettsyndrome.org>

International Society of Travel Medicine

2386 Clower Street, Suite A-102
Snellville, GA, 30078
Telephone: 770-736-7060
Web site: <http://www.istm.org>

Intersex Society of North America

979 Golf Course Drive, No. 282
Rohnert Park, CA, 94928
Web site: <http://www.isna.org>

Iron Disorders Institute

2722 Wade Hampton Boulevard,
Suite A, Greenville, SC, 29615
Toll free: 888-565-IRON
Web site: <http://www.irondisorders.org>

J

Jeffrey Modell Foundation

747 Third Avenue
New York, NY, 10017
Telephone: 212-819-0200
Web site: <http://www.info4pi.org>

A nonprofit research foundation devoted to primary immune deficiencies.

Juvenile Diabetes Research Foundation International

120 Wall Street
New York, NY, 10005-4001
Toll free: 800-533-CURE (2873)
Web site: <http://www.jdrf.org>

K

Karolinska Institutet

SE-171 77
Stockholm, Sweden
Telephone: +46 8 524 800 00
Web site: <http://www.mic.ki.se/Diseases/C02.html>

This research institute posts links pertaining to virus diseases on its web site.

Kidney Cancer Association

1988 Momentum Place
Chicago, IL, 60689-5319

Toll free: 800-850-9132
Web site: <http://www.kidneycancer.org>

L

Lab Tests Online—American Association for Clinical Chemistry

1850 K Street NW, Suite 625
Washington, DC, 20006
Web site: <http://labtestsonline.org>

Lab Tests Online is the product of a collaboration among professional societies representing the clinical laboratory community. It was designed to help patients and caregivers better understand the many clinical lab tests that are part of routine care as well as diagnosis and treatment of a broad range of conditions and diseases.

Lance Armstrong Foundation

P.O. Box 161150
Austin, TX, 78716
Telephone: 512-236-8820
Web site: <http://www.livestrong.org>

LD OnLine

2775 S. Quincy Street
Arlington, VA, 22206
Web site: <http://www.ldonline.org>

LD OnLine seeks to help children and adults reach their full potential by providing accurate and up-to-date information and advice about learning disabilities and ADHD.

Learning Disabilities Association of America

4156 Library Road
Pittsburgh, PA, 15234-1349
Telephone: 412-341-1515
Web site: <http://www.ldanatl.org>

Leukemia and Lymphoma Society

1311 Mamaroneck Avenue
White Plains, NY, 10605
Telephone: 914-949-5213
Web site: <http://www.leukemia.org>
Formerly the Leukemia Society of America.

Lighthouse International

111 East 59th Street
New York, NY, 10022-1202

Telephone: 212-821-9200 or 212-821-9713 (TTY)
Web site: <http://www.lighthouse.org>

A comprehensive resource for those affected by vision impairment.

Little People of America/National Headquarters

P.O. Box 745
Lubbock, TX, 79408
Toll free: 888-LPA-2001
Web site: <http://www.lpaonline.org>

Little People of America posts information on growth issues at its web site.

Livestrong.com

15801 NE Twenty-fourth St.
Bellevue, WA, 98008
Web site: <http://www.livestrong.com>

Associated with Lance Armstrong, Livestrong is an online information source for health-related topics.

Lupus Foundation of America

2000 L Street NW, Suite 710
Washington, DC, 20036
Telephone: 202-349-1155
Web site: <http://www.lupus.org>

Lyme Disease Foundation

P.O. Box 332
Tolland, CT, 06084-0332
Telephone: 860-870-0070
Web site: <http://www.lyme.org>

Lymphoma Research Foundation of America (New York office)

111 Broadway, 19th Floor
New York, NY, 10006
Toll free: 800-235-6848
Web site: <http://lymphoma.org>

M

Maple Syrup Urine Disease Family Support Group

Telephone: 740-548-4475
Web site: <http://www.msud-support.org>

March of Dimes

1275 Mamaroneck Avenue
White Plains, NY, 10605

Toll free: 888-663-4637
Web site: <http://www.marchofdimes.com>

The mission of this national organization is to improve the health of babies by preventing birth defects and infant mortality. Its web site offers information on the cause and prevention of birth defects as well as "The March of Dimes Global Report on Birth Defects: The Hidden Toll of Dying and Disabled Children".

Massachusetts General Hospital Department of Orthopedic Surgeons

55 Fruit Street
Boston, MA, 02114
Telephone: 617-726-2000
Web site: <http://www.massgeneral.org/ORTHO>

The Massachusetts General Hospital Department of Orthopedic Surgeons provides information about various orthopedic conditions at its web site.

Mayo Clinic

200 First Street SW
Rochester, MN, 55905
Web site: <http://www.mayoclinic.com>

The Mayo Clinic provides information for patients on many diseases and conditions and their treatment at its health information web site.

McGowan Institute for Regenerative Medicine

100 Technology Drive, Suite 200
Pittsburgh, PA, 15219-3110
Telephone: 412-235-5100
Web site: <http://www.mirm.pitt.edu>

The McGowan Institute is a research center in regenerative medicine founded jointly by the University of Pittsburgh School of Medicine and the University of Pittsburgh Medical Center.

McKinley Health Center

1109 S. Lincoln Avenue
Urbana, IL, 61801
Telephone: 217-333-2701
Web site: <http://www.mckinley.uiuc.edu/handouts>

The University of Illinois McKinley Health Center web site offers information concerning various diseases and conditions at their web site.

Medical College of Wisconsin

8701 Watertown Plank Road
Milwaukee, WI, 53226
Web site: <http://www.healthlink.mcw.edu>

The Medical College of Wisconsin posts patient information on various diseases at its HealthLink web site.

Melissa's Living Legacy Foundation

3111 Winton Road S.
Rochester, NY, 14623
Web site: <http://www.teenslivingwithcancer.org>

Written for teens, this foundation's web site describes many cancers and what a patient can expect during diagnosis and treatment. It also has a page where teens can write in their own stories about living with cancer.

Memorial Sloan-Kettering Cancer Center

1275 York Avenue
New York, NY, 10065
Telephone: 212-639-2000
Web site: <http://www.mskcc.org>

The Memorial Sloan-Kettering Cancer Center posts information many cancers on its web site.

Meningitis Foundation of America

212 W 10th Street, Suite B-330
Indianapolis, IN, 46202
Toll free: 800-668-1129
Web site: <http://www.meningitisfoundationofamerica.org>

Mental Health America

2000 N. Beauregard St., 6th Floor
Alexandria, VA, 22311
Toll free: 800-969-6642
Web site: <http://www.mentalhealthamerica.net>

A nonprofit organization dedicated to helping all people live mentally healthier lives.

Organizations

Mesothelioma Applied Research Foundation

P.O. Box 91840
Santa Barbara, CA, 93190-1840
Telephone: 805-563-8400
Web site: <http://www.curemeso.org>

Mothers Against Drunk Driving

P.O. Box 541688
Dallas, TX, 75354-1688
Toll free: 800-GET-MADD
Web site: <http://www.madd.org>

Mothers Against Drunk Driving is a nonprofit organization that seeks to stop drunk driving, support victims of this crime, and prevent underage drinking.

Mulhauser Consulting

55, De Tracey Park
Newton Abbot, TQ13 9QT, UK
Web site: <http://www.counsellingresource.com/distress/personality-disorders/foundation/index.html>

This group publishes materials from the former Personality Disorders Foundation at its web site.

Multiple Sclerosis Foundation

6350 North Andrews Avenue
Fort Lauderdale, FL, 33309-2130
Toll free: 888-MSFOCUS
Web site: <http://www.msfacts.org>

Muscular Dystrophy Association—USA, National Headquarters

3300 E. Sunrise Drive
Tucson, AZ, 85718
Toll free: 800-572-1717
Web site: <http://www.mda.org>

Muscular Dystrophy Campaign

61 Southwark Street
London, SE1 0HL, UK
Toll free: 0800 652 6352
Web site: <http://www.muscular-dystrophy.org>

Muscular Dystrophy Canada

2345 Yonge Street, Suite 900
Toronto ON M4P 2E5 Canada
Toll free: 866-MUSCLE-8
Web site: <http://www.muscle.ca>

N

Narcolepsy Network

79 Main Street
North Kingston, RI, 02852
Toll free: 888-292-6522
Web site: <http://narcolepsynetwork.org>

National Adrenal Diseases Foundation

505 Northern Boulevard
Great Neck, NY, 11021
Telephone: 516-487-4992
Web site: <http://www.nadf.us>

National Alliance on Mental Illness

Colonial Place Three,
2107 Wilson Boulevard,
Suite 300
Arlington, VA, 22201-3042
Telephone: 703-524-7600
Web site: <http://www.nami.org>

The National Alliance on Mental Illness provides education, support, and advocacy for people with severe mental illnesses and for their families.

National Alopecia Areata Foundation

14 Mitchell Boulevard
San Rafael, CA, 94930
Telephone: 415-472-3780
Web site: <http://www.naaf.org>

National Aphasia Association

350 7th Avenue, Suite 902
New York, NY, 10001
Toll free: 800-922-4622
Web site: <http://www.aphasia.org>

National Association for Children of Alcoholics

11426 Rockville Pike, Suite 100
Rockville, MD, 20852
Toll free: 888-55-4COAS
Web site: <http://www.nacoa.org>

The National Association for Children of Alcoholics works on behalf of children affected by a parent's alcohol or drug abuse.

National Association for Colitis and Crohn's Disease

800 South Northwest Highway,
Suite 200
Barrington, IL, 60010
Toll free: 800-662-5874
Web site: <http://www.nacc.org.uk>

National Association for Down Syndrome

P.O. Box 206
Wilmette, IL, 60091
Telephone: 630-325-9112
Web site: <http://www.nads.org>

National Association of Anorexia Nervosa and Associated Disorders

P.O. Box 7
Highland Park, IL, 60035
Telephone: 847-831-3438
Web site: <http://www.anad.org>

National Association of Rescue Divers

P.O. Box 590474
Houston, TX, 77259-0474
Web site: <http://www.rescuediver.org/med/bends.htm>

This organization's web site provides information on the medical history of the bends, as well as the condition, its symptoms, and treatment.

National Ataxia Foundation

2600 Fernbrook Lane, Suite 119
Minneapolis, MN, 55447
Toll free: 762-553-0167
Web site: <http://www.ataxia.org>

National Attention Deficit Disorder Association

9930 Johnnycake Ridge Road,
Suite 3E
Mentor, OH, 44060
Telephone: 440-350-9595
Web site: <http://www.add.org>

National Biological Information Infrastructure, USGS Biological Informatics Office

302 National Center
Reston, VA, 20192
Telephone: 703-648-4216
Web site: <http://westnilevirus.nbii.gov>

The National Biological Information Infrastructure provides information and statistical data on West Nile virus at its web site.

National Bone Marrow Transplant Link

29209 Northwestern Highway,
Number 624
Southfield, MI, 48034
Toll free: 800-LINK-BMT
Web site: <http://www.nbmtlink.org>

National Brain Tumor Foundation

22 Battery Street, Suite 612
San Francisco, CA, 94111-5520
Toll free: 800-934-2873
Web site: <http://www.braintumor.org>

National Cancer Institute

Public Inquiries Office, 6116
Executive Boulevard, Room 3036A
Bethesda, MD, 20892-8322
Toll free: 800-4-CANCER
Web site: <http://cancernet.nci.nih.gov>

National Center for Biotechnology Information, National Library of Medicine

Building 38A
Bethesda, MD, 20894
Telephone: 301-496-2475
Web site: <http://www.ncbi.nlm.nih.gov>

The National Center for Biotechnology Information, a division of the National Library of Medicine, provides detailed information about genes and genetic diseases.

National Center for Complementary and Alternative Medicine

9000 Rockville Pike
Bethesda, MD, 20892
Toll free: 888-644-6226
Web site: <http://www.nia.nih.gov>

National Center for Environmental Health, Centers for Disease Control and Prevention

4770 Buford Highway NE
Atlanta, GA, 30341-3724

Toll free: 888-232-6789
Web site: <http://www.cdc.gov/nceh>

National Center for Injury Prevention and Control

4770 Buford Highway NE,
Mailstop K65
Atlanta, GA, 30341-3724
Telephone: 770-488-1506
Web site: <http://www.cdc.gov/ncipc>

National Center for PTSD

215 North Main Street
White River Junction
VT, 05009
Toll free: 802-296-5132
Web site: <http://www.ncptsd.org>

National Center for Voice and Speech, Denver Center for the Performing Arts

1101 13th Street
Denver, CO, 80204
Telephone: 303-446-4834
Web site: <http://www.ncvs.org>

The National Center for Voice and Speech web site offers e-based learning for better vocal health.

National Clearinghouse for Alcohol and Drug Information

P.O. Box 2345
Rockville, MD, 20847-2345
Toll free: 800-729-6686
Web site: <http://www.health.org>

National Coalition for LGBT Health

1325 Massachusetts Avenue NW,
Suite 705
Washington, DC, 20005
Telephone: 202-558-6828
Web site: <http://www.lgbthealth.net>

National Coalition for the Homeless

2201 P Street NW
Washington, DC, 20037
Telephone: 202-462-4822
Web site: <http://www.nationalhomeless.org>
The National Coalition for the Homeless is an advocacy network for homeless

persons and providers of services to end homelessness.

National Council on Alcoholism and Drug Dependence

20 Exchange Place, Suite 2902
New York, NY, 10005
Toll free: 800-NCA-CALL
Web site: <http://www.ncadd.org>

National Digestive Diseases Information Clearinghouse (NDDIC)

2 Information Way
Bethesda, MD, 20892-3570
Toll free: 800-891-5389
Web site: <http://digestive.niddk.nih.gov>

The NDDIC is a service of the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health.

National Dissemination Center for Children with Disabilities

P.O. Box 1492
Washington, DC, 20013
Toll free: 800-695-0285
Web site: <http://www.nichcy.org>

National Down Syndrome Society

666 Broadway, 8th Floor
New York, NY, 10012-2317
Toll free: 800-221-4602
Web site: <http://www1.ndss.org>

National Eating Disorders Association

603 Stewart Street, Suite 803
Seattle, WA, 98101
Toll free: 800-931-2237
Web site: <http://www.nationaleatingdisorders.org>

National Endocrine and Metabolic Diseases Information Service

6 Information Way
Bethesda, MD, 20892-3569
Toll free: 888-828-0904
Web site: <http://www.endocrine.niddk.nih.gov>

A division of the National Institute of Diabetes and Digestive and Kidney Diseases.

Organizations

National Eye Institute

2020 Vision Place
Bethesda, MD, 20892-3655
Telephone: 301-496-5248
Web site: <http://www.nei.nih.gov>

National Federation of the Blind

1800 Johnson Street
Baltimore, MD, 21230
Telephone: 410-659-9314
Web site: <http://www.nfb.org>

National Foundation for Celiac Awareness

P.O. Box 544
Ambler, PA, 19002-0544
Telephone: 215-325-1306
Web site: <http://www.CeliacCentral.org>

National Fragile X Foundation

P.O. Box 37, 1615 Bonanza Street,
Suite 202
Walnut Creek, CA, 94597
Toll free: 800-688-8765
Web site: <http://www.fragilex.org>

National Graves' Disease Foundation

P.O. Box 1969
Brevard, NC, 28712
Telephone: 828-877-5251
Web site: <http://www.ngdf.org>

National Headache Foundation

820 N. Orleans, Suite 217
Chicago, IL, 60610
Toll free: 888-643-5552
Web site: <http://www.headaches.org>

National Heart, Lung, and Blood Institute

P.O. Box 30105
Bethesda, MD, 20824-0105
Telephone: 301-592-8573
Web site: <http://www.nhlbi.nih.gov>
A division of the National Institutes of Health.

National Hemophilia Foundation

116 West 32nd Street, 11th Floor
New York, NY, 10001
Telephone: 212-328-3700
Web site: <http://www.hemophilia.org>

National Hopeline Network Crisis and Suicide Prevention Center

Kristin Brooks Hope Center,
1250 24th Street NW, Ste 300
Washington, DC, 20037
Toll free: 800-784-2433
Web site: <http://www.hopeline.com>
The National Hopeline Network Crisis and Suicide Prevention Center seeks to assist individuals in crisis and prevent suicide in doing so.

National Human Genome Research Institute

9000 Rockville Pike,
31 Center Drive, MSC 2152,
Building 31, Room 4B09
Bethesda, MD, 20892-2152
Telephone: 301-402-0911
Web site: <http://www.genome.gov>
The National Human Genome Research Institute is home to the Human Genome Project, an international research effort aimed at mapping the human genome.

National Institute for Occupational Safety and Health

1600 Clifton Road
Atlanta, GA, 30333
Toll free: 800-232-4636
Web site: <http://www.cdc.gov/NIOSH>

Part of the Centers for Disease Control and Prevention, the National Institute for Occupational Safety and Health is responsible for conducting research and making recommendations regarding the prevention of work-related injury and illness.

National Institute of Allergy and Infectious Diseases

Office of Communications and
Public Liaison, 6610 Rockledge
Drive, MSC 6612
Bethesda, MD, 20892-66123
Toll free: 866-284-4107
Web site: <http://www3.niaid.nih.gov>

National Institute of Arthritis and Musculoskeletal and Skin Diseases

1 AMS Circle
Bethesda, MD, 20892-3675

Toll free: 877-226-4267
Web site: <http://www.niams.nih.gov>

National Institute of Child Health and Human Development

P.O. Box 3006
Rockville, MD, 20847
Toll free: 800-370-2943
Web site: <http://www.nichd.nih.gov>

National Institute of Dental and Craniofacial Research

45 Center Drive, MSC 6400
Bethesda, MD, 20892
Telephone: 301-496-4261
Web site: <http://www.nidcr.nih.gov/OralHealth>

National Institute of Diabetes and Digestive and Kidney Diseases

Building 31, Room 9A06,
31 Center Drive, MSC 2560
Bethesda, MD, 20892-2560
Telephone: 301-496-2560
Web site: <http://www2.niddk.nih.gov>

National Institute of Environmental Health Sciences

P.O. Box 12233
Research Triangle Park, NC, 27709
Telephone: 919-541-3345
Web site: <http://www.niehs.nih.gov>

National Institute of General Medical Sciences

45 Center Drive, MSC 6200
Bethesda, MD, 20892-6200
Telephone: 301-496-7301
Web site: <http://www.nih.gov/nigms>

National Institute of Mental Health

Science Writing, Press, and
Dissemination Branch,
6001 Executive Boulevard,
Room 8184, MSC 9663
Bethesda, MD, 20892-9663
Toll free: 866-615-6464
Web site: <http://www.nimh.nih.gov>

National Institute of Neurological Disorders and Stroke

P.O. Box 5801
Bethesda, MD, 20824
Web site: <http://www.ninds.nih.gov>

National Institute on Aging
31 Center Drive, MSC 2292,
Building 31, Room 5C27
Bethesda, MD, 20892
Telephone: 301-496-1752
Web site: <http://www.nia.nih.gov>

National Institute on Alcohol Abuse and Alcoholism
5635 Fishers Lane, MSC 9304
Bethesda, MD, 20892-9304
Telephone: 301-443-3860
Web site: <http://www.niaaa.nih.gov>

National Institute on Deafness and Other Communication Disorders, National Institutes of Health
31 Center Drive, MSC 2320
Bethesda, MD, 20892-2320
Telephone: 301-496-7243 (voice)
Telephone: 301-402-0252 (TTY)
Web site: <http://www.nih.gov>

National Institute on Drug Abuse
6001 Executive Boulevard,
Room 5213
Bethesda, MD, 20892-9651
Telephone: 301-443-1124
Web site: <http://www.drugabuse.gov>

National Institutes of Health
9000 Rockville Pike
Bethesda, MD, 20892
Telephone: 301-496-4000
Web site: <http://www.nih.gov>

National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center
2 AMS Circle
Bethesda, MD, 20892-3676
Toll free: 800-624-2663(BONE)
Web site: <http://www.niams.nih.gov>

National Kidney and Urologic Diseases Information Clearinghouse
3 Information Way
Bethesda, MD, 20892-3580
Toll free: 800-891-5390
Web site: <http://kidney.niddk.nih.gov>

National Kidney Disease Education Program
3 Kidney Information Way

Bethesda, MD, 20892
Toll free: 866-454-3639
Web site: <http://nkdep.nih.gov>

National Kidney Foundation
30 East Thirty-third Street
New York, NY, 10016
Toll free: 800-622-9010
Web site: <http://www.kidney.org>

National Lead Information Center
422 South Clinton Avenue
Rochester, NY, 14620
Toll free: 800-424-LEAD
Web site: <http://www.epa.gov/lead>
A federal clearinghouse for information on lead in paint, dust, and soil.

National Library of Medicine
8600 Rockville Pike
Bethesda, MD, 20894
Web site: <http://www.nlm.nih.gov/medlineplus>
The National Library of Medicine's MedlinePlus web site contains encyclopedia articles and directs users to medical journal articles and web sites on a wide range of diseases and their treatment.

National Lymphedema Network
Latham Square, 1611 Telegraph Avenue, Suite 1111
Oakland, CA, 94612-2138
Toll free: 800-541-3259
Web site: <http://www.lymphnet.org>

National Marfan Foundation
22 Manhasset Avenue
Port Washington, NY, 11050
Toll free: 800-862-7326
Web site: <http://www.marfan.org>

National Mental Health Association
2000 N. Beauregard Street,
6th Floor
Alexandria, VA, 22311
Toll free: 800-969-6642
Web site: <http://www.nmha.org>

National Mental Health Consumer Self Help Clearinghouse
1211 Chestnut Street, Suite 1207
Philadelphia, PA, 19107

Toll free: 800-553-4539
Web site: <http://www.mhselfhelp.org>

National Mental Health Information Center
P.O. Box 42557
Washington, DC, 20015
Toll free: 800-789-2647
Web site: <http://mentalhealth.samhsa.gov>

National Multiple Sclerosis Society
733 Third Avenue
New York, NY, 10017
Toll free: 800-344-4867
Web site: <http://www.nmss.org>

National Organization for Albinism and Hypopigmentation (NOAH)
P.O. Box 959
East Hampstead, NH, 03826-0959
Toll free: 800-473-2310
Web site: <http://www.albinism.org>

National Organization for Disorders of the Corpus Callosum
18032-C Lemon Drive
Yorba Linda, CA, 92886
Telephone: 714-747-0063
Web site: <http://www.nodcc.org>

National Organization for Rare Disorders
55 Kenosia Avenue, P.O. Box 1968
Danbury, CT, 06813-1968
Toll free: 800-999-6673
Web site: <http://www.rarediseases.org>

National Organization on Fetal Alcohol Syndrome
900 17th Street NW, Suite 910
Washington, DC, 20006
Toll free: 800-66-NOFAS
Web site: <http://www.nofas.org>

National Osteoporosis Foundation
1232 Twenty-second Street NW
Washington, DC, 20037-1292
Toll free: 800-231-4222
Web site: <http://www.nof.org>

National Ovarian Cancer Coalition
2501 Oak Lawn Avenue, Suite 435
Dallas, TX, 75219

Organizations

Toll free: 888-682-7426
Web site: <http://www.ovarian.org>

National Pediculosis Association
P.O. Box 610189
Newton, MA, 02461
Toll free: 866-323-5465
Web site: <http://www.headlice.org>

National PKU News
6869 Woodlawn Avenue NE,
Suite 116
Seattle, WA, 98115-5469
Web site: <http://www.pkunews.org>

National Prion Disease Pathology Surveillance Center
Case Western Reserve University,
2085 Adelbert Road, Room 418
Cleveland, OH, 44106
Telephone: 216-368-0587
Web site: <http://www.cjdsurv.com>

National Psoriasis Foundation
6600 SW Ninety-second Avenue,
Suite 300
Portland, OR, 97223-7195
Telephone: 503-244-7404
Web site: <http://www.psoriasis.org>

National Reyé's Syndrome Foundation
P.O. Box 829
Bryan, OH, 43506-0829
Toll free: 800-233-7393
Web site: <http://www.reyessyndrome.org>

National Rosacea Society
800 South Northwest Highway,
Suite 200
Barrington, IL, 60010
Toll free: 800-NO-BLUSH
Web site: <http://www.rosacea.org>

National Scoliosis Foundation
5 Cabot Place
Stoughton, MA, 02072
Toll free: 800-NSF-MYBACK
Web site: <http://www.scoliosis.org>

National Sexual Violence Resource Center
123 North Enola Drive
Enola, PA, 17025

Toll free: 877-739-3895
Web site: <http://www.nsvrc.org>
The National Sexual Violence Resource Center is a national information and resource hub relating to all aspects of sexual violence.

National Sleep Foundation
1522 K Street NW, Suite 500
Washington, DC, 20005
Telephone: 202-347-3472
Web site: <http://sleepfoundation.org>

National Spinal Cord Injury Association
1 Church Street #600
Rockville, MD, 20850
Toll free: 800-962-9629
Web site: <http://www.spinalcord.org>

National Stroke Association
96 Inverness Drive East, Suite I
Englewood, CO, 80112-5112
Toll free: 800-787-6537
Web site: <http://www.stroke.org>

National Stuttering Association
119 W. 40th Street, 14th Floor
New York, NY, 10018
Toll free: 800-937-8888
Web site: <http://www.nsastutter.org>

National Sudden Infant Death Resource Center
2115 Wisconsin Ave., NW
Washington, DC, 20007
Toll free: 866-866-7437
Web site: <http://www.sidscenter.org>

National Tay-Sachs and Allied Diseases Association
2001 Beacon Street, Suite 204
Brookline, MA, 02146
Toll free: 800-906-8723
Web site: <http://www.ntsad.org>

National Toxicology Program
P.O. Box 12233, MD, K2-03,
111 T. W. Alexander Drive
Durham, NC, 27713
Telephone: 919-541-0530
Web site: <http://ntp.niehs.nih.gov>
The National Toxicology Program evaluates a wide range of chemicals found in food products, medicines, and the

environment for possible harmful effects on human health.

National Vitiligo Foundation
P.O. Box 23226
Cincinnati, OH, 45223
Telephone: 513-541-3903
Web site: <http://www.nvfi.org>

National Weather Service, Office of Climate, Water, and Weather Services
1325 East West Highway
Silver Spring, MD, 20910
Web site: http://www.nws.noaa.gov/om/brochures/heat_wave.shtml
The National Weather Service offers information on the heat index as well as heat-related disorders on its web site.

National Women's Health Information Center
8270 Willow Oaks Corporate Drive
Fairfax, VA, 22031
Toll free: 800-994-9662
Web site: <http://www.4woman.gov>
Web site: <http://www.womenshealth.gov>

A service of the Office on Women's Health in the Department of Health and Human Services.

Nemours Center for Children's Health Media, Alfred I. Dupont Hospital for Children
1600 Rockland Road
Wilmington, DE, 19803
Web site: <http://www.KidsHealth.org>
This organization is dedicated to issues of children's health and produces the KidsHealth web site.

Nephron Information Center
Web site: <http://www.nephron.org>
The Nephron Information Center is a gateway site with many links to information and current research.

Neuroscience for Kids
Web site: <http://faculty.washington.edu/chudler/alz.html>

A web site maintained by Eric Chudler at the University of Washington, Seattle. It features easy-to-understand information on a range of topics related to the brain and nervous system. The web site gives an extensive bibliography of readings for children and teens.

New York State Department of Health

Corning Tower, Empire State Plaza
Albany, NY, 12237
Web site: <http://www.health.state.ny.us>

The New York State Department of Health posts information on various health issues on its web site.

New York Thyroid Center, Herbert Irving Pavilion

161 Fort Washington Avenue,
8th Floor
New York, NY, 10032
Telephone: 212-305-0442
Web site: <http://cpmcnet.columbia.edu/dept/thyroid>

The New York Thyroid Center, part of the Columbia University Medical Center Department of Surgery, posts information on thyroid diseases and their treatment at its web site.

New York University Langone Medical Center

550 First Avenue
New York, NY, 10016
Telephone: 212-263-7300
Web site: <http://www.med.nyu.edu/patientcare/library>

The Langone Medical Center of New York University posts illustrated information about various diseases at its web site.

New Zealand Dermatological Society

c/o Tristram Clinic, 6 Knox Street
Hamilton, New Zealand
Web site: <http://www.dermnetnz.org>

NHS Direct

Riverside House, 2a Southwark
Bridge Road

London, UK, SE1 9HA
Web site: <http://www.nhsdirect.nhs.uk>
Britain's NHS Direct provides information on various health issues at its web site.

NLD on the Web!

Web site: <http://www.nldontheweb.org>
NLD on the Web! is a web site that provides information about nonverbal learning disabilities.

Nobel Web AB

Sturegatan 14
Stockholm Sweden
Web site: http://nobelprize.org/educational_games/medicine/immunity

The official web site of the Nobel Foundation, Nobel Web AB posts information on the immune system, including an interactive game and several articles written for children.

North American Menopause Society

5900 Landerbrook Drive, Suite 390
Mayfield Heights, OH, 44124
Telephone: 440-442-7550
Web site: <http://www.menopause.org>



Obsessive-Compulsive Foundation

P.O. Box 961029
Boston, MA, 02196
Telephone: 617-973-5801
Web site: <http://www.ocfoundation.org>

Occupational Safety and Health Administration

200 Constitution Avenue NW
Washington, DC, 20210
Web site: <http://www.osha.gov>
Part of the Department of Labor, the Occupational Safety and Health Administration helps to ensure safe and healthy working conditions.

Office of the Surgeon General

5600 Fishers Lane, Room 18-66
Rockville, MD, 20857

Telephone: 301-443-4000
Web site: <http://www.surgeongeneral.gov>
A part of the federal Office of Public Health and Science.

The Ohio State University Medical Center

410 W. 10th Avenue
Columbus, OH, 43210
Toll free: 800-293-5123
Web site: <http://medicalcenter.osu.edu/patientcare>

The OSU Medical Center posts information on many diseases at its web site.

Online Asperger's Syndrome Information and Support (OASIS)

Web site: <http://www.udel.edu/bkirby/asperger>

Operation Smile

6435 Tidewater Dr.
Norfolk, VA, 23509
Telephone: 757-321-7645.
Web site: <http://www.operationsmile.org>

Operation Smile provides cleft palate/lip surgeries for children without access to medical care in many countries.

Optometrists Network

93 Bedford Street, Suite 5D
New York, NY, 10014
Web site: <http://www.optometrists.org>

Oral Cancer Foundation

3419 Via Lido, #205
Newport Beach, CA, 92663
Telephone: 949-646-8000
Web site: <http://www.oralcancerfoundation.org>

Osteogenesis Imperfecta Foundation

804 W. Diamond Ave, Suite 210
Gaithersburg, MD, 20878
Toll free: 800-981-2663
Web site: <http://www.oif.org>

Outdoor Action Program, Princeton University

350 Alexander Street
Princeton, NJ, 08540

Organizations

Telephone: 609-258-3552
Web site: <http://www.princeton.edu/~oa/safety/hypocold.shtml>

The Outdoor Action Program at Princeton University posts the Outdoor Action Guide to Hypothermia And Cold Weather Injuries at its web site.

Ovarian Cancer National Alliance
910 17th Street NW, Suite 1190
Washington, DC, 20006
Toll free: 866-399-6262
Web site: <http://www.ovariancancer.org>

Overeaters Anonymous
P.O. Box 44020
Rio Rancho, NM, 87174
Telephone: 505-891-2664
Web site: <http://www.overeatersanonymous.org>

Overeaters Anonymous is a support organization that deals specifically with recovery from excessive eating.

P

Pan American Health Organization
525 23rd Street NW
Washington, DC, 20037
Telephone: 202-974-3000
Web site: <http://www.paho.org>

The Pan American Health Organization provides information about travel medicine in the western hemisphere on its web site.

Parents of Galactosemic Children
P.O. Box 2401
Mandeville, LA, 70470-2401
Toll free: 866-900-PGC1
Web site: <http://www.galactosemia.org>

Patient Power
9220 SE 68th Street
Mercer Island, WA, 98040-5135
Web site: <http://www.patientpower.info>

Patient Power offers a webcast series called "Living with PKU." Approaches to managing PKU, including information about a phenylalanine-restricted diet, is available from its web site.

Penn State Milton S. Hershey Medical Center
500 University Drive
Hershey, PA, 17033
Toll free: 800-243-1455
Web site: <http://www.hmc.psu.edu/healthinfo>

The Penn State College of Medicine posts health information on its web site.

Pennsylvania Coalition Against Rape
125 N. Enola Drive
Enola, PA, 17025
Telephone: 717-728-9764
Web site: <http://www.pcar.com>

PFLAG (Parents, Families & Friends of Lesbians and Gays)
1101 14th Street NW, Suite 1030
Washington, DC, 20005
Telephone: 202-638-4200
Web site: <http://www.pflag.org>

PFLAG is a national organization promoting tolerance and acceptance among gay, lesbian, and bisexual persons and their family and friends.

Pituitary Disorders Education & Support
P.O. BOX 571
Brighton, MI, 48116
Telephone: 810-923-3379
Web site: <http://www.pituitarydisorder.net/index.html>

Pituitary Network Association
P.O. Box 1958
Thousand Oaks, CA, 91358
Telephone: 805-499-9973
Web site: <http://www.pituitary.org>

Postpartum Education for Parents
P.O. Box 6154
Santa Barbara, CA, 93160
Toll free: 805-564-3888
Web site: <http://www.sbpep.org>

Postpartum Support International
P.O. Box 60931
Santa Barbara, CA, 93160

Toll free: 800-994-4PPD
Web site: <http://postpartum.net>

Prader-Willi Syndrome Association
8588 Potter Park Drive, Suite 500
Sarasota, FL, 34238
Toll free: 800-926-4797
Web site: <http://www.pwsausa.org>

Psychology Today
115 East 23rd Street, 9th Floor
New York, NY, 10010
Web site: <http://www.psychologytoday.com>

The web site of the magazine Psychology Today provides information on various psychological conditions.

Q

QuitNet
Web site: <http://www.quitnet.org>
This site helps smokers quit smoking and provides news and resources related to smoking cessation.

R

Rape, Abuse, and Incest National Network
635-B Pennsylvania Avenue SE
Washington, DC, 20003
Toll free: 800-656-HOPE
Web site: <http://www.rainn.org>

Raynaud's Association
94 Mercer Avenue
Hartsdale, NY, 10530
Toll free: 800-280-8055
Web site: <http://www.raynauds.org>

Reach Out for Youth with Ileitis and Colitis
84 Northgate Circle
Melville, NY, 11747
Telephone: 631-293-3102
Web site: <http://www.reachoutforyouth.org>

Research to Prevent Blindness
645 Madison Avenue, Floor 21
New York, NY, 10022-1010

Toll free: 800-621-0026
Web site: <http://www.rpbusa.org>

RESOLVE, The National Infertility Association

1310 Broadway
Somerville, MA, 02144
Telephone: 617-623-0744
Web site: <http://www.resolve.org>

Royal Adelaide Hospital

275 North Terrace, First Floor
Adelaide, SA, 5000, Australia
Telephone: +61 (8) 8222 5075
Web site: <http://www.stdservices.on.net/std/nsu/facts.htm>

The Royal Adelaide Hospital web site contains information on many diseases.

S

Sarcoma Foundation of American

9884 Main Street, P.O. Box 458
Damascus, MD, 20872
Toll free: 212/668-1000
Web site: <http://www.curesarcoma.org/aboutSarcoma.htm>

Scleroderma Foundation

300 Rosewood Drive, Suite 105
Danvers, MA, 01923
Toll free: 800-722-4673
Web site: <http://www.scleroderma.org>

Seasonal Affective Disorder Association

P.O. Box 989
Steyning, England, BN44 3HG
Web site: <http://www.sada.org.uk>

Seeing Eye Inc.

P.O. Box 375
Morristown, NJ, 07963-0375
Telephone: 973-539-4425
Web site: <http://www.seeingeye.org>
Seeing Eye Inc. is the pioneer guide dog school in the United States. Its web site provides an excellent overview of its history and of guide-dog training.

Selective Mutism Foundation

P.O. Box 13133
Sissonville, WV, 25360

Web site: <http://www.selectivemutismfoundation.org>

Selective Mutism Group

30 South J Street, 3A
Lake Worth, FL, 33460
Web site: <http://www.selectivemutism.org>

Sexual Medicine Society of North America

1100 E. Woodfield Road, Suite 520
Schaumburg, IL, 60173
Telephone: 847-517-7225
Web site: <http://www.smsna.org>

The Sexual Medicine Society of North America aims to promote, encourage, and support the highest standards of practice, research, education, and ethics in the study of the anatomy, physiology, pathology, diagnosis, and treatment of human sexual function and dysfunction.

Shape Up America!

6707 Democracy Boulevard,
Suite 306
Bethesda, MD, 20817
Web site: <http://www.shapeup.org>

Shape Up America! offers up-to-date information about healthy weight and increased exercise.

Sickle Cell Disease Association of America

231 East Baltimore Street, Suite 800
Baltimore, MD, 21202
Toll free: 800-421-8453
Web site: <http://www.sicklecelldisease.org>

Sickle Cell Information Center

Grady Memorial Hospital,
P.O. Box 109
Atlanta, GA, 30303
Web site: <http://www.scinfo.org>

Sight and Hearing Association

1246 University Ave. W., Suite 226
St. Paul, MN, 55104-4125
Toll free: 800-992-0424
Web site: <http://www.sightandhearing.org>

Sjögren's Syndrome Foundation

6707 Democracy Boulevard,
Suite 325
Bethesda, MD, 20817
Toll free: 800-475-6473
Web site: <http://www.sjogrens.com>

Skin Cancer Foundation

149 Madison Avenue, Suite 901
New York, NY, 10016
Telephone: 212-725-5176
Web site: <http://www.skincancer.org>

Smoke-Free.gov

Web site: <http://www.smokefree.gov>
This federal web site offers resources to help people quit smoking.

Social Phobia/Social Anxiety Association

2058 E. Topeka Drive
Phoenix, AZ, 85024
Web site: <http://www.socialphobia.org>

Social Security Administration Office of Public Inquiries

Windsor Park Building,
6401 Security Boulevard
Baltimore, MD, 21235
Toll free: 800-772-1213
Web site: <http://www.ssa.gov/disability>

The Social Security Administration maintains a web site called Social Security Online, which provides information about benefits available for people with disabilities.

Society for Adolescent Medicine

1916 Copper Oaks Circle
Blue Springs, MO, 64015
Telephone: 816-224-8010
Web site: <http://www.adolescenthealth.org>
The Society for Adolescent Medicine is committed to improving the health care of adolescents, including reproductive health issues.

Southern California Orthopedic Institute

6815 Noble Avenue
Van Nuys, CA, 91405
Telephone: 818-901-6600

Organizations

Web site: <http://www.scoi.com/scoilio.htm>

Spina Bifida Association

4590 MacArthur Boulevard, NW
Washington, DC, 20007
Toll free: 800-621-3141
Web site: <http://www.sbaa.org>

Spine-health.com

790 Estate Drive
Deerfield, IL, 60015
Telephone: 312-224-4150
Web site: <http://www.spine-health.com>

Stuttering Foundation of America

P.O. Box 11749, 3100 Walnut
Grove Road, Suite 603
Memphis, TN, 38111-0749
Toll free: 800-992-9392
Web site: <http://www.stutteringhelp.org>

Substance Abuse and Mental Health Services Administration

1 Choke Cherry Road
Rockville, MD, 20857
Toll free: 877-SAMHSA-7
Web site: <http://www.homeless.samhsa.gov>

A part of the Department of Health and Human Services, the Substance Abuse and Mental Health Services Administration provides links to numerous articles about homelessness at its Homelessness Resource Center web site.

Sudden Infant Death Syndrome Network, Inc.

PO Box 520
Ledyard, CT, 06339
Web site: <http://www.sids-network.org>

T

ThyCa: Thyroid Cancer Survivors' Association

P.O. Box 1545
New York, NY, 10159
Toll free: 877-588-7904
Web site: <http://www.thyca.org>

1904

TMJ Association

P.O. Box 26770
Milwaukee, WI, 53226-0770
Telephone: 262-432-0350
Web site: <http://www.tmj.org>

TOPS Club

4575 South 5th Street
Milwaukee, WI, 53207-0360
Toll free: 800-932-8677
Web site: <http://www.tops.org>
TOPS Club is designed for people of all ages who are trying to Take Off Pounds Sensibly (hence, the name).

Tourette Syndrome Association

42-40 Bell Boulevard, Suite 205
Bayside, NY, 11361
Toll free: 800-237-0717
Web site: <http://www.tsa-usa.org>

Trichotillomania Learning Center

207 McPherson Street, Suite H
Santa Cruz, CA, 95060-5863
Telephone: 831-457-1004
Web site: <http://www.trich.org>

TSS Information Service

P.O. Box 450
Godalming Surrey GU7 1GR UK
Web site: <http://www.toxicshock.com>

Turner Syndrome Society of the United States

10960 Millridge North Drive,
No. 214A
Houston, TX, 77070
Toll free: 800-365-9944
Web site: <http://www.turnersyndrome.org/index.php>

U

UNAIDS

20 Avenue Appia
CH - 1211 Geneva 27, Switzerland,
Telephone: 41-22-791-3666
Web site: <http://www.unaids.org/en>
UNAIDS is the Joint United Nations Program on HIV/AIDS, which works globally to fight the epidemic.

Union of Concerned Scientists

1600 Clifton Road
Atlanta, GA, 30333
Toll free: 800-311-3435
Web site: <http://www.ucsusa.org>

A science-based, nonprofit organization that combines independent scientific research and citizen action to work toward a healthy environment and a safer world.

United Cerebral Palsy

1660 L Street NW, Suite 700
Washington, DC, 20036
Toll free: 800-872-5827
Web site: <http://www.ucp.org>

United Ostomy Association

19772 MacArthur Boulevard
Irvine, CA, 92612-2405
Toll free: 800-826-0826
Web site: <http://www.uoa.org>

University of California, San Francisco Memory and Aging Center

400 Parnassus Avenue
San Francisco, CA, 94143
Telephone: 415-476-6880
Web site: <http://www.ucsfhealth.org>

University of Iowa Hospitals and Clinics

200 Hawkins Drive
Iowa City, IA, 52242
Web site: <http://www.uihealthcare.com>
The University of Iowa Hospitals and Clinics posts information on a variety of diseases at its web site.

University of Maryland Medical Center

22 S. Greene Street
Baltimore, MD, 21201-1595
Telephone: 410-328-8667
Web site: <http://www.umm.edu/ency>
The University of Maryland Medical Center publishes information on various conditions at its web site.

University of Michigan Health System

1500 E. Medical Center Drive
Ann Arbor, MI, 48109

Telephone: 734-936-4000
 Web site: <http://www.med.umich.edu>
The University of Michigan Health System posts information on various conditions as part of its web-based Health Advisors.

University of Texas M. D. Anderson Cancer Center
 1515 Holcombe Boulevard
 Houston, TX, 77030
 Toll free: 800-392-1611
 Web site: <http://www.mdanderson.org/diseases/braincancer>
The M. D. Anderson Cancer Center provides a section on brain tumors at its web site.

University of Virginia Health System
 P.O. Box 800224
 Charlottesville, VA, 22908
 Telephone: 434-924-3627
 Web site: <https://www.med.virginia.edu/uvahealth>
The University of Virginia posts information about many health issues on its web site.

V
Vanderbilt University Medical Center, Delirium and Cognitive Impairment Study Group, Center for Health Services Research
 1215 21st Avenue S., 6th Floor
 Medical Center East, Suite 6000
 Nashville, TN, 37232-8300
 Telephone: 615-936-1010
 Web site: <http://www.icudelirium.org/delirium>
Vanderbilt University Medical Center and Veterans Administration sponsor a web site that provides information regarding the identification and treatment of delirium among intensive

care patients. The introductory sections on delirium are particularly good.

Vascular Disease Foundation
 1075 S. Yukon, Suite 320
 Lakewood, CO, 80226
 Telephone: 303-989-0500
 Web site: <http://www.vdf.org>

Vestibular Disorders Association
 P.O. Box 13305
 Portland, OR, 97213-0305
 Web site: <http://www.vestibular.org>

W
Wake Forest Institute for Regenerative Medicine
 Richard H. Dean Biomedical Research Building, 391 Technology Way
 Winston-Salem, NC, 27157
 Telephone: 336-713-7293
 Web site: <http://www.wfirm.org>

The Wake Forest Institute for Regenerative Medicine was in 2009 focused on tissue engineering as a way to treat battlefield injuries as well as solve the problem of the shortage of donors for organ transplantation.

WE MOVE
 204 West 84th Street
 New York, NY, 10024
 Toll free: 800-437-MOV2
 Web site: <http://www.wemove.org>

WE MOVE is dedicated to educating and informing patients, professionals and the public about the latest clinical advances, management, and treatment options for neurologic movement disorders.

Weight-control Information Network
 1 WIN Way
 Bethesda, MD, 20892-3665
 Toll free: 877-946-4627
 Web site: <http://win.niddk.nih.gov>

The Weight-control Information Network is a federally supported web site dealing with obesity and weight control

White Ribbon Campaign
 365 Bloor Street East, Suite 203
 Toronto, Ontario,
 Canada, M4W 3L4,
 Telephone: 416-920-6684
 Web site: <http://www.whiteribbon.ca>
A nonprofit organization focusing on men working to end men's violence against women.

Williams Syndrome Association
 P.O. Box 297
 Clawson, MI, 48017
 Toll free: 800-806-1871
 Web site: <http://www.williams-syndrome.org>

World Health Organization
 Avenue Appia 20
 1211 Geneva 27, Switzerland
 Web site: <http://www.who.int>

World Organization for Animal Health
 12 rue de Prony
 Paris, France, 75017
 Telephone: +33 (0)1 44 15 18 88
 Web site: <http://www.oie.int>

The World Organization for Animal Health provides information on diseases that affect animals, including avian influenza.

Y
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The Yale Child Study Center has been committed to research, treatment, and training related to children and their families for nearly 100 years.

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