

# 100

# QUESTIONS & ANSWERS

Why and how  
did I get diabetes?

○○○○

What is the  
difference between  
type 1 and  
type 2 diabetes?

○○○○

Are there any  
medications I  
can take to help  
prevent diabetes?

○○○○

How does my  
doctor confirm  
the diagnosis of  
diabetes?

○○○○

What can happen  
if my diabetes is  
not properly treat-  
ed and controlled?

*About*

# Diabetes



*by*

Michael Bryer-Ash, MD,  
FRCP (Lond), FRCP (C)

# **100 Questions & Answers About Diabetes**

Michael Bryer-Ash, MD  
FRCP(Lond), FRCP(C)



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## Dedication

This book is dedicated to the memory of the late Dr. Jonathan B. Jaspan (1947–1997), a consummate clinician and educator and a talented researcher, who gave much to the field of diabetes and touched the lives of many.



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Diabetes is a disease that is different from most other diseases for two important reasons. First, like hypertension, it can be a “silent killer.” That is, there are few symptoms until late in the disease, at which time it is usually too late to reverse the damage. Because of this lack of symptoms, people with diabetes, and too often their physicians, do not give it a high priority. This is one of the reasons that diabetes is the leading cause of blindness in people less than 74 years of age, the leading cause of dialysis (using machines to replace kidney function), and the major reason for amputations of toes, feet, and legs. All of this need not happen if glucose levels in people with diabetes could be kept to near-normal levels.

Second, people with diabetes must be actively involved in its treatment. For almost all other diseases, doctors prescribe medicines and the only responsibility for the patient is to take them appropriately. Not so with diabetes. Patients must carefully watch their diet, exercise more often, measure their own glucoses in many cases, and keep appointments in which preventive tests (e.g., measurements of albumin leakage into the urine) and examinations (e.g., dilated eye exams by qualified ophthalmologists) are carried out—all of this when patients feel fine. Therefore, people with diabetes must know a lot about their disease to stay motivated and to be able to make appropriate decisions that would minimize bad outcomes from this disease.

Dr. Bryer-Ash’s book, *100 Questions & Answers About Diabetes*, should be very helpful in that regard. In addition to basic information about diabetes, it discusses topics not usually covered by more basic books for the public. These topics include discussions of potential cures for diabetes, prevention of diabetes, important

information for family members and caregivers of people with diabetes; hints for developing a professional career in diabetes, for volunteering in diabetes, for advocating for diabetes causes, for developing support groups; critical information for participating in sports, for smoothing the experience of children in their school environments, and for travel across time zones. The book is written for the sophisticated reader. This audience will benefit immeasurably from reading Dr. Bryer-Ash's book and certainly will not feel "talked down to." Instead, with this information, they will be important members, indeed the most important members, of the team that is caring for their diabetes.

**Mayer B. Davidson, MD**

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*Charles Drew University &*

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*Past President, American Diabetes Association*

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# *What Is Diabetes?*

Why and how did I get diabetes?

What are the symptoms of diabetes?

Is there such a thing as borderline diabetes?  
What is it?

*More . . .*

## *1. Why and how did I get diabetes?*

### **Deficiency**

A lack or shortage, especially of something essential to health.

### **Insulin**

A hormone produced by the beta cells of the pancreas, which facilitates the entry of glucose and other substances into cells and which has several other functions.

### **Pancreas**

A gland deep in the abdomen, behind the stomach, that produces hormones (insulin, glucagon) and digestive enzymes.

### **Glucose**

A basic sugar used to fuel body cells.

### **Type 1 diabetes**

Characterized by an almost complete deficiency of insulin due to the immune system erroneously attacking and destroying the insulin-producing cells in the pancreas.

Diabetes occurs for a number of reasons, but the ultimate cause of the high blood sugar that characterizes the disorder is either **deficiency** of the hormone **insulin** or a combination of insulin deficiency and resistance of the body tissues to its actions. In response to food intake, insulin is released by specialized cells in the **pancreas** and is necessary for adequate amounts of **glucose** and other nutrients from food to be absorbed into certain tissues of the body. When insulin is lacking or the body resists its actions, the level of glucose in the blood becomes excessively high and diabetes is diagnosed. The difference in the balance between the two characterizes the two major forms of diabetes—type 1 and type 2 (see Question 2). Whatever the form of diabetes, its basis is to some extent hereditary and to some extent environmental. The hereditary contribution is more or less constant throughout recent human evolution. It is the environmental component that has changed markedly over the last 100 years, leading to the dramatic rise in the frequency of diabetes in almost all societies. You developed diabetes because either you are strongly predisposed due to hereditary reasons or because there are factors in your lifestyle and environment (such as gaining weight, getting insufficient exercise, taking certain medications) that increase the likelihood of diabetes or, as is usually the case, a combination of both. This is not all bad, because the environment and lifestyle can often be changed, with dramatic improvement in the severity of the diabetes. For more on this, see Question 5.

## *2. What is the difference between type 1 and type 2 diabetes?*

**Type 1 diabetes** is entirely due to an almost complete deficiency of insulin. The deficiency is the result of

the **immune system** erroneously attacking and destroying the insulin-producing cells in the pancreas. For the proper functioning of our bodies, it is necessary for insulin to be present at all times in the bloodstream and tissues, not only after we have eaten. Insulin is essential to maintain the structure of our tissues and prevent them from being broken down in an uncontrolled manner. Without any insulin present, our tissues literally melt away into simple compounds that leave our bodies when we urinate. Accordingly, people with type 1 diabetes have high levels of sugar and breakdown products of fat and protein in the bloodstream and urine and develop the typical symptoms described in Question 4.

**Type 2 diabetes** is due to a combination of our body tissues becoming resistant to the action of insulin (for the reasons described previously in Question 1) and the inability of the pancreas to make enough extra insulin to overcome it. Although this latter component of the problem is often viewed as a failure of the pancreas, it is not true in the strictest sense. While it is common for the insulin-producing capability of the pancreas to decline throughout later adult life, it was nevertheless sufficient throughout most of human evolution to prevent us from developing diabetes. It is only in recent times, when our lifestyle and environment have caused many of us to become very insulin resistant, that the insulin-producing capacity is unable to compensate. In the true sense, it fails because we impose an excessive load upon it. This is true, even for those of us who have a hereditary predisposition to becoming insulin resistant. The difference between the two forms of diabetes is illustrated in **Figure 1**.

### **Immune system**

The body's system that protects it from foreign substances, cells, and tissues. The immune system includes the thymus, spleen, lymph nodes, lymphocytes, B-cells and T-cells, and antibodies.

### **Type 2 diabetes**

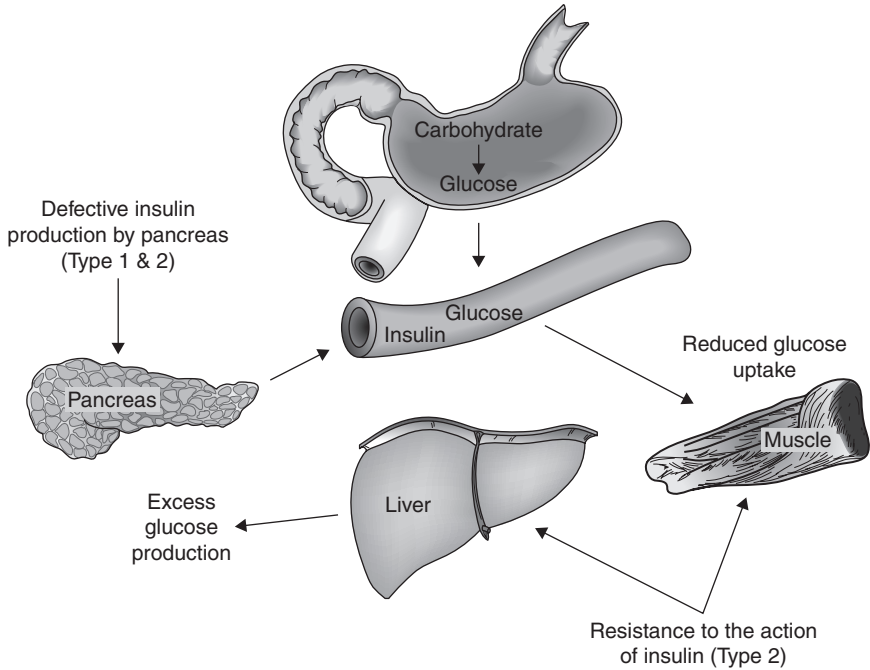
Caused by a combination of body tissues becoming resistant to the action of insulin and the inability of the pancreas to make enough extra insulin to overcome it.

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*It is only in recent times, when our lifestyle and environment have caused many of us to become very insulin resistant, that the insulin-producing capacity is unable to compensate.*

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**Figure 1** The cause of type 1 and type 2 diabetes.

### ***3. What is the difference between diabetes mellitus and diabetes insipidus?***

The word diabetes is an interesting one. Its origin is in the Greek language where it is derived from the word for a siphon or, more simply, a pipe or hose. This word was used to describe the disorder in ancient times (and diabetes was recognized in great antiquity) because those suffering from it produced such plentiful amounts of urine that they were reminiscent of a water pipe. The reason for the plentiful amounts of urine lies in the fact that when the sugar glucose reaches excessively high levels in our bloodstream, it is filtered into the kidney and enters the urine in large quantities. Due to its chemical and

physical properties, when large amounts of glucose are filtered by our kidneys into the urine, it cannot be fully reabsorbed and retains a large amount of water with it, thus creating very large volumes of urine. The second part of the name, **mellitus**, is derived from the word meaning sweet, as in mellifluous music. Mellitus was added when it was discovered that the urine in a person with diabetes and very high blood sugar is sweet.

**Diabetes insipidus** is a disorder with an entirely different basis, but its sufferers share the siphon-like quality of very frequent and very high volume urination. Diabetes insipidus is due to failure of production or action of another vital hormone, known as **arginine vasopressin (AVP)**, also called **antidiuretic hormone (ADH)**, that is responsible for maintaining the normal volume and concentration of our urine. When AVP is deficient (usually due to damage or disease of the hypothalamus or pituitary gland) or fails to work (usually due to disease of or damage to the kidney), we are unable to concentrate our urine and it becomes excessively dilute. As such, it appears pale, almost colorless and watery—in a word insipid, hence *insipidus*. It is not sweet, as it has negligible amounts of sugar in it.

#### ***4. What are the symptoms of diabetes?***

The typical symptoms of diabetes occur as a result of the high levels of glucose in the bloodstream and its passage into the urine and other tissues. These are frequent urination and thirst. Thirst arises as a result of the dehydration caused by the frequent urination. Dehydration and loss of nutrient calories in the urine lead to weight loss and hunger. Passage of glucose into the tissues of the eye can cause fluctuating

#### ***Diabetes mellitus***

A condition characterized by inadequate production of insulin or resistance of the body's tissues to its actions, which results in excessive levels of glucose in the blood.

#### ***Diabetes insipidus***

Increased urine production caused by inadequate secretion of vasopressin by the pituitary gland or by resistance of the kidney to its actions.

#### ***Arginine vasopressin (AVP)***

A hormone that is responsible for maintaining the normal volume and concentration of our urine. Also called antidiuretic hormone (ADH).

#### ***Antidiuretic hormone (ADH)***

A hormone that is responsible for maintaining the normal volume and concentration of our urine. Also called arginine vasopressin (AVP).

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*One of every four people believed to have diabetes is unaware of it and is undiagnosed.*

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#### **Neuropathy**

Nerve damage.

#### **Prediabetes**

A condition in which abnormalities in plasma glucose levels lie in-between normal and standard accepted definitions of diabetes.

"Borderline diabetes," "impaired fasting glucose," and "impaired glucose tolerance" are other terms used to describe types of this condition.

#### **Retinopathy**

Eye damage.

#### **Nephropathy**

Kidney damage.

degrees of blurred vision. When these symptoms are prolonged and severe, as is typical with type 1 diabetes, serious changes occur in our blood chemistry due to the deficiency of insulin. Those changes, coupled with dehydration, result in dizziness, weakness, drowsiness, and ultimately coma, which if untreated can lead to death. Both type 1 and type 2 diabetes, when severe and inadequately treated, can be associated with coma and death. Although coma is less common in type 2 diabetes, it is more common for it to result in death, as people with type 2 diabetes tend to be older and to have more medical problems. Two other important points are worth noting. The first is that diabetes may not cause any symptoms. In fact, one of every four people believed to have diabetes is unaware of it and is undiagnosed. However, as diabetes of even moderate severity can lead to complications and shorten lifespan, it is important to make the diagnosis, even in people without symptoms. The second point is that the majority of people with diabetes may not have any symptoms from the elevated blood sugar, but it can still present with symptoms from its complications. Thus, people may be diagnosed with diabetes after presenting with symptoms of nerve damage (**neuropathy**—see Question 32) or a heart attack or stroke (see Question 35). In fact, one of every three people admitted with a sudden heart event is found to have diabetes or **prediabetes** (see Question 9) of which he or she or the doctor was unaware. Neuropathy is present in two of every five patients with type 2 diabetes at the time of diagnosis, while eye damage (**retinopathy**—see Question 33) is present in one of every five and kidney damage (**nephropathy**—see Question 34) is present in one in ten, indicating that the diabetes was ongoing for many months or even years before diagnosis.

## 5. *Can diabetes be cured?*

In general, we do not consider that diabetes can be cured once it has been diagnosed. People with type 2 diabetes can reverse the detectable abnormalities of diabetes by lifestyle adjustment without the use of medications (discussed in Question 28). However, the tendency to manifest high blood sugar again is always present if the patient is under significant metabolic stress, such as that caused by medications, severe illness, injury, regaining lost weight, cessation of exercise, aging, etc. Therefore we consider that diabetes can be under excellent control or in **remission**, but we do not usually use the word cured. Even people with type 1 diabetes who have undergone successful pancreas or islet transplantation and no longer require insulin therapy cannot be considered cured. There is a significant possibility that their diabetes will one day come back for a variety of reasons, including rejection of the transplant or a renewed attack on the transplanted **islet tissue** by the patient's immune system.

Perhaps the closest we have been able to come in the search for a true cure for diabetes is the effect of **bariatric surgery** (“weight loss surgery”), which either involves procedures to restrict the entry of food into the stomach or procedures to bypass the stomach and upper intestine, thus reducing food absorption. Procedures of the bypass type have shown prolonged remission of diabetes in up to 80% of cases for as long as 10 years. Remission for 10 years or more is approaching a definition of a true cure, and in the future this and other medications or procedures that provide a long-term reversal of obesity may come to be generally accepted as “curing” type 2 diabetes.

### **Remission**

A temporary or permanent decrease of manifestations of a disease.

### **Islet tissue**

Groups of cells found within the pancreas that produce and release insulin, glucagons, and other substances.

### **Bariatric surgery**

Weight loss surgery.

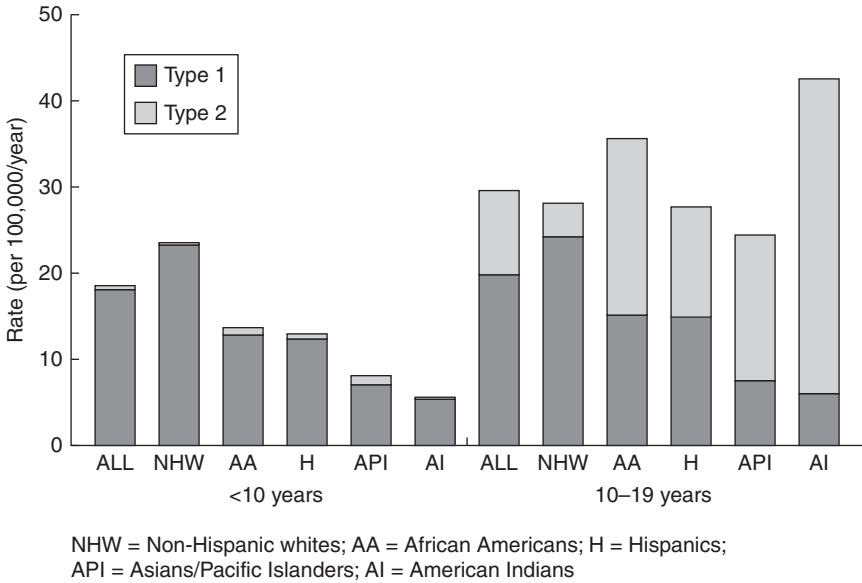
## ***6. Does diabetes affect all racial groups equally?***

No, there are significant differences in the hereditary tendency to acquire diabetes (**Figure 2**). In general Caucasians (non-Hispanic whites) have a lower tendency to develop type 2 diabetes than other ethnic groups. The situation with regard to type 1 diabetes is the opposite, with the highest prevalence currently being in the regions in and near Finland, Sardinia, and Kuwait. Lifestyle does not appear to be more important than the hereditary tendency in determining the chance of a person to develop type 1 diabetes. However, in the case of type 2 diabetes it is an important factor. Thus, certain ethnic groups may have a very high tendency to develop type 2 diabetes under one set of environmental circumstances, but they may have a very low tendency under different environmental conditions. A case in point is the Pima tribe of Native Americans living in Arizona. Half of the Pima have type 2 diabetes, while their genetically related cousins living in the Chiapas region of Mexico pursuing a nonurban lifestyle have a low frequency of the disorder. The two most common and most important factors contributing to a high prevalence of type 2 diabetes in groups at high hereditary risk are weight gain and lack of physical exercise.

## ***7. Are my brothers and sisters and my children at risk of diabetes?***

If you have type 1 diabetes, your first-degree relatives (i.e. mother, father, brother, sister, and your children) are about ten times more likely than the general population to get type 1 diabetes. The frequency of type 1 diabetes in the general population is about half a percent (i.e., one in two hundred), so the risk in your first-degree relatives is about  $10 \times 1/2$ , or 5%. Fortunately, this is not particularly

**Rate of new cases of type 1 and type 2 diabetes among youth aged <20 years, by race/ethnicity, 2002–2003**



**Figure 2** Difference in frequency of occurrence of diabetes by race and ethnicity.

Source: Courtesy of SEARCH for diabetes in youth study.

high. Also, it is related to age. About 90% of cases of type 1 diabetes occur before age 35. Therefore, the parents of a person with type 1 diabetes are at considerably less, and ever decreasing, risk compared to his or her siblings and children. The risk of getting type 1 diabetes for an identical twin of a person with type 1 diabetes is 30–50%, indicating that environmental factors are very important, even though they are not well understood. In the case of type 2 diabetes, the risk is considerably higher. On average, one out of three of the children of an individual with type 2 diabetes will develop the disease. Two out of three of the children will develop diabetes when both parents have the disease. The risk of getting type 2 diabetes for an identical twin of a person with type 2 diabetes is 75–90%, indicating that genetic (hereditary) factors are very important.

## 8. Can a person have both type 1 and type 2 diabetes at the same time?

Generally speaking, we do not diagnose both disorders in the same individual. If people have type 1 diabetes, they are completely lacking effective circulating insulin. By definition, this is not the case in people with type 2 diabetes, so having the one disorder effectively rules out the other. However, people with type 1 diabetes may be prone to the same metabolic problems as those with type 2 diabetes. In other words, if people with type 1 diabetes gain weight, become sedentary, or are members of an ethnic group at high risk for type 2 diabetes, they may become insulin resistant and their diabetes will be more difficult to control. Higher doses of insulin will be required and they may develop the metabolic problems that tend to be associated with type 2 diabetes, such as cholesterol and related blood fat abnormalities, as well as high blood pressure. These will add to their risk of cardiovascular disease. Some people with apparent type 2 diabetes appear to have a partial form of type 1 diabetes, which has stopped short of complete destruction of their insulin-producing cells in the pancreas. This is known as LADA or *latent autoimmune diabetes of the adult*. They tend to require insulin treatment earlier in the course of their diabetes, but are not considered to have both diseases.

### Borderline diabetes

A condition in which plasma glucose falls in between normal and standard accepted definitions for diabetes. "Prediabetes" is another term commonly used for the same condition.

### Fasting

Abstaining from eating food, usually for nine hours or more.

## 9. Is there such a thing as borderline diabetes? What is it?

The term **borderline diabetes** has now been replaced by the term *prediabetes*. Both terms indicate that a person has abnormalities in his or her plasma glucose levels that fall short of standard accepted definitions for frank diabetes. **Table 1** shows the normal ranges for both **fasting** plasma glucose and for plasma glucose after a

**Table 1 Definition of Diabetes & Prediabetes**

Normal Blood Sugar	mg/dl	mmol/L
Fasting 2 hours after glucose*	60–99 less than 140	3.3–5.5 less than 7.8
<b>Prediabetes:</b> Fasting 2 hours after glucose	100–125 140–199	5.6–6.9 7.8–11.1
<b>Diabetes:</b> Fasting 2 hours after glucose Anytime	126 or above 200 or above 200 or above with symptoms**	7.0 or above 11.2 or above

\*75 Grams of glucose by mouth.

\*\*Such as thirst, frequent urination, weight loss or blurred vision.

glucose load by mouth. The reason that a standardized 75 gram (a little under 3 ounces) glucose load is used is to allow a direct comparison between different individuals under the same conditions. The table also shows the glucose levels above which diabetes is diagnosed. The range between the upper end of normal and diabetes itself is the prediabetic range. For fasting glucose, the range is 100 to 125 mg/dl and for glucose values 2 hours after a standard 75 gram glucose drink by mouth, it is 140 to 199 mg/dl. The former is termed *impaired fasting glucose*, or IFG, and the latter is termed *impaired glucose tolerance*, or IGT. When either is present, an individual is described as having prediabetes. There are at least two reasons why it is important to identify prediabetes. One reason is that people with prediabetes have a known increased risk of progression to frank type 2 diabetes and, second, prediabetes, especially of the IGT type, is associated with a significantly higher risk of cardiovascular disease and death. Therefore, knowledge that one has prediabetes necessitates regular follow-up and also permits early intervention to prevent progression to frank diabetes.

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*Knowledge that one has prediabetes necessitates regular follow-up and also permits early intervention to prevent progression to frank diabetes.*

---



## ***10. Why do some women get diabetes when they are pregnant? Is this dangerous for them or their baby?***

Pregnancy is a situation in which insulin resistance (see Question 2) is a normal feature. This is because it is beneficial for the nutrients absorbed from a pregnant woman's meals to be channeled first to the growing fetus. The development of maternal insulin resistance in the second half of pregnancy assures that this will occur. At least part of the reason for the development of maternal insulin resistance is that the placenta produces substances that lead to insulin resistance and as the placenta grows, the insulin resistance increases. This is called physiologic (i.e., normal) insulin resistance. Indeed, a healthy pregnant woman may be more insulin resistant than the average patient with type 2 diabetes! However, the vast majority (>95%) of otherwise healthy pregnant women do not get diabetes in this situation because the pancreas is able to make enough insulin to overcome the insulin resistance and keep the glucose levels normal. A small minority of women cannot do so and their glucose levels rise. These women tend to be the same women who are destined to get type 2 diabetes later in life. The risk of developing type 2 diabetes is much higher in a woman who has had diabetes detected in pregnancy (**gestational diabetes mellitus** or GDM). GDM provides a unique opportunity to follow the natural history of type 2 diabetes in the years prior to its onset in women, since most GDM goes away very rapidly, often within hours, after the baby is delivered and reappears in later life as type 2 diabetes. If untreated, GDM can cause harm to both mother and baby, especially at or soon after delivery. Fortunately, outcomes of GDM are generally excellent in most developed countries.

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*A healthy pregnant woman may be more insulin resistant than the average patient with type 2 diabetes!*

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### **Gestational diabetes mellitus (GDM)**

Diabetes detected in pregnancy.

# *Can Diabetes Be Prevented?*

Does regular exercise help to prevent type 2 diabetes?

Is there a particular type of diet that will reduce my chance of type 2 diabetes?

Are there any natural herbs, minerals, or other remedies that prevent diabetes?

*More . . .*

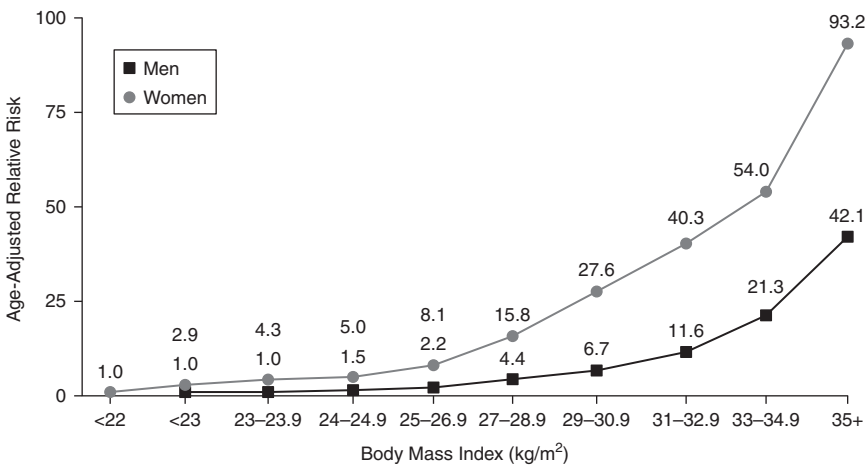
## 11. How does my weight affect my risk of type 2 diabetes?

### Body mass index (BMI)

A clinical means of relating weight to height by a formula. To calculate your own BMI, divide your weight in pounds by the square of your height in inches (i.e., your height multiplied by itself) and then multiply the answer by 703.

*A BMI of 18 to almost 25 is considered to be healthy.*

Weight and risk of type 2 diabetes are clearly linked. **Figure 3** shows the risk of development of type 2 diabetes, as it relates to body weight. For clinical purposes, weight is related to height by a formula known as **body mass index** or BMI. In our society, a BMI of 18 to almost 25 is considered to be healthy and from 25 to almost 30 is considered overweight. From 30 to 35 is considered to be obese and from 35 to 40 is severely obese. A BMI that is greater than 40 is considered morbidly obese, indicating that a person with this degree of obesity is at very serious risk of both immediate and long-term health problems. To calculate your own BMI, divide your weight in pounds by the square of your height in inches (i.e., your height multiplied by itself) and then multiply the answer



**Figure 3** Relationship between weight risk of type 2 diabetes.

Source: Data from Chan JM et al. *Diabetes Care*. 1994;17:961–969; Colditz G et al. *Ann Intern Med*. 1995;122:481–486.

by 703. For example, if you are 5 feet 8 inches (68 inches) tall and weigh 148 pounds, your BMI will be 148 divided by  $68 \times 68$ , i.e.,  $148/4624 = 0.032$  and then multiplied by 705, i.e., your BMI is 22.6. Congratulate yourself, as your weight is in the healthy range! Figure 3 shows the risk for development of type 2 diabetes according to weight for both men and women. The risk of having type 2 diabetes increases as weight increases, even within the normal range, especially for women. Severe and morbid obesity are associated with an almost 100 times greater chance of diabetes in women and almost 50 times for men. The reason for this is principally because the likelihood of having insulin resistance, a major causative factor for type 2 diabetes (see Question 2), increases as weight rises. Very physically active individuals who are overweight or obese by usual standards may be at little increased risk due to the protective effect of exercise (see Question 12).

### ***12. Does regular exercise help to prevent type 2 diabetes?***

Yes, regular exercise of at least moderate intensity provides some protection against the onset of type 2 diabetes. Exercise improves insulin resistance and thereby makes insulin more effective at removing glucose from the blood. In patients with prediabetes (see Question 9), exercise can prevent the progression of elevated glucose values toward the frankly diabetic range, or even restore them to normal. Exercise also consumes **calories** from those stored in the exercising muscle as starch (**glycogen**) and the need to replenish these stores draws glucose out of the bloodstream and thereby reduces the circulating levels. Exercise also helps to maintain a healthy body weight and avoid the weight gain that can lead to diabetes (see Question 11),

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*Regular exercise of at least moderate intensity provides some protection against the onset of type 2 diabetes.*

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#### **Calorie**

A unit used to express heat or energy value of food.

#### **Glycogen**

Starch, which comprises sugars linked together in a storage pattern.

although it is not as certain that exercise is as helpful in promoting weight reduction. Weight reduction is much more dependent on restriction of food intake. However, exercise is clearly important in maintaining weight loss. Finally, it is worth noting that exercise has beneficial effects on the other risk factors that combine with diabetes to cause vascular disease. For example, exercise increases the good (or **HDL**) cholesterol and improves levels of other blood fats, while lowering blood pressure and enhancing cardiovascular (i.e., heart and blood vessel) conditioning.

**HDL**

High-density lipoprotein; “good cholesterol.”

### *13. Are there any medications I can take to help prevent diabetes?*

Yes, there are a number of medications that will help to reduce the likelihood of a person developing type 2 diabetes, but not type 1 diabetes. These are shown in **Table 2**. None are labeled by the Food and Drug Administration for this indication. Our use of them is mainly confined to choosing a drug that will tend to slow progression to type 2 diabetes when the drug is needed for another condition. For example, when a patient at risk for diabetes needs treatment for high blood pressure, one would consider using a drug that has been shown to slow progression to diabetes in

**Table 2 Medications That May Help to Prevent Diabetes**

Medication	Approved Use
Ramipril	Blood pressure
Losartan	Blood pressure
Carvedilol	Blood pressure
Metformin	Type 2 diabetes
Acarbose	Type 2 diabetes
Hydroxychloroquine	Rheumatoid arthritis, malaria
Vitamin D	Vitamin supplementation
Aspirin	Pain and inflammation

those at high risk, as opposed to one that might actually accelerate it. Early use of drugs that are approved to treat type 2 diabetes in people at high risk of development of type 2 diabetes (mainly those with prediabetes—for definition see Question 9) has also been shown to prevent or delay the onset of the disease. Examples of this use are also shown in Table 2. Whether this represents prevention of diabetes or pretreatment of diabetes is not conclusively known. To be considered true prevention, the drug needs to modify the course and progression of the underlying factors leading to the disease and not merely lower the blood sugar. This means the rate at which those at risk progress to diabetes should be reduced in a sustained manner. It should be emphasized that one must be very cautious in advocating the use of oral antidiabetic drugs in this manner. The FDA and other authoritative bodies have not evaluated the ratio of risk to benefit sufficiently to recommend their use in prediabetes.

#### ***14. Is there a particular type of diet that will reduce my chance of type 2 diabetes?***

The most important aspect of any diet to prevent type 2 diabetes is its calorie (i.e., energy) content. If calorie intake exceeds calorie usage, then the excess calories will, in the absence of other modifying factors, be directed toward the body's energy storage compartment, which is, of course, the fat tissue. Therefore, a diet that matches calorie consumption with output is the key to prevention of overweight and obesity and therefore diabetes. If one is already overweight, then the diet should provide fewer calories than are required, so that energy will be drawn from the body fat stores and gradual weight loss will occur. Even

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*The most important aspect of any diet to prevent type 2 diabetes is its calorie (i.e., energy) content.*

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modest weight loss can be very beneficial. The benefits can be shown very early, almost as soon as calorie intake drops below that required to maintain body weight and before significant weight loss actually occurs. The consumption side of this balance is, of course, food intake. The output side that we can control is exercise. Neither can operate successfully to regulate weight independent of the other. Very calorie-dense foods, such as those with a high fat content (e.g., cheese, ice cream, fried foods, and processed meats) are common components of diets that lead to weight gain, obesity, and ultimately diabetes. Although sugar itself does not cause diabetes, foods with a high content of refined sugar, such as sodas and candies, are also more likely to be associated with weight gain and diabetes than those with natural sugars. Natural sugars tend to be associated with **fiber**, which delays and limits their absorption. Thus, portion for portion, more sugar is consumed in foods high in refined sugar. The question of whether a specific diet composition can prevent diabetes, independent of its actual energy content, is not entirely known. Studies have shown that diets high in grain and fiber tend to be associated with a lower frequency of diabetes in the population. This may be related to the more gradual breakdown and absorption of the components of the meal, especially the **carbohydrates**, as discussed previously.

### **Fiber**

The structural part of plants and plant products that consists of carbohydrates that are wholly or partially indigestible.

### **Carbohydrates**

Substances composed of long chains of oxygen, hydrogen, and carbon molecules. Carbohydrates in food (for example, sugar and starch) provide energy for the body and, if present in excess, are stored as fat.

Since, in all parts of the world, the explosive rise in diabetes is clearly linked to weight gain (with some population groups being more susceptible than others) rather than to a specific type of diet, the dietary focus should remain on eating a healthy diet that provides the recommended amounts of important nutrients, in quantities necessary to maintain a healthy weight (see Question 11) and prevent undesirable weight gain.

For more information, visit <http://www.diabetes.org/nutrition-and-recipes/nutrition/foodpyramid.jsp>.

### ***15. Does stress affect my risk of getting diabetes?***

The perception of stress differs greatly among individuals. What one person may perceive as stressful, another may not. For this reason, stress is quite hard to measure in real-life situations. Artificial measures of accepted stress, such as electric shocks or deprivation of sleep, are very hard to apply to day-to-day life. However, people who report that they are more stressed, regardless of the actual nature of the stress itself, are more likely to suffer from diabetes. Furthermore, it has recently become apparent that measurable physical and psychological stress, such as that caused by sleep deprivation and social stress, is more likely to be associated with the presence of diabetes. This may in part explain the difference in the frequency of diabetes found in people of similar genetic background and measurable physical characteristics (body weight, amount of exercise, etc.) in different regions and societies. Exactly how perceived stress, whether physical, social, or psychological, leads to diabetes is not yet understood.

### ***16. What other factors increase my risk of getting diabetes?***

Besides excess weight, hereditary risk, and lack of exercise, another factor that can increase the risk of developing diabetes is the use of certain medications. Among these medications, the type associated most strongly with increased risk are the steroids (also called glucocorticoids), whose members include prednisone, methylprednisolone, hydrocortisone, and

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*Among these medications, the type associated most strongly with increased risk are the steroids (also called glucocorticoids).*

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**Counterregulatory hormones**

Naturally occurring hormones that prepare the body to combat stress.

dexamethasone. The steroids belong to a class of naturally occurring stress hormones known as **counter-regulatory hormones**, which prepare the body to combat stress. They tend to raise blood sugar. Other stress hormones include the so-called *catecholamines* such as epinephrine (adrenaline) and norepinephrine (noradrenaline), which also raise the blood sugar. Synthetic versions of these compounds, which include some drugs used in weight loss medications, cold and allergy medications, asthma medications, and stimulants, can also cause a rise in blood sugar. Certain types of diuretic pills (“water pills”) such as thiazides can also occasionally raise blood sugar, although these pills are commonly and appropriately used in people with diabetes. A certain type of cholesterol-modifying drug known as niacin can raise the blood sugar, sometimes quite markedly. The long-acting (“extended release”) version of niacin is less likely to do this. Certain types of medications used to treat psychiatric conditions (the atypical antipsychotics) can lead to a higher frequency of diabetes, although this appears to be largely due to their tendency to cause weight gain. Certain classes of antiviral drugs, especially those used for the treatment of HIV/AIDS, can lead to diabetes.

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*Certain classes of antiviral drugs, especially those used for the treatment of HIV/AIDS, can lead to diabetes.*

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In the case of all these drugs, the prescribing physician needs to consider the potential benefit of the drug in question to the patient and weigh this against the known risks, including the risk of developing diabetes. In many cases, the potential benefit of using these drugs, which may be life-saving, is believed to outweigh the risks and the blood sugar should be monitored and treated appropriately if diabetes occurs. Once the drug in question is discontinued, the diabetes usually goes away and treatment can be discontinued.

### ***17. Is there anything I can do to reduce my children's risk of getting diabetes?***

There is presently little that can reliably be done to reduce a person's risk of type 1 diabetes, as discussed in Question 19. However, type 2 diabetes has undergone a dramatic increase in children and adolescents in recent years, and it is clear that this is driven, in the most part, by childhood and adolescent overweight and obesity as well as lack of regular exercise. Therefore, establishment of a healthy pattern of eating in childhood, without excess calorie intake, and encouragement of regular exercise can be the most effective means of preventing the development of diabetes. It is important not only to provide children with these elements, but to ensure that they understand how to make healthy choices for themselves and that they realize the lifelong benefits that maintenance of healthy body weight and regular exercise can bring. In this way, they are more likely to establish and attach importance to a healthy lifestyle in adulthood and thus reduce their likelihood of developing diabetes lifelong.

### ***18. Are there any natural herbs, minerals, or other remedies that prevent diabetes?***

While it would be premature to answer *yes* to this question, it does appear that certain compounds can favorably impact the blood sugar and may have the potential to delay or prevent diabetes. Those for whom there is at least some evidence include uncooked walnuts, gymnema sylvestre (also known as *gurmarbooti* or *gurmar*), green tea, and certain compounds of chromium, zinc, and vanadium. While it is not known how most of these compounds work, the metallic compounds may work by facilitating the body's mechanisms

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*Establishment of a healthy pattern of eating in childhood, without excess calorie intake, and encouragement of regular exercise can be the most effective means of preventing the development of diabetes.*

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for releasing insulin, or responding to insulin. Overall, the effect of most of these items is quite mild, and they may influence the blood sugar by a few points. However, occasional individuals have a fairly dramatic response. In addition, there is a known association between low levels of vitamin D and diabetes. It is possible that this may not result from the lack of vitamin D itself, but from other factors somehow related to low vitamin D levels. Replenishment of vitamin D has not been shown to prevent diabetes long term and it is too early to draw conclusions about this. Some of these compounds are shown in **Table 3**.

### ***19. Can type 1 diabetes also be prevented?***

At the present time, we do not think that type 1 diabetes can effectively be prevented. Part of the problem is that we do not know the exact environmental trigger(s), although there is provocative evidence for a number of factors, such as early exposure to cow's milk, certain viral strains, and lack of stimulation of the immune system at an early age by natural exposure to infective agents. The evidence is insufficient to make specific recommendations for avoidance of, or **immunization** against, specific potential triggering agents. A number of clinical trials of agents that

#### **Immunization**

The process of inducing immunity, usually through inoculation or vaccination.

**Table 3 Herbs, Minerals, Etc. That May Help to Prevent Diabetes**

Name
Chromium picolinate
Zinc
Walnuts
Bitter melon
Gymnema sylvestre
Tea
Flaxseed
Vitamin D

modify the immune system attack on the insulin-producing cells of the pancreas (see Question 2) are under way. In general, these agents cause a number of side effects. Trials are focused on patients with newly diagnosed diabetes, to determine whether very early diabetes can be reversed, before their use in people without symptoms who are at an increased risk of development of the disease can be justified. There is also a significant genetic (hereditary) component of risk for type 1 diabetes (see Question 7) that can presently not be modified. First, therapies based on genetic modification in general are still at a very early stage of development. Second, the exact gene or genes that require modification are not conclusively known.

***20. Several members of my close family have diabetes. Will attempts at prevention still work for me?***

Please refer to Question 19 regarding type 1 diabetes. Regarding type 2 diabetes, your success in preventing diabetes depends upon a combination of how successful you are at attaining the necessary goals and how susceptible your family is. Inherited susceptibility can range from modest to very high. The risk also depends very much on whether both sides of a person's family have a hereditary pattern of diabetes. If both the mother and the father's sides have a high frequency of diabetes, then their offspring will have a marked tendency to develop type 2 diabetes. The general degree of risk is described in Question 7. In spite of the importance of heredity, it is clear that environment and lifestyle play a major role. This is clearly the case because hereditary tendencies to disease change little over the course of a few generations, while environment and lifestyle can change very rapidly. The recent

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*If both the mother and the father's sides have a high frequency of diabetes, then their offspring will have a marked tendency to develop type 2 diabetes.*

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explosive rise in the frequency of type 2 diabetes in most regions of the world clearly implicates the latter as the most important factor. The most readily identifiable lifestyle factors that precipitate type 2 diabetes are weight gain and lack of exercise. Greater than 90% of type 2 diabetes in our society results from one, or usually both, of these factors. Depending on the severity of your inherited risk, a greater or lesser degree of adherence to a lifestyle that avoids overweight or obesity and engages you in regular exercise will effectively prevent you from developing type 2 diabetes.

# *How Do I Know I Have Diabetes?*

How does my doctor confirm the diagnosis of diabetes?

My doctor says I have hypoglycemia. Isn't that the opposite of diabetes?

I have a strong family history of diabetes. How often should I be checked for it?

*More . . .*

## ***21. What are the most common symptoms of diabetes?***

The common and early symptoms of diabetes result from the effect of the high blood sugar entering the urine and drawing fluid from the body's tissues along with it. This leads to excess urine production with frequent urination. The loss of body fluid leads to thirst, in order to replace the fluid loss. As long as the person with diabetes is able to keep pace with his or her thirst by regular fluid intake, he or she will remain relatively well. However, without free access to fluid, which can occur for a variety of reasons, one will become dehydrated, which leads to dizziness upon standing upright, drowsiness, confusion, and ultimately fainting and unconsciousness. Due to the wasting of calories as glucose in the urine, patients will complain of hunger and will usually lose weight if high blood sugar is very marked. However, it is important to note that only a minority of people with diabetes will experience these symptoms. Frequently, the degree of high blood sugar is more moderate, with little sugar entering the urine and causing no immediate symptoms. However, diabetes of even modest severity can cause considerable harm and lead to serious chronic complications. Therefore, it is important to detect diabetes that is **asymptomatic** (i.e., without symptoms), which is the reason that screening programs to detect diabetes in those at highest risk have been developed. If asymptomatic diabetes is not discovered for a sufficiently long period (many months or years), patients may actually present with long-term complications of the previously unrecognized diabetes, such as heart attack, stroke, heart failure, neuropathy (nerve damage), nephropathy (kidney damage), or retinopathy (eye damage). These are discussed in Questions 32 to 35.

### ***Asymptomatic***

Having no complaints or symptoms.

## ***22. How does my doctor confirm the diagnosis of diabetes?***

Your doctor will perform one of the standard measurements for the diagnosis of diabetes approved by the accepted authoritative body in whichever part of the world you live. In the United States, this is generally set by the American Diabetes Association (ADA) and is accepted by most practitioners, insurers, and health providers as valid. The most current ADA criteria for the diagnosis of diabetes are shown in Table 1 (see Question 9). Your doctor may or may not ask you to fast prior to measuring the blood glucose or he or she may perform a standard 2-hour test known as the oral glucose tolerance test. Unless they are clearly and indisputably abnormal, or accompanied by typical symptoms of diabetes (discussed in Question 4), the results should be confirmed on a different day, since the diagnosis of diabetes carries many implications and necessitates lifelong monitoring and treatment. Very soon, the test that measures the average blood glucose over the past 3 months (the Hemoglobin A1c or HbA1c test) is also likely to become a standard test for detection and diagnosis of diabetes.

Different diagnostic procedures are used for pregnant women, most of whom should be screened for the presence of diabetes of pregnancy (“gestational diabetes”) during the 24th to 28th week of pregnancy or earlier if they are at high risk or had diabetes in a previous pregnancy. This involves an initial 1-hour screening test for which fasting is not required. If the screening test is positive, it is followed by a more detailed 3-hour test for which prior fasting is necessary.



### ***23. Can I “feel” my high and low blood sugars reliably?***

*Although many people with diabetes confidently state that they can reliably detect both their high and low blood sugars without actual measurement, studies have shown that these beliefs are not usually accurate.*

Although many people with diabetes confidently state that they can reliably detect both their high and low blood sugars without actual measurement, studies have shown that these beliefs are not usually accurate. It is generally easier to be aware of **hypoglycemia** (“low sugars”) than high blood sugars. This is because the margin of safety between blood sugars in the lower part of the normal range and dangerously low blood sugars is quite narrow—only about 25 mg/dl—and the body has a vigorous and rapid response system, designed to ensure that a source of energy is rapidly found and consumed. Nevertheless, especially after longstanding diabetes or a period of very tight glucose control, symptoms of low blood sugar are often not detected by patients. If they are detected, they are perceived with insufficient time to take preventive action. Typical early symptoms of hypoglycemia are shakiness, sweatiness, hunger, abdominal discomfort, palpitations (i.e., a fluttering sensation in the chest), and headache. When blood sugar is very low, confusion and disorientation often occur together with sometimes bizarre behavior, but these features are generally noted by others rather than the affected person him- or herself. In the case of **hyperglycemia**, people with diabetes are usually quite unaware of the presence or severity of high sugars until secondary symptoms such as frequent urination and thirst occur. For the great majority of people, the only sure way to detect high blood sugar is to perform regular glucose monitoring.

#### **Hypoglycemia**

An abnormally low level of glucose in the blood; symptoms include shakiness, sweatiness, hunger, abdominal discomfort, palpitations, and confusion.

#### **Hyperglycemia**

An abnormally high level of glucose in the blood; secondary symptoms include frequent urination and thirst.

### ***24. My doctor says I have hypoglycemia. Isn't that the opposite of diabetes?***

Yes, hypoglycemia (low blood sugar) is the opposite of the hyperglycemia (high blood sugar) that characterizes

diabetes. Certain treatments for diabetes and several conditions unrelated to diabetes can cause hypoglycemia. The most common form of hypoglycemia occurs in otherwise healthy young individuals, more commonly in women than men, and is quite benign, although it can be associated with distressing symptoms. Fortunately, it is usually treatable by adjustment of the composition and timing of meals. Sometimes, hypoglycemia can be caused by serious conditions and your doctor will be able to determine whether you are one of the small percentage of people who needs further investigation and specialist referral.

It is important to note that hypoglycemia can be an early feature of diabetes. This type of hypoglycemia occurs in people with prediabetes (see Question 9) who are resistant to the action of insulin and yet are still capable of mounting a vigorous insulin release from the pancreas to overcome it. In the later stages of absorption of calories from a meal, the insulin levels may remain high as the blood glucose level is falling quite rapidly. This may lead to a temporary but sometimes distressing period of low blood sugar that usually occurs about 3 to 5 hours after a meal. It tends to resolve if the prediabetes progresses to frank diabetes, but in some people, it may persist for some years. It is also often treatable by dietary adjustment or other means.

***25. Could I have had diabetes for a long time and not known it?***

Yes, indeed, you could have had diabetes for a considerable period of time, months or even years, and been unaware of it. However, it is unlikely that you could have had severe diabetes with very high blood sugars for a long time without having to seek medical attention,

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*It is important that asymptomatic diabetes is detected and treated, because it can lead to serious health consequences, which may be irreversible when detected.*

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as you would have experienced complications. However, milder degrees of diabetes are often without obvious symptoms, although in retrospect patients will realize that all was not well when they start to feel the benefits of treatment. Studies have shown that, on average, type 2 diabetes has been present for several years by the time it is diagnosed. It is important that asymptomatic diabetes is detected and treated, because it can lead to serious health consequences, which may be irreversible when detected. About one of every three people has detectable neuropathy (nerve damage) at the time of diagnosis, indicating that longstanding diabetes has been present. Less commonly, eye damage (retinopathy) and/or kidney damage (nephropathy) are discovered at the time of diagnosis. These are serious consequences of diabetes and are the leading causes of blindness and kidney failure in working age adults in the United States, as well as much of the industrialized world. As serious, or even more serious than this, is the potential for undetected and untreated diabetes to lead to heart attacks, strokes, heart failure, or amputations. Indeed, almost 4 of every 10 patients admitted to hospital with a sudden serious cardiac event will be found to have previously unsuspected and undiagnosed diabetes or prediabetes. It is now clear that prediabetes is almost as serious a risk factor for such cardiac events and death from them as full-blown diabetes.

***26. I have a strong family history of diabetes. How often should I be checked for it?***

The frequency with which you should be checked for diabetes depends upon your degree of risk, your age, and lifestyle factors. Even if you have a strong family history of type 1 diabetes, your risk of developing it is still only about 5% and is much lower after the age of 35.

Furthermore, type 1 diabetes usually presents with obvious symptoms, such as those described in Question 21, and is unlikely to be missed. Since there is presently little that can be done to prevent type 1 diabetes, screening is usually not performed. If you have a strong family history of type 2 diabetes, the frequency with which you should be screened also depends on age and lifestyle factors. If you are young (younger than 30), physically active, and lean, then you are not at high risk and regular screening is not necessary. As you get older, especially if you get more sedentary and gain weight, as most of us do, then regular screening is advisable. Since screening for diabetes with a fasting or random blood glucose measurement is rapid and inexpensive, there is no reason not to perform it at least annually in individuals at high risk and every 2 to 3 years in those at lesser, but still significant, risk. In general, all pregnant women should be screened for gestational diabetes between 24 and 28 weeks of pregnancy. Some authorities exclude younger (younger than 25 years old) women, who are otherwise at low risk, from the need for screening.

***27. I had diabetes during my last pregnancy. Am I at risk of diabetes in the future?***

Yes, you are at high risk both of having type 2 diabetes in the future and of having diabetes again with your next pregnancy. The reason for this is that women destined to get type 2 diabetes in middle age or beyond tend to be the same women who will develop diabetes in pregnancy. Therefore, the presence of diabetes in pregnancy is an indicator of future risk for type 2 diabetes. Because type 2 diabetes is a disorder of aging, the diabetes in pregnancy tends to be more severe and requires more intensive treatment with each successive

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*If you are young (younger than 30), physically active, and lean, then you are not at high risk and regular screening is not necessary. As you get older, especially if you get more sedentary and gain weight, as most of us do, then regular screening is advisable.*

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pregnancy, unless steps are taken between pregnancies to reverse one or more risk factors, such as excess weight or lack of exercise.

### ***28. Can diabetes sometimes be temporary and go away again?***

Yes, this can and does occur, in the case of both types of diabetes. However, in the case of type 1 diabetes, the disappearance is very predictably temporary and the diabetes will almost inevitably return within months or a year or two. The reasons for it are complex and relate to the fact that type 1 diabetes is often diagnosed under conditions of physical stress. When the diabetes is treated and the stress to the body has resolved, there may be sufficient remaining insulin-producing capability in the pancreas to keep the blood sugar normal under most circumstances. Eventually, however, the pancreas fails and permanent diabetes supervenes.

In the case of type 2 diabetes, although the hereditary factors causing it cannot be reversed, the environmental and lifestyle factors can be changed. The latter are the cause of the explosive rise in the number of people affected with diabetes in recent years. Questions 1, 11, 12, 16, and 20 discuss some of these causative factors. Although we do not generally refer to type 2 diabetes as being cured once it has been diagnosed (see Question 5), it can certainly go into remission (cease to be an active medical problem) for long periods, depending on how successfully the causative factors are addressed. Because excess weight and sedentary lifestyle are the two most important and serious causative factors, weight reduction and adherence to an exercise program can often put type 2 diabetes into

remission for as long as they are maintained. Sometimes, all medications, even insulin, can be stopped and all measures of diabetes, including blood glucose and hemoglobin A1c (HbA1c—the measure of your blood sugar control averaged over 3 months), will completely normalize. Other associated conditions, such as high blood pressure and cholesterol abnormalities, will also improve greatly. The possibility of stopping all medications is more likely to occur earlier in the course of diabetes and before long-term complications have developed. Unfortunately, many of us in modern society are unable to sustain weight reduction and exercise for long periods and the failure rate is high.



*What  
Are the  
Consequences  
of Diabetes?*

What can happen if my diabetes is not properly treated and controlled?

What is diabetic neuropathy?

I hear a lot about footwear and foot care for diabetes.  
Why is this so important?

*More . . .*



## ***29. What can happen if my diabetes is not properly treated and controlled?***

Uncontrolled diabetes, which generally refers to glucose levels that are higher rather than lower than the target range, can lead to immediate short-term and longer-term consequences. The short-term consequences result from the very high blood glucose itself, which is described in Question 4. If severe enough or untreated for long enough, markedly high blood glucose levels can result in coma and ultimately death, due to the severe abnormalities of blood chemistry that occur. It is important to note that only a very small minority of patients with either form of diabetes will die in this way. Therefore, although immediate **decompensation** of diabetes is a serious and life-threatening condition, with a high death rate if detected and treated too late, the majority of people with diabetes should be more concerned about the damaging effects of diabetes that are not well controlled, yet not sufficiently poorly controlled to focus their attention.

### **Decompensation**

A serious deterioration in a medical condition.

The longer-term consequences of less than adequate diabetes control are the result of damage to the small (micro) and larger (macro) vessels of the circulation. The most common manifestations are diabetic eye disease (retinopathy), which is the leading cause of blindness in working-age adults in the United States; diabetic kidney disease (nephropathy), which is the leading cause of severe kidney failure necessitating dialysis or transplantation in working-age adults in the United States; and nerve damage (neuropathy), which is present in about 1 out of 3 people with diabetes at the time of diagnosis and in over 7 out of 10 by the time diabetes has been present for 10 years. Both retinopathy and nephropathy can be entirely without symptoms

until they reach an advanced and irreversible stage, leading to blindness and the need for kidney dialysis or transplant. Diabetic neuropathy can cause very troublesome symptoms and lead to loss of sensation, mainly in the feet, which places the patient at high risk of trauma, infection, and amputations of the legs and feet.

Disease of the large blood vessels leads to a high rate of heart attack, stroke, heart failure, and amputation of the (usually lower) limbs. About two of every three patients with diabetes will die as a result of large vessel disease. Fortunately, studies have shown that good control of diabetes can prevent or delay the progression of many of these serious problems, but other contributing factors, such as blood pressure and cholesterol, must also be given careful attention.

However, we are only achieving target levels of diabetes control in about half of all people with diabetes in America today.

### ***30. Does diabetes put me at risk of any other diseases or illnesses?***

Aside from the direct consequences of high blood sugar itself, which are discussed in Question 29, people with diabetes are at risk of suffering from other associated diseases. In the case of type 1 diabetes, the diseases either result from the high blood sugar or from the root cause of the diabetes, which is a predisposition to destroy the hormone-producing tissues (called **autoimmunity**). Thus, a person with type 1 diabetes is more likely to suffer from adrenal gland damage (Addison's disease), thyroid gland damage (Graves' or, much more commonly, Hashimoto's disease), and several other disorders. Fortunately, except in the case of

#### **Autoimmunity**

A predisposition to produce autoantibodies.

thyroid disease, which affects about one in three people with type 1 diabetes, the likelihood of developing one of these other disorders is not high, but can be so in certain families. Most people with type 1 diabetes are screened annually for thyroid disease. In the case of type 2 diabetes, the other diseases appear to be independent, but related. In other words, they and the diabetes arise from a common soil in the affected person's metabolic makeup. These related diseases include cholesterol and other blood fat abnormalities (**dyslipidemia**), high blood pressure (**hypertension**), and gout. The first two are commonly seen in people with type 2 diabetes, while the third is less so.

#### **Dyslipidemia**

Cholesterol and other blood fat abnormalities.

#### **Hypertension**

High blood pressure.

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*Diabetic coma is loss of consciousness occurring as a result of very high blood sugar.*

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### ***31. What is diabetic coma?***

Diabetic coma is loss of consciousness occurring as a result of very high blood sugar. Its causes are similar in both type 1 and type 2 diabetes, but with the important difference that other abnormalities of the blood chemistry may contribute to the coma in type 1 diabetes. These other abnormalities occur as a result of the almost total lack of insulin that is present in type 1 diabetes. For this reason, while blood sugar is almost always very high in people with type 2 diabetes who are in diabetic coma, being several hundreds (of mg/dl) to 2000 or more, it can be less elevated in people with type 1 diabetes, sometimes as low as only 200 or 300. In the case of type 1 diabetes, diabetic coma can occur solely as a result of having insufficient insulin in the body (e.g., running out of or not taking one's insulin), while in the case of type 2 diabetes, there is almost always another stress to the body that precipitates the coma, such as infection, dehydration, etc. If the serious abnormalities of blood chemistry that led to diabetic coma are not corrected rapidly, death can occur. Although the derangements

in blood chemistry are more complex and severe in type 1 diabetes than in type 2 diabetes, there is a higher mortality in type 2 diabetic coma because people suffering from it tend to be older, in less robust health, and with more cardiac risk factors. Also, additional symptoms of nausea, vomiting, and abdominal pain occur in the derangements of type 1 diabetes leading to coma and the diagnosis may be made earlier as a result. In the early stages of coma in type 2 diabetes, abnormalities of brain function and consciousness are more prominent due to the extreme degree of dehydration. Moreover, the illness that precipitated the coma may carry its own serious health risks. Although only a minority of patients with diabetes will succumb to coma, it remains an important medical emergency that requires immediate intervention.

### ***32. What is diabetic neuropathy?***

Diabetic neuropathy is the term used to describe the usually chronic damage to nerves that occurs as a result of untreated, or inadequately treated, high blood sugar. It results from a complex sequence of events that leads to damage and destruction of the minute blood vessels that nourish nerves along their course to the region of the body they serve after leaving the spinal canal. Each such nerve is a single cell. The longest nerves, much like long chains, are the most susceptible to damage. If a **peripheral nerve** (i.e., a nerve cell not contained in the brain or spinal column) emerging from the spinal column and traveling to the toes were the thickness of a piece of string, it would be 3 miles in length! At frequent intervals along its length, each peripheral nerve receives nourishment from tiny blood vessels. If any of these tiny blood vessels are irreversibly damaged, that part of the nerve dies and no signals are conducted in

#### **Peripheral nerve**

A nerve cell not contained in the brain or spinal column.

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*Diabetic neuropathy is most frequently a problem in the feet, hands, and male genitals.*

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**Protective sensation**

The perception of potential injury, such as awareness of sharp, rough, excessively hot or cold objects, or friction.

either direction along it, i.e., the chain fails at its weakest link. Although there are a vast number of individual nerve fibers serving any one area of the body, when a sufficiently large number get damaged, symptoms will result. Since the longest nerve fibers serve the parts of the body that are farthest from the spinal column, it is not surprising that they are the ones most frequently damaged. Therefore, diabetic neuropathy is most frequently a problem in the feet, hands, and male genitals. The symptoms represent a spectrum from those due to injury responses of the non-fatally injured nerves, such as pain, burning, and abnormal sensations such as bunched socks under the feet, to those due to loss of impulses, such as numbness and unperceived injury due to loss of **protective sensation**. This includes inability to perceive heat and sharp pain, leading to burns and puncture wounds. Although the typical form of diabetic neuropathy causes these symptoms, there are a number of other less common forms that can lead to sudden pain, weakness, and other unsuspected symptoms in almost every region of the body. Discussion of the whole range of these is beyond the scope of this book.

### ***33. What is diabetic retinopathy?***

Diabetic retinopathy is damage to the eye that results from chronically untreated or inadequately treated high blood sugar. In its more advanced form, it can result in severe visual loss or blindness if untreated, and this can occur suddenly without warning. It is the leading cause of blindness in working age adults in the United States and more than 20,000 people become blind as a result of diabetes each year. In order to prevent this, all people with diabetes should periodically be screened with an eye exam or photography of the

inner lining of the eye (**retina**). Because it is often not possible to pinpoint precisely when type 2 diabetes actually develops, as it may be silent and unrecognized for months or even years, people with type 2 diabetes should be examined for retinopathy at the time of diagnosis, while those with type 1 diabetes should be examined between 3 and 5 years after the diagnosis has been made. The frequency with which follow-up visits is recommended will depend upon the findings and the measures taken to address them. For example, if no retinopathy is detected, follow-up examination in 2 years may be recommended, whereas in the case of serious findings requiring active treatment, follow-up in 3 months or fewer may be required.

Although it has clearly been shown that the rate of progression of diabetic retinopathy is related to the control of the blood sugar, there are several other factors involved. There is a hereditary tendency, so that if a close relative with diabetes developed retinopathy, you are more likely to do so. You should inform your eye doctor, who will be especially vigilant. Control of blood pressure has been shown to delay worsening of retinopathy and control of cholesterol abnormalities also plays a role in preventing progression. Quitting smoking can slow the progression of diabetic retinopathy. Therefore, all of these factors must be carefully addressed to prevent retinopathy successfully. Finally, it is important to note that retinopathy is not the only form of eye damage that can occur in diabetes. Other disorders, including **glaucoma** (increased pressure inside the eye) and **cataracts** (opacity of the lens of the eye), are more common in diabetes. Therefore, a comprehensive specialist eye exam is periodically needed and retinal photographs alone are not adequate.

**Retina**

The inner lining of the eye.

**Glaucoma**

Increased pressure inside the eye.

**Cataracts**

Opacity of the lens of the eye.

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*Diabetic nephropathy is the term used to describe kidney damage that occurs in diabetes.*

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### **34. What is diabetic nephropathy?**

Diabetic nephropathy is the term used to describe kidney damage that occurs in diabetes, usually of long-standing. The damage to the kidney in diabetes can result from the high blood sugar itself, which leads to an expansion of certain types of material in the filtering mechanism of the kidney. This expansion damages the delicate cells responsible for filtering waste materials through the kidney. Eventually, there are abnormal pressures and changes in the important electrical balance in this complex structure. These changes lead to leakage of proteins that are usually either retained or reabsorbed by the kidney. The blood pressure can rise due to overload of fluid and constriction of small blood vessels. The rise in blood pressure further damages the kidney if not treated. If there is an excessive leak of protein, the body becomes protein deficient, which can lead to generalized puffiness and swelling. Eventually, the kidneys can fail and their functions must be replaced by the processes of either **hemodialysis** (blood filtering and removal of wastes through a machine) or **peritoneal dialysis** (a simpler process whereby wastes are exchanged into fluids introduced into the abdominal cavity), or a kidney transplant is required.

#### **Hemodialysis**

Blood filtering and removal of wastes through a machine.

#### **Peritoneal dialysis**

A process whereby wastes are exchanged into fluids introduced into the abdominal cavity.

Although complete kidney failure is not a common outcome in diabetes in percentage terms, diabetes is the most common cause of kidney failure in working age adults and occurs in more than 25,000 people each year in the United States. Kidney failure is extremely disruptive to the sufferer's life and is very expensive to treat. The tendency to get diabetic kidney damage has an inherited component, so that if a close relative with diabetes suffers from it, an individual is more likely to experience it. However, it can be delayed or even

prevented. Good control of blood sugar and blood pressure, together with use of certain types of drugs known as *ACE-inhibitors* or *ARBs*, has been shown to markedly slow progression of diabetic kidney damage. Moreover, it can be detected very early by sensitive tests in common use.

### ***35. Why is the risk of blood vessel diseases increased so much in diabetes?***

There are several reasons why the risk of vascular diseases, such as heart attack, stroke, and diseases of the vessels in the limbs (**peripheral vascular disease**), is increased in both types of diabetes. The weight gain and lack of exercise common in people with type 2 diabetes lead to other conditions such as abnormal cholesterol levels and high blood pressure, which are potent causes of vascular disease. If all of these risk factors are not treated effectively, the probability of vascular disease remains high. High blood sugar over months and years leads to a chemical reaction of the sugar in the blood vessels, damaging them structurally. Perhaps most importantly, we now know that diabetes and obesity can be described as irritants to the body tissues, meaning that the body becomes generally inflamed. We know that this is so because we can measure high levels of compounds that indicate **inflammation** in the blood of many people with diabetes. It turns out that this inflammation, when maintained over time, extends to the lining of the blood vessels, which attracts inflammatory cells out of the bloodstream. Cholesterol also takes on an inflamed form, enters the lining of the blood vessels, and attracts still more inflammatory cells from the bloodstream, setting the stage for serious damage.

#### ***Peripheral vascular disease***

Diseases of the vessels in the limbs.

#### ***Inflammation***

Swelling, pain, tenderness, and disturbed function in an area of the body, usually as a result of injury.



Other contributors to vascular disease include the fact that high blood pressure results from nephropathy, which further damages blood vessels. This further damages the kidney and blood pressure rises still further, setting up a vicious cycle. Even short periods of high glucose, such as may occur after meals in people with diabetes and even prediabetes, can cause problems with the function of blood vessels, making them more sticky, inflamed, and less able to relax. Whether these repeated briefer periods of high blood sugar combine over time to cause permanent vascular damage is not known. However, it is known that the risk of vascular disease is already high in people with prediabetes.

***36. Can my diabetes affect my sex life?  
If so, how and what can I do about it?***

Diabetes can have a profound effect upon a person's sexual drive, functioning, and satisfaction. This is especially apparent in men, although there is some evidence that some women with diabetes can also experience adverse effects on their sexual responses. The reason for the significant effects on male sexual function arises from the complexity of the penile erection mechanism. This requires satisfactory nerve, blood vessel, and hormone function to be achieved and sustained. Diabetic nerve damage (see Question 32) can be of two main types. One form is damage to the system that serves conscious movement and sensation and the other is damage to the system that serves unconscious or automatic responses, such as bowel contraction and the heart beat. The erectile mechanism is served by the latter, while the sensation of pleasure in sexual performance is served by the former. Since the nerves to the genital area are relatively lengthy, they are prone to the damage described in

Question 32. Normal erectile function also depends on a healthy blood supply to the penis, as erection entails engorgement of the organ with blood. If the blood supply is compromised, the quality of the erection will be poor. As discussed in Question 35, vascular damage is commonly associated with diabetes and frequently affects the health of the vessels supplying the genitals. Finally, normal levels of the male hormone testosterone are necessary not only for sexual interest (**libido**), but also for perception of pleasurable sensations from sexual arousal. Low testosterone levels, already common in middle-aged and older men, are even more common in men with diabetes. Indeed, there is suggestive evidence that low testosterone levels may contribute to worsening of diabetes, thus creating a vicious cycle that further depresses hormone levels. In light of the three strikes of diabetic nerve damage, vascular damage, and diminished levels of male hormone, it is not surprising that poor sexual performance and diminished satisfaction are a frequent finding in men with diabetes. Indeed, more than half of all men with type 2 diabetes of five or more years' duration will complain of one or more symptoms of sexual dysfunction. Sometimes this is worsened by medications commonly used by people with diabetes, such as certain blood pressure-lowering drugs.

### **Libido**

Sexual interest.

### ***37. I feel as if my memory has gotten worse since I developed diabetes. Could I be right?***

You may well be right. Studies have shown that memory, and other higher brain functions, can be negatively affected by diabetes. This pertains to both type 1 and type 2 diabetes and to both adults and children. A large part of this effect is related to blood sugar control. Children with repeated episodes of low blood

sugar have been shown to have poor long-term memory performance. However, both high and low blood sugar levels are associated with poor memory performance. This affects recall of things previously remembered and memorization of new information. The effect of low blood sugar on memory appears to be the same whether a person is aware of the blood sugar or unaware of it. When memory problems are associated with high blood sugars, the good news is that they are often reversible with improved control of the diabetes, even in older people. Therefore, if you feel that your memory has deteriorated, a first step would be to ensure that your diabetes is under the best possible control, without unnecessary high or low blood sugars.

In addition to controlling blood sugars, it is important to remember that diabetes is a chronic disorder and that we age along with our diabetes. Memory function tends to decline with age, even in people without diabetes. Also, it is possible that some of the medications that you are taking may affect memory, independently of any effect on your blood sugar. This is particularly true of medications that may cause drowsiness (and therefore inattention to information that you may need to memorize) or low blood pressure. Medications given to treat the pain of neuropathy are the most likely to cause drowsiness. Finally, people with diabetes are at a significantly higher risk of diseases of the blood vessels, including those in the brain (see Question 35), and are at higher risk of brain injury. Such injury may not be noticed as a single severe event, but as a series of smaller unobserved events that ultimately lead to impaired brain functioning, including memory impairment.

### ***38. I hear a lot about footwear and foot care for diabetes. Why is this so important?***

Proper care and protection of the feet are extremely important for people with diabetes. This is due to the fact that the feet are frequently affected by diabetic nerve damage with a resultant loss of protective sensation. Protective sensation is the perception of potential injury, such as awareness of sharp, rough, or excessively hot or cold objects or friction, such as rubbing against the inside of shoes. When this is impaired, it is possible for the person with diabetes to sustain wounds, abrasions, burns, or freezing of which he or she may be unaware. Other types of injuries such as bites and blisters can similarly occur unnoticed. Even fractures to the bones of the foot can occur painlessly when more severe forms of diabetic nerve damage are present. The most serious consequence of unperceived injury is infection. Because the blood supply to the feet may also be impaired, the healing and immune response to both the injury and the infection can be compromised, so that a chronically infected wound results. The most dangerous consequences of chronically infected wounds are spread of infection to the deeper tissues, including the bones, and entry of infectious organisms into the bloodstream, which can lead to blood poisoning (**septicemia**) or spread by the bloodstream of infection to other body tissues. Both of these consequences can cause severe illness or even death. Local infection of the bones of the feet can require amputation, since infection in the bone (called “**osteomyelitis**”) is very difficult to treat. Even powerful modern antibiotics given **intravenously** over several weeks may fail to completely eradicate infection in bone when its blood supply is poor.

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*Protective sensation is the perception of potential injury, such as awareness of sharp, rough, or excessively hot or cold objects or friction, such as rubbing against the inside of shoes.*

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#### **Septicemia**

Blood poisoning, due to infection, which is usually bacterial in origin.

#### **Osteomyelitis**

Infection in the bone.

#### **Intravenously**

Through a vein.

Diabetic nerve damage in the feet may lead to disturbance of the mechanics of the foot, such that pressure may occur on bony areas not designed to bear this. This can cause unusual prominences of the bones of the feet on all of their surfaces, which are more prone to injury than usual. Corns, calluses, cracks, fissures, and ulcers of the feet can all occur in people with diabetes in the absence of specific injury, but as a result of abnormal pressure distribution caused by nerve damage.

For all of these reasons, it is very important to protect the feet by wearing suitable footwear, not going barefoot, paying attention to the environment (i.e., removal or covering of protruding furniture legs etc. and hard, abrasive floor surfaces), performing daily inspection of the feet, foot hygiene, nail care, and prompt cleaning and dressing of minor injuries.

# *Treatments for Diabetes*

What should I eat and what should I avoid?  
Please be specific!

Who should take pills and who should take insulin?

Are there any medications prescribed for  
other conditions that can improve or worsen  
my diabetes?

*More . . .*

### ***39. Is diet and exercise management alone really effective for diabetes?***

Diet and exercise are in fact the most effective treatments of all for most forms of type 2 diabetes, but are not primary measures for management of type 1 diabetes. In type 1 diabetes, profound insulin deficiency necessitates that insulin treatment is the principal form of treatment. Nevertheless, attention to diet and exercise can provide benefits in diabetes control and general health in patients with type 1 diabetes and should be included in the comprehensive treatment plan.

In the case of type 2 diabetes, the reason that diet and exercise are so effective is because lack of exercise and weight gain are the most significant causes of the disease and reversal of these issues can essentially reverse the problem of development of diabetes. Figure 3 (Question 11) shows the increasing likelihood of developing diabetes with increasing weight and this is discussed in Question 11. However, if one loses weight, one is able to travel back down the slope of diabetes to a large extent. Reduction in weight can reduce or even eliminate the need for medications in many patients, even those who have been on insulin injections for several years. The most striking example of this is bariatric surgery, which has been shown to reverse diabetes and to do so for several years, being effective as long as weight reduction is maintained. This is further discussed in Question 5.

Exercise works by making the body more sensitive to the actions of insulin and also by using up stored energy in the exercising muscles. The muscles then replace this energy by pulling in glucose and other sources of energy from the bloodstream. While this process can occur to some extent without insulin and in

the absence of exercise, it occurs much more efficiently when the muscles are conditioned through regular exercise and normal levels of insulin are present. In addition, exercise helps to prevent recurrence of weight gain after successful attempts at reduction through diet. However, the longer diabetes has been present, the less effective diet and exercise are likely to be as treatment, although they are virtually always beneficial to some extent. Unfortunately, however, as we all know, there are many factors working against our ability to succeed in managing diabetes with diet and exercise in modern society. Longstanding success with diet and exercise alone is therefore the exception rather than the rule.

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*The longer diabetes has been present, the less effective diet and exercise are likely to be as treatment.*

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#### ***40. What should I eat and what should I avoid? Please be specific!***

It depends. Nutrient needs are based on a number of different factors. Weight and coexisting conditions like high cholesterol and high blood pressure are important in determining an appropriate meal plan. Most people with type 2 diabetes need to treat all of these conditions.

Sugars and starches are primarily responsible for high blood sugar after a meal. These include fruit, juice, milk, soda, desserts, beans, peas, bread, pasta, rice, potatoes, and corn. A moderate restriction of these types of carbohydrates will help control after-meal blood sugar. However, restricting these foods too much may also be harmful, so it is important to seek professional guidance when choosing an appropriate carbohydrate amount. Avoiding fried foods and fatty meats (ground meat, sausage, bacon, bologna, hot dogs) and choosing healthier cooking oils, like canola and olive oil instead of shortening, lard, and butter, will help control your cholesterol levels and may assist with weight loss.



If high blood pressure is a concern, then sodium restriction and weight loss may be helpful. Eliminating canned and jarred items (unless they are low sodium) and reducing added salt can help lower your blood pressure. Using fresh or frozen foods is a much better choice when reducing your sodium intake.

When attempting weight loss, smaller portions of high calorie density foods like processed meats, fats, and refined sugars are important. Increasing portions of low calorie foods like vegetables can make you feel full and therefore less likely to munch on foods that are not as healthy. As with any weight loss program it is recommended that you talk to your doctor before starting an exercise program.

An ideal meal for someone with typical type 2 diabetes who is accustomed to consuming about 2000 calories per day and who is interested in weight loss includes:

Fiber	>10 g/meal
Sodium	<650 mg
Carbohydrate	~45 g/meal
Fat	<20 g/meal
Saturated Fat	<5 g/meal
Cholesterol	<60 mg
Protein	35 g/meal
	(28 g = 1 oz)

Following these guidelines should produce the recommended 1-pound-per-week weight loss. Please note, however, that all dietary changes should be reviewed by your healthcare provider in regards to your particular health status. Those who have advanced kidney problems may need to decrease portions of protein.

To determine if you are meeting these recommendations you must look at the food label. All of this information can be found there.

#### ***41. What are the best and safest pills for diabetes?***

There is really no best or safest pill for treatment of diabetes, because certain pills (usually called oral antidiabetic drugs or OADs) are appropriate for certain patients but not for others. Therefore, it is important for the prescribing physician to take a number of factors pertaining to the patient into account before recommending a specific OAD or combination of OADs. **Table 4** shows the currently available types of OAD and the main advantages and disadvantages of each. Although therapy must be individually selected for each patient, certain general statements can be made. The newer OADs sitagliptin and saxagliptin, which belong to a class of OADs known as DPP-IV inhibitors, appear to be especially safe, in that sitagliptin does not interact with other drugs (although saxagliptin alters plasma levels of some drugs and needs to be either not used or used with caution when taking these) and do not appear to have any serious side effects. Although a few patients may have experienced serious allergic reactions with sitagliptin, this is a very tiny minority of the many patients who have taken the drug. Which OAD could be considered the best (in the sense of most effective) is quite debatable, because several types of OAD have similar effectiveness and this varies according to the timing of their use in the course of the diabetes. One must also consider the fact that some OADs tend to fail after a certain time of use, while others have less of a tendency to do so. In addition, some OADs, such as pioglitazone, have other benefits in addition to their effect on blood sugar, such as improving the

**Table 4 Pills for Diabetes Mellitus (Oral Antidiabetic Drugs—OADs)**

Class	Name	Brand Name	Doses/Day	Potency	Benefits	Side Effects	Hypoglycemia	Effect on Weight	Cost
Biguanide	Metformin	Generic	2–3	+++	↓Side effects	Diarrhea, nausea Lactic acidosis*	–	↓	\$
	Metformin ER	<i>Glucofage XR</i> ®	1	+++				↓	\$
Sulfonylurea	Glipizide	Generic	1–2	+++	Rapid onset	Occ. allergy Occ. allergy Occ. allergy	++	↑↑	\$
	Glyburide	Generic	1–2	+++	Rapid onset		+++	↑↑	\$
	Glimepiride	Generic	1	+++	Rapid onset		++	↑↑	\$
Meglitinide	Repaglinide	<i>Prandin</i> ®	3	+++	Short-acting		+	↑	\$
	Nateglinide	<i>Starlix</i> ®	3	+++	Short-acting		+	↑	\$
TZD	Rosiglitazone	<i>Avandia</i> ®	1–2	+++	↑HDL	CHF ↑MI slow onset CHF slow onset	–	↑↑	\$\$\$
	Pioglitazone	<i>Actos</i> ®	1	+++	↑HDL ↓TG ↓MI		–	↑↑	\$\$\$
DPP-IV I	Sitagliptin	<i>Januvia</i> ®	1	++	Rhinitis <sup>§</sup> , URTI, HA, UTI	–	–	–	\$\$\$
	Saxagliptin	<i>Onglyza</i>	1	++	URT, HA, UTI		–	–	–
α-Glucosidase I	Acarbose	<i>Precose</i> ®	3	+	↓CVD	Diarrhea, gas Diarrhea, gas	–	–	\$
	Miglitol	<i>Starlix</i> ®	3	+			–	–	\$
BABR	Colesevelam	<i>Welchol</i> ®	3	+	↓Cholesterol	Bloating, gas	–	–	\$\$\$

*Abbreviations:* ER: extended release; Occ: occasional; TZD: Thiazolidinedione (glitazone); HDL: high density lipoprotein (good cholesterol)  
 CHF: congestive heart failure; MI: myocardial infarction (heart attack); TG: triglycerides; DPP-IV I: dipeptidyl peptidase IV inhibitor;  
 URTI: upper respiratory tract infection (e.g., cold); HA: headache; UTI: urinary tract infection; α-glucosidase I: α-glucosidase inhibitor;  
 CVD: cardiovascular disease; BABR: bile-acid binding resin;

*Note:* Many combination preparations of these medications are available. Combination use provides convenience and cost savings, but the properties of each of their component medications are unchanged.

\*Lactic acidosis is a rare but serious side effect that can be prevented by not using this drug in persons with certain medical conditions.

§Rhinitis is nasal congestion, stuffiness, and runny nose.

cholesterol level and lowering blood pressure and perhaps even lowering the rate of heart attacks. Taken together, all this indicates that there is no single best drug for all patients with diabetes, but that for each patient there is one or more OADs that are safest and most effective for him or her.

### ***42. Who should take pills and who should take insulin?***

Presently, it is necessary for all patients with type 1 diabetes to take insulin by injection or pump. This is because they are profoundly deficient in insulin, which is essential for life. No other therapies can restore insulin in a person with type 1 diabetes apart from giving the hormone itself.

In the case of type 2 diabetes, the majority of patients can be controlled with one or more pills for their diabetes, usually for several years. The available types of oral medication for diabetes usually either improve the body's ability to make insulin, or make the body tissues more sensitive to it. Frequently, patients will take a combination of medicines that do both. A little over a decade ago, only one type of pill was available for diabetes in the United States but now there are at least six different classes of pills. Thus, by taking a combination of these, it is possible for people with diabetes to remain off insulin for longer, sometimes for many years. In addition to the blood glucose level, there are other factors that predict whether a person with type 2 diabetes will be likely to require insulin therapy earlier. People with type 2 diabetes who are not significantly overweight tend to require insulin treatment fairly early. About one out of every five people with type 2 diabetes actually seems to have a partial form of type 1 diabetes (the abbreviated name of which is LADA,

**Autoantibody**

An antibody that an organism produces against any of its own tissues or cells.

short for “latent autoimmune diabetes of the adult”), based on clinical features, presence of related conditions or measurement of markers of immune attack against the insulin-producing cells of the pancreas (known as **autoantibodies**) in the blood. This partial form of type 1 diabetes appears to have become arrested before it became very severe. However, people with LADA usually respond better to insulin treatment than to pills.

In spite of the presence of indicators of LADA, the usual approach is to treat a patient with pills whenever it appears safe to do so. This means that certain people with a high blood sugar level who are being given a trial of pills will need to be followed very closely for the first few days or weeks to be sure that the blood sugar is responding. They will also need to check their own glucose and report these values to their physician or diabetes educator.

***43. My doctor says that I need to start insulin. If I do, will I ever get off it?***

People with type 1 diabetes usually cannot discontinue insulin use once they have started. This is because of the very severe deficiency of insulin in this disorder. However, there are a couple of exceptions to this general rule. First, there is often a brief period of improvement in pancreas function after the initial diagnosis of type 1 diabetes. This so-called “honeymoon period” can last for a few weeks to a couple of years. During this time, the amount of insulin needed to control the blood glucose is much lower and the occasional patient needs none at all. Second, people who have received either a pancreas transplant or a pancreatic islet cell transplant can sometimes stop using insulin. The latter procedure is still considered

an experimental therapy. Although they can reduce or eliminate the need for insulin injections, these procedures should not be undertaken lightly, because they are associated with a lifelong need for powerful immunosuppressive (antirejection) drugs that can cause serious side effects.

In principle, it is possible for a person with type 2 diabetes to discontinue insulin once he or she has started it, if the lifestyle factors that led to the worsening of the diabetes can be reversed. Since the overwhelming majority of cases of type 2 diabetes are associated with overweight and lack of exercise, weight reduction and commencement of a regular exercise program will almost always result in significant improvement in glucose control and can lead a person on insulin being able to discontinue it. Unfortunately, in our society, it is very difficult for most people with type 2 diabetes to consistently pursue these goals and the majority will remain on insulin once it has been started. Also, it is a normal part of aging for the insulin-secreting cells of the pancreas (**beta cells**) to show declining function. The rate of this decline may be faster in people with type 2 diabetes. This leads to a need to intensify treatment over time and may explain in part why the majority of those who start insulin treatment will not be able to discontinue it without significant deterioration in control of their diabetes.

#### **Beta cells**

The insulin-producing cells of the pancreas.

#### ***44. I take several types of pills for my diabetes. How can I reduce the expense?***

There are several ways in which the expense of your diabetes medications can be reduced. Many of them apply to medications in general. Whenever possible, you should try to use the medications that are on your insurance plan's preferred list or those that have the

lowest co-pays. These are generally the generic medications. Your doctor should consider prescribing generic medications whenever possible, always weighing in mind the benefits of saving money versus giving you the most effective and safe treatment for your individual condition. If brand-name medications are necessary, whenever possible your doctor will be willing to prescribe the specific brand that is preferred by your healthcare formulary with the lowest co-payment (first or second tier if more than one brand are available that have little difference between their efficacy and safety). Many plans will fill mail-in prescriptions for a 90-day supply with the same single co-pay as a 30-day supply at a retail pharmacy. Recently, some retail pharmacies have begun to offer the same programs. Also, some large national chain pharmacies, such as Walmart, have begun to maintain their own formularies with very low co-pays that discount further from those offered by your medical plan. Walmart, Target, and some Ralph's pharmacies, along with others, will provide a 30-day supply of some generic antidiabetic, blood pressure, and cholesterol drugs for \$4. They will honor these prices even if you do not have medical insurance coverage for your medications. Although the items on these formularies tend to be limited in number and are usually generic, several of the medications commonly used by people with diabetes and related conditions can be found on them. Some plans cover only certain dosage strengths of medications at the lowest co-pay, so these should be prescribed by your doctor when there is a choice. Finally, a number of brand-name medications are available in a combination formula with a generic medication (for example, pioglitazone with metformin and sitagliptin with metformin) usually at the same price as the brand-name drug alone. In this case, the generic medication is free,

as there is only one co-pay for a prescription. However, be sure that the combination preparation is not in a higher tier (co-pay level) than the individual preparations, as there may then be no saving.

Remember that one way *not* to save money is to ask your doctor to prescribe more medication than you are actually required to take on your prescription in order to make it last longer. This violates the terms of both the doctor's and your contract with your healthcare plan and the agreements between the healthcare plan and the pharmacy and could result in loss of coverage.

#### ***45. Why is it so important for people with diabetes to control their blood pressure and cholesterol as well?***

It is very important for people to control their blood pressure and cholesterol because of the increased risk of vascular disease carried by people with diabetes (see Question 35). High blood pressure and abnormal levels of cholesterol and other blood fats are frequently found in people with diabetes and contribute additional risk for vascular disease. In some studies involving people with type 2 diabetes, control of cholesterol and blood pressure has been found to confer more protection against progression of small vessel (microvascular) disease than control of blood sugar itself! Not only is this the case, but the serious complications in the eyes, nerves, and kidneys caused by damage to the small blood vessels (discussed in Questions 32, 33, and 34) have been shown to be reduced by treatment of **cholesterol** and blood pressure. Some of the drugs used for these conditions may even provide a minor benefit in control of the blood sugar itself, while some may worsen it. When possible, your doctor will choose

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*In some studies involving people with type 2 diabetes, control of cholesterol and blood pressure has been found to confer more protection against progression of small vessel (microvascular) disease than control of blood sugar itself!*

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#### **Cholesterol**

A fatty substance normally present in blood.



those medications for blood pressure and cholesterol that will improve (or not worsen) control of your blood sugar and prevent or delay the progression of the complications of diabetes.

#### ***46. What is the difference between basal insulin and bolus insulin?***

##### ***Basal insulin***

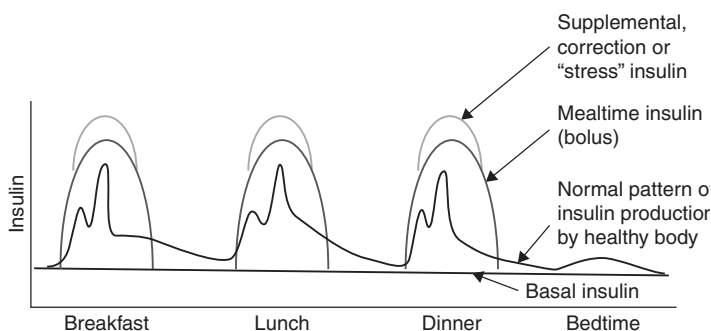
The insulin required to control your blood sugar in the absence of food intake.

**Basal insulin** refers to the insulin required to control your blood sugar in the absence of food intake. A certain amount of insulin is always necessary to keep the blood sugar in the normal range, even in the absence of eating for prolonged periods. Without any insulin in the body, the starch, fat, and protein in the body will break down with severe health consequences, as occurs in people with type 1 diabetes. The amount of insulin that the body requires in the absence of food intake is known as the basal requirement and it is provided by the one or two injections of long-acting insulin that most patients give themselves each day. If a person is using an insulin pump, then it is covered by the basal setting on the pump. Modern insulin pumps offer several basal settings in each 24-hour period, as the basal insulin production in a healthy individual varies over the course of the day, being higher in the 2-to 3-hour period before arising in the morning, for example.

##### ***Bolus insulin***

The insulin required to remove the energy derived from a meal from the bloodstream and into the tissues to replenish energy stores. Bolus insulin can also be given when the blood sugar is too high.

**Bolus insulin** refers to the insulin required to remove the energy derived from a meal from the bloodstream and into the tissues, to replenish energy stores. This is typically provided by the short-acting insulin injection given just prior to eating or by the bolus setting for patients on an insulin pump. Recently developed and marketed forms of insulin very closely match the pattern of insulin production from the pancreas itself in response to food. In this way, they are able to



**Figure 4** Basal, bolus, and stress/supplemental/correction insulin delivery.

prevent the blood sugar from rising excessively after a meal, while also preventing the occurrence of low blood sugar after the glucose from the meal has been cleared from the bloodstream. The latest insulin pumps offer different rates and patterns in which this bolus is given, in order to more effectively deal with rapidly or more slowly absorbed types of foods. **Figure 4** shows the normal pattern in which the body releases insulin and describes how basal, bolus, and supplemental insulin are given to mimic this as closely as possible.

Of course, once it has been delivered to the body, the insulin cannot distinguish between basal and meal-derived glucose and so different types of insulin preparation will overlap with each other in their action. Distinguishing between the two requires specialized knowledge and is beyond the scope of this book.

***47. I am afraid that my diabetes treatment will cause me to gain weight. How can I prevent this?***

Some types of medication for diabetes do tend to lead to weight gain. This is especially true of the

classes of medications known as thiazolidinediones, sulfonylureas, meglitinides, and insulin itself. Members of each of these classes of medications have been described in Table 4 (see Question 41). These types of medications all have proven effectiveness in lowering blood sugar and controlling diabetes and have an important place in its management. However, weight gain is definitely an undesirable side effect associated with them. The ways in which weight gain can be minimized or prevented include using, whenever possible, medications that do not cause weight gain, such as the classes known as DPP-IV inhibitors or  $\alpha$ -glucosidase inhibitors. Another option is to take medications that are actually known to cause weight reduction in many people who take them, such as the classes known as biguanides, incretin mimetics, or synthetic amylin (e.g., pramlintide). Some representatives of these classes can also be found in Table 4. If medications known to cause weight gain must be used, then your doctor will try to use them in the lowest effective dose, often by combining them with other types of medications.

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*Finally, it is important to remember that adhering to a diet and exercise plan is just as important when you are taking pills for diabetes as it was beforehand.*

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Finally, it is important to remember that adhering to a diet and exercise plan is just as important when you are taking pills for diabetes as it was beforehand. Many patients who are prescribed pills are told that they have failed diet and exercise. This is not entirely true. The diet and exercise may be making an important contribution to the control of the diabetes, but is not quite enough to control the blood sugar adequately. This important contribution will be lost if the program is not continued and some weight gain in people who start pills or injections for their diabetes is undoubtedly due to this.

***48. I am afraid that I might forget I have taken my insulin and take it twice, or mistakenly take my long-acting dose for my short-acting and vice versa. What should I do if this happens?***

If you think you have taken your insulin twice or taken more or less than you need at that particular point in time, you should not panic, but follow a plan designed to ensure that you do not experience serious consequences from this. First of all, it is surprising how often taking too much insulin does not actually lead to a seriously low level of blood glucose. Having said that, a careful response is needed if you suspect that you have taken too much insulin. In the case of too little insulin, it is often sufficient to monitor the glucose carefully—about every couple of hours is generally sufficient to detect any problems and address them—and be sure to take the right amount at the next scheduled dosage. A brief exposure to high glucose is usually not harmful (unless it is a repetitive event) and the glucose may take 24 hours or so to settle back to its usual pattern. If the reduced dosage is noted quickly, such as before eating the upcoming meal, then the remaining amount can be given. If the meal is underway already, then a slightly smaller meal or subsequent snack can be eaten. If the problem is noted later and the blood sugar is very high, then some additional (supplemental) insulin can be taken to bring it down. The best approach can vary among different patients and your doctor or diabetes educator will have a recommendation for a supplemental scale that may be right for you in these circumstances.

In the case of having taken too much insulin, the blood glucose should also be monitored every couple

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*It is surprising how often taking too much insulin does not actually lead to a seriously low level of blood glucose.*

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of hours and a snack should be kept with you until you feel comfortable that the danger of a serious low blood sugar has passed. You should probably not drive, work at heights, or operate heavy or dangerous machinery during this time. Many people with insulin-requiring diabetes keep a kit containing a syringe of glucagon, a hormone that counteracts the effects of insulin. If the blood sugar falls rapidly and oral glucose, sugar, or a snack is ineffective, glucagon can be given and will usually reverse the falling glucose within a few minutes. Your doctor can prescribe such a kit for you to keep on hand if you feel it is necessary and reassuring. If you recall that you have taken your insulin twice or taken too much fairly soon after having already done so, then you can take some additional carbohydrate at the meal or a larger-than-usual snack between meals.

***49. I am on insulin for my diabetes and I am overweight. If I lose weight, will I be able to stop the insulin shots?***

Encouragingly, the answer is yes. It is often a pleasant surprise to learn that you do not have to lose a dramatic amount of weight for this to occur. Even a loss of between 5% and 10% in your weight can have remarkable benefits on your blood sugars. Some patients often experience a significant reduction in the amount of insulin they need after only a modest weight reduction. Lowering the insulin dosage helps to control appetite and further helps efforts at weight reduction. Lowering the insulin dosage reduces appetite by reducing the likelihood of hypoglycemia, which must be treated by food intake, thus limiting the success of weight loss efforts. Unfortunately, even with such an incentive, the majority of people with diabetes who start insulin will need to remain on it, due to the difficulty of achieving

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*Some patients often experience a significant reduction in the amount of insulin they need after only a modest weight reduction.*

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and sustaining successful weight reduction and also to the fact that the body's own insulin production may by now be quite deficient (see Question 43). Available approved medications for weight reduction are also seldom helpful long term, due to limiting side effects and lack of effectiveness. However, patients who have undergone bariatric surgery (see Question 5) are often able to achieve sustained weight loss and discontinue insulin for the medium to long term. This approach is being increasingly used for people with severe degrees of obesity and serious health problems related to it, including diabetes.

***50. Do any traditional or nonprescription remedies for diabetes really help control blood sugar? If so, which ones do you recommend?***

There are a number of nonprescription remedies that are known to be effective at lowering blood sugar. In fact, one of the most frequently used and established treatments for diabetes, metformin, was derived from the traditional knowledge that the leaves of the French lilac plant reversed the symptoms of diabetes in some patients. This fact had been known to Europeans for more than 200 years before its eventual isolation and chemical modification to the medication that we now use. Other nonprescription remedies that have been found to be effective to varying degrees include cinnamon (it appears that the cinnamon stick itself must be used rather than powdered cinnamon alone), the herb gymnema sylvestre (gurmarbooti, gurmar), raw walnuts, bitter melon, and some compounds of the metals chromium and zinc. The beneficial effects of these are generally mild and can be more effective in some people with diabetes than in others, as is also the case for prescription medications. There is generally little down side to trying some of these supplements, as long as the glucose level is carefully

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*One of the most frequently used and established treatments for diabetes, metformin, was derived from the traditional knowledge that the leaves of the French lilac plant reversed the symptoms of diabetes in some patients.*

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monitored and conventional medications are also taken if they are needed. Since these remedies are not labeled or approved by the Food and Drug Administration for this use, there is no specific standardization for their formulation, which can therefore vary widely between manufacturers. Sometimes, exaggerated claims may be made for their effectiveness while at the same time a disclaimer is offered acknowledging that such compounds are not intended to diagnose or treat any disease!

***51. Are there any medications prescribed for other conditions that can improve or worsen my diabetes?***

Yes, there are a number of medications used to treat other conditions that can affect your blood sugar control. Most of these effects are small, but can be quite dramatic, such as the effect of certain types of steroid medications. Examples of various drugs and how they can affect your blood sugar are shown in **Table 5**.

**Table 5 Examples of Medications in Common Use That Can Affect Blood Sugar**

Medication	Usual Use	Effect on Sugar	Amount of Effect
Antiretroviral drugs (some)	HIV/AIDS	↑	++
Antidepressants (some)	Depression	↑	++ to +++
Carvedilol	Blood pressure	↓ or ↑	+
Estrogen	BCP, menopause	↑	+ to ++
Etanercept	RA, SLE, psoriasis	↓	++
Losartan	Blood pressure	↓	+
Niacin	Cholesterol	↑	+ to ++
Octreotide	Various	↑ or ↓	+
Pentamidine	Infection	↓ but later ↑	+ to ++
Pentoxifylline	Arterial disease	↓	+
Pseudoephedrine	Colds & allergies	↑	+
Ramipril	Blood pressure	↓	+
Steroids	Inflammation	↑	+++
Thiazides	Blood pressure	↑	+

*Abbreviations:* HIV: human immunodeficiency virus; AIDS: acquired immune deficiency syndrome; BCP: birth control pill; RA: rheumatoid arthritis; SLE: systemic lupus erythematosus.

***52. I hear that there are seven different types of pills for diabetes now. Is there a preferred order in which to try them and can they all be combined?***

The various types of medications for diabetes are illustrated in Table 4 (Question 41). While there is no right or wrong order in which to try them, there are certain important principles that guide the use of diabetic medications. Important examples of these principles are effectiveness, safety, avoidance of weight gain, avoidance of low blood sugar, avoidance of side effects, long-lasting effectiveness, smallest number of pills required per day, lowest cost, and lack of interaction with other medications being taken by the patient. The overriding principle is that treatment must be tailored to the specific needs of each individual patient. Thus, while no medication can be said to be right for every patient, there is almost always a medication or combination of medications that can be used in each individual patient. Decision making is further complicated by the cost structure of your medical insurance company's drug formulary. Thus, while a certain pill may be more or less desirable from a medical perspective, the cost may factor significantly into the decision as to whether to use it and this can differ among various insurance plans.

Although many and complex factors must be taken into consideration, certain generally accepted patterns of practice have evolved among those caring for people with diabetes. Metformin is often the drug of first choice because it is inexpensive, does not cause weight gain (it may cause a modest weight loss), and does not cause low blood sugar. However, it has certain side effects and cannot be used in

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*Although many and complex factors must be taken into consideration, certain generally accepted patterns of practice have evolved among those caring for people with diabetes.*

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patients who have various medical problems, such as liver and kidney disease or some forms of serious lung and heart problems. After metformin, the sulfonylureas are often used frequently, even though they can cause both low blood sugar and weight gain. However, they are generally very inexpensive. If this were not the case, sulfonylureas would probably be used much less often than they are and will probably be less and less used as the cost of safer alternative pills comes down over time. The newer class of pills known as DPP-IV inhibitors (e.g., sitagliptin) is very safe, convenient, and fairly effective, and does not cause weight gain or low blood sugar, but is more costly. The thiazolidinediones (TZDs or glitazones) are effective and do not cause low blood sugar, but they can be associated with weight gain and fluid retention and should not be used in people with, or at high risk for, heart failure. They are also expensive. The latter two types of pills therefore remain second line when cost is an issue. Other types of pills such as the meglitinides and the alpha-glucosidase inhibitors have their place in the management of diabetes, but are also usually not first-line drugs. **Table 6** shows an example of a common order in which diabetes pills can be used when considerations of cost are set aside.

These classes of pills can be used in most combinations. Not all of these combinations are specifically approved by the Food and Drug Administration, but many are. The only classes of medication that have been specifically shown to be no more effective when combined together than when used alone are the sulfonylureas and the meglitinides, since they both work through a similar mechanism to release insulin, although they activate it in different ways.

**Table 6 Example of an Order in Which Oral Antidiabetic Drugs Can Be Tried**

Medication	Choice	Reasons(s)
Metformin	1st	Potent, no weight gain, no hypoglycemia, inexpensive
DPP-IV-I	2nd	Mid-potent, no weight gain, no hypoglycemia, very few side effects, can be used with liver or kidney disease
Pioglitazone	3rd	Potent, durable effect, no hypoglycemia, cholesterol benefits, heart protective
Meglitinides	4th	Potent, rapid effect, less hypoglycemia
Sulfonylureas	5th	Potent, rapid effect, inexpensive
Acarbose	6th	No hypoglycemia, no weight gain
Colesevelam	7th	No hypoglycemia, no weight gain, cholesterol benefits

*Note:* This table does not take into account potential reasons why one or other drugs may not be suitable for a given patient. Treatment decisions must be tailored to the needs and for the safety of the patient. This is an example only.

### ***53. How does the treatment based on “lizard spit” work?***

The treatment based on lizard spit is exenatide (Byetta®), which is a synthetic version of a compound found in the saliva of a specific type of poisonous lizard that inhabits the southwestern United States and parts of Central America. The compound from the saliva is unrelated to the venom and is not poisonous. This compound (exendin-4) is a reptilian version of a compound that is released upon eating from cells lining the human intestine (glucagon-like peptide-1 or GLP-1). GLP-1 has several actions that favorably regulate glucose levels in the body. It travels in the bloodstream

to the pancreas and increases the release of insulin, thereby lowering blood glucose. It also reduces the release of the hormone glucagon. This is useful because glucagon tends to raise blood glucose through an action on the liver. The remarkable feature of these actions of GLP-1 is that they only occur when the blood sugar is elevated above fasting levels. Thus, GLP-1 does not cause hypoglycemia. GLP-1 decreases the rate of emptying of the stomach, slowing delivery of calories to the intestine and making their absorption more gradual. This also serves to keep blood glucose levels lower. GLP-1 acts on the brain to increase the feeling of fullness after eating (known as *satiety*) and to reduce hunger, which helps to limit food intake.

Unfortunately, however, human GLP-1 is very rapidly broken down and inactivated by the body after release into the bloodstream, most being removed within a few minutes. This is where exenatide comes in. This derivative of the reptilian compound is resistant to the human mechanism for breaking it down and lasts in the bloodstream for several hours. This makes it approximately ten times as powerful as natural human GLP-1. For these reasons, exenatide, which must be taken by twice-daily injection, is effective at lowering blood sugar in people with diabetes and, in more than eight out of ten people who take it, it leads to weight loss, in part due to its appetite-suppressant properties. More than four out of ten people who start exenatide treatment will experience nausea and about one out of seven will experience at least one episode of vomiting. This often passes after a few uses, but some patients cannot tolerate this medication. To minimize this problem, it is given in a lower dose initially and the dosage is increased after the first month. It comes in prefilled pens containing one

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- *Heloderma suspectum* (*Gila Monster*) and *Heloderma horridum* (*Beaded Lizard*) are the only venomous lizards in North America.
  - Exendin-4 is *not* derived from nor related to the venom, but is produced in the salivary glands of the Gila monster.
  - Exenatide is a synthetic version of the substance produced in the lizard's salivary glands. It is more potent than the equivalent human substance and more resistant to breakdown in the body.
  - Exenatide must be given by injection. It lowers blood sugar and often leads to weight loss, although it can be effective even if the user does not lose weight.
  - It often causes nausea initially and sometimes vomiting.
  - Rarely, pancreatitis may occur.
- 

**Figure 5** Properties of exenatide.

month's treatment. **Figure 5** shows some of the properties of exenatide.

***54. Many patients start on pills but end up on insulin. Why do pills tend to fail in the end and do they all fail at the same rate?***

Pills for type 2 diabetes tend to fail after a period of time because the severity of the diabetes tends to progress. Diabetes is a disorder associated with aging, reduction in physical activity, and increasing body weight. Since all of these things tend to progress with time, it is not surprising that the severity of the diabetes tends to progress and the response to pills that were previously effective tends to be diminished. Not only this, but there appears to be a normal aging-related decline in the ability of the pancreas to make insulin that is steeper in those with diabetes. Since one is presently unable to prevent this or prevent aging from occurring, the only factors that are controllable to prevent progression of the diabetes are weight and exercise, and these are notoriously difficult to manage with consistent success. Therefore, it is not surprising that many people with type 2 diabetes

tend to require more and higher doses of pills over time and that many eventually fail to be controlled on pills alone.

The pills do not all tend to fail at the same rate. The sulfonylurea drugs and metformin (see Questions 41 and 52 for a description) tend to fail at a rate of about 5% of patients who were previously controlled on them per year. Thus, after 10 years, half of the patients taking these drugs initially successfully will no longer be controlled on them. However, there is encouraging news from some of the newer types of pills for diabetes. It appears as if the medications of the TZD class and possibly the DPP-IV inhibitor class (see Questions 41 and 52 for a description) may actually modify the course of the diabetes itself and slow its progression. The TZD type of drugs acts to improve the body's response to the insulin it produces, while the DPP-IV inhibitor class may act to restore the health of the insulin-producing cells of the pancreas. Whether these types of drugs are able to achieve these improvements in a long-term manner, such that patients on them will not require insulin or other drugs by injection at all, remains to be shown by long-term studies.

# *Monitoring and Living with Diabetes*

What information should I bring to my doctor to help him or her manage my diabetes with me?

How accurate are glucose monitors?

How will my diabetes affect my work? Are there any jobs I cannot do?

*More . . .*

## 55. *How often do I need to check my blood sugar?*

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*How often you need to check your blood sugar depends upon how the information that blood sugar testing provides will be used.*

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How often you need to check your blood sugar depends upon how the information that blood sugar testing provides will be used. All too often, people with diabetes are instructed to test their blood sugar frequently and yet neither they nor their physician or other caregivers make significant use of the information. Generally, when treatment (such as the amount of insulin to be taken before the next meal) is not being adjusted immediately or even day to day, there is little justification for very frequent testing. Except for people who cannot or will not test, all people with diabetes should be prepared to check their blood sugar frequently when they are sick, under severe physical stress, or taking medications that are known to markedly affect the blood sugar level, such as steroids. Examples of possible glucose monitoring schedules for various circumstances are shown in **Table 7**.

**Table 7** Glucose Monitoring Strategies

Type of Diabetes	Testing Strategy
Type 1, 2, or GDM on intermittent insulin 2 to 4 times daily	Before meals, bedtime, occ. after meals, & during night
Type 1 or 2 on continuous insulin infusion (pump)	Before meals, bedtime, sometimes after meals, & during night
Type 2 on oral antidiabetic pills (OADs)	Before breakfast and supper alternating with before lunch and bedtime, 3 days/week
Type 2 or GDM on lifestyle intervention	As for type 2 on OADs, 1 to 3 days/week
All types, when sick or unstable	As needed to intervene effectively, q2-hours if needed

**56. What is the target level for my blood sugar?**

The target level for your blood sugar depends on who you are and on the other circumstances of your health. Various authoritative expert bodies have published blood sugar targets to aim at before and 2 hours after meals at various stages of life, including for children, adults, pregnant women, and the elderly. The various recommendations differ in certain respects, but are generally similar and those of the American Diabetes Association and the American Association of Clinical Endocrinologists are shown in **Table 8**. Wherever possible, otherwise healthy individuals with diabetes should aim to achieve blood sugar levels that are as close to normal as possible, as long as these can be reached without side effects that are either distressing or dangerous. This is a matter of judgment between you and your physician. The main side effects of the various pills for diabetes are shown in Table 4 (Question 41).

The target levels for blood sugar can either be described by blood sugar levels themselves or in overall terms, according to the Hemoglobin A1c

**Table 8 Blood Sugar and A1c Targets for Diabetes**

Time	ADA (mg/dl)	AACE (mg/dl)
Fasting	70–130	Less than 110
2 hours after eating	Less than 180	Less than 140
A1c	Less than 7.0% and as close to 6% as is safely achievable; less than 8% in young children, the elderly, and those at high risk of hypoglycemia	Less than 6.5%

*Source:* Data from ADA: American Diabetes Association; AACE: American Association of Clinical Endocrinologists.



(HbA1c or A1c), which is an average measure of blood sugar over the prior 3–4 months, approximately. For all people with diabetes, but especially those who do not need to perform frequent self-monitoring of blood sugar or who are unable to do so, the HbA1c is a very helpful measure and the American Diabetes Association recommends that it is performed at least twice per year. Recently, it has been recommended that the HbA1c should be reported in terms of the estimated average blood glucose (eAG) to which it corresponds, which may be more meaningful to most persons with diabetes. The corresponding values of each and the formula to make this calculation are shown in **Table 9**.

***57. What information should I bring to my doctor to help him or her manage my diabetes with me?***

The most important pieces of information that you can bring to your doctor are the results of your home

**Table 9 The Relationship Between HbA1c and Estimated Average Glucose Level (eAG)**

HbA1c (%)	eAG (mg/dl)
5	97
6	126
6.5	140
7	154
7.5	169
8	183
8.5	197
9	212
9.5	226
10	240
11	269
12	298

Formula used to calculate mean blood glucose (eAG) from A1c:  
 $eAG(\text{mg/dl}) = (28.7 \times \text{HbA1c}) - 46.7$ .

Source: Data from American Diabetes Association (ADA).

glucose testing (and preferably your glucose monitor, also) and an updated list of the medications you are currently taking, not only for diabetes, but for other medical problems as well. The glucose testing results are important because they reflect the most current state of control of your blood sugar. Also, if you are taking your glucose tests at various times of day, your log will show where you are best controlled and where you are not so well controlled, which allows your doctor to recommend the most effective adjustment to your treatment, or to suggest factors that might be influencing your sugar levels. Generally speaking, the more complex your therapy and the longer you have had diabetes, the more important the home glucose test results become. For example, if you have developed diabetes relatively recently, are on one medication only, and your periodic HbA1c tests show that you are generally well controlled, the home glucose results are less critical than if you have had diabetes for several years, are on multiple pills and/or insulin, and have complications of your diabetes (see Part 4). The reason that it helps to bring your monitor is that the results may suggest a problem with it and it can be examined when you are seen. Also, the information in it can often be downloaded into the clinic computer and analyzed in a number of ways to show trends and patterns that can be very helpful. When you keep a record of your readings, it is much better to enter them into one of the commercially available logbooks designed for the purpose than to write them down one after the other on a sheet of paper, which often makes them quite hard to follow and understand.

The importance of the list of your current medications and dosages is that your doctor can only safely

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*If you are taking your glucose tests at various times of day, your log will show where you are best controlled and where you are not so well controlled.*

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make adjustments to your medicines (for diabetes and other related conditions) in light of accurate knowledge of what you are presently taking. This includes herbs, supplements, and alternative medicines. This leads to one final important point, which is to remind you never to be hesitant to reveal to your doctor whether you are, or are not, taking your prescribed medicines correctly. Your doctor's aim is to serve your healthcare needs and to advise and assist you. He or she does not wish to judge or blame you. You have ownership and control of your medical problems and are free to make your own decisions as to whether to follow medical advice or not to do so. The only time a responsible physician will not agree to partner with you in such a decision is if it would be unethical or dangerous and his or her primary obligation not to harm you would be violated.

***58. What tests should my doctor be doing on a regular basis to monitor my diabetes?***

Some of the tests that your doctor will perform to monitor your diabetes and the status of any of its chronic complications are shown in **Table 10**. The main things that interest your doctor are monitoring the control of your blood sugar, the control of your cholesterol and blood pressure, and the presence or progress of any long-term complications of your diabetes (see Part 4 for discussion of these), and to check for the presence or absence of other related conditions. Tests in this context can refer to clinical examination, such as checking the condition of your feet and testing the sensation, laboratory blood tests, and special tests, as indicated, such as scans or other images. Many of these your doctor can do himself

**Table 10** Items That May Be Checked Regularly in Persons with Diabetes

Item	Monitoring Tool
Glucose control	HbA1c, fructosamine, CBGs, eAG
Lipids	Fasting lipid panel ± special lipid tests
Blood pressure	BP cuff measurements
Large vessel health	EKG, carotid IMT
Small vessel health	
Feet	Inspection, microfilament, capillary refill, ABIs
Kidneys	Serum creatinine, estimated CCr, MACR
Eyes	Retinal imaging, dilated eye exam
Peripheral nerves	Monofilament, NCV testing, touch and vibration perception, proprioception*
Autonomic nerves	Postural BP, pulse, RR variation

*Abbreviations:* HbA1c: hemoglobin A1c; CBGs: capillary (fingerstick) blood glucoses; eAG: estimated average glucose; BP: blood pressure; EKG (ECG): electrocardiogram; IMT: intimal-medial thickness by ultrasound; ABIs: ankle-brachial indices; CCr: creatinine clearance; MACR: microalbumen-to-creatinine ratio; NCV: nerve conduction velocity; RR: R-wave to R-wave (on EKG).

\*Position sense.

and others may require referral to another specialist. A detailed eye examination is an example of the latter.

### ***59. What is the best kind of glucose monitor?***

Since insulin became available, probably nothing has more revolutionized the day-to-day management of diabetes, especially type 1 diabetes, than the arrival of the capillary glucose monitor. So successful has this technology been that this is a difficult question to answer specifically because there are up to 20 approved glucose monitors for use at any one time, with new or updated models appearing frequently. Also, different features are important to different individuals, depending on their needs. Probably the best way to answer this question is to discuss some of the available features. Size is one of the first that springs to mind. Monitors have been getting ever

smaller since they first appeared more than 30 years ago. It is now possible to get a monitor that is about the same size as a standard lipstick (e.g., One Touch Ultra-Mini®) and is yet highly functional. Memory size is not as important as it might at first seem. A memory of about 100 readings is probably sufficient, although almost every monitor now has more. There is limited practical usefulness of going back too far, since treatment decisions should be based on recent information, rather than distant data. Sample size is sometimes important and most available meters now use much smaller blood samples than was previously the case. Microsample meters such as some Freestyle® and One Touch® models use samples less than 1/50th the size of an actual droplet of blood. Many monitors will permit sampling from sites other than the fingertip, such as the forearm (most) and palm, which is useful for those with sensitive fingers or for people who are heavily involved in manual or delicate work. The speed of obtaining the reading is now usually around 5 seconds after the blood sample is applied, although some models (such as the Prestige IQ®) can take up to 50 seconds. This is much shorter than models in the early days, which could take from 1 to 2 minutes. Most meters can now be linked by cable, Bluetooth, or broadband to a computer and their contents are downloadable, including to the Internet. Some meters have multistrip cassettes that dispense between 10 and 20 test strips, such as the Accucheck Compact Plus®, for added convenience. Other features include the ability to display results graphically (e.g., One Touch Ultrasmart®), to function at high altitude (e.g., Advocate Duo®), and to speak the results for those with limited vision (e.g., Prodigy Duo®). The features of 10 available glucose

**Table 11 Features of 10 Available Capillary Glucose Monitors**

Name	Vol	Site	Time	Mem	DL	Other
One Touch Ultra 2	1.0	F, A	5	500	+	
One Touch Ultrasart	1.0	F, A	5	3000	+	Graphs
One Touch Ultramini	1.0	F, A	5	50	-	1.2 oz
Accucheck Compact+	1.5	F, A	5	300	+IR	Drum, no code
Accucheck Advantage	4.0	F	26	480	+	
Advance Microdraw	1.5	F, P	15	250	+	
Freestyle Flash	0.3	F, A	7	250	+IN	
Advocate Duo	0.7	F, A	7	450	+	To 10,742 ft
Prodigy Duo	0.6	F, A	6	450	+	Talks, 5 oz
Prestige IQ	4.0	F	50	365	+	WB/plasma

Vol: Sample vol in  $\mu$ L; F=finger; A=arm; P=palm; Time=time to results in seconds; Mem=memory capacity; DL=downloadable; IR=infrared; WB=whole blood.

monitors are shown in **Table 11** and an example of a typical data printout can be seen in **Figure 6**.

Finally, those with longstanding or complicated diabetes might want to consider the option of continuous glucose monitoring, which is discussed in **Question 60**. However, bear in mind that you will still require a conventional capillary glucose monitor.

Date ▼	Breakfast					Lunch					Dinner					Night			Cmnt
	Bef	Aft	Meds	Carb	Other	Bef	Aft	Meds	Carb	Other	Bef	Aft	Meds	Carb	Other	Gluc	Meds	Carb	
12/08/02	68	131	20M	30							151	10M	80		✗				
12/08/02											129								
12/07/02	172		20M	30		140			15		179	10M	45						
12/08/02	114		20M	30		88			15		144	10M	80			185		15	
12/05/02	264		20M	15	♥	199	143		30	✗		10M	120		✗				
12/04/02		185	20M	30	♥						309	4A	30						
12/04/02											223	5A							
Average	137	154				194	146				201	232				133			
In Target	40%	88%				43%	88%				27%	33%				71%			
# Results	15	7				14	8				11	3				7			

**Figure 6 Example of a data printout from contemporary glucose monitor.**

Source: Used with permission from LifeScan, Inc. © 2009

### ***60. Should I get one of the new continuous glucose monitors?***

There are now three types of continuous glucose monitors available. They all transmit glucose results wirelessly from a small sensor placed just beneath the skin via a transmitter whose signal is received by the monitor placed anywhere from 5 to 10 feet away. Results are sent from every minute to every 5 minutes and the trend of the readings can be shown on graphs. One, the Medtronic Realtime System<sup>®</sup>, can transmit the results into the same unit that is used as the insulin pump. However, even though the same unit acts as both monitor and pump, it is still necessary for the wearer to program and set the amount of insulin to be delivered. Studies have shown that the additional information provided by the frequently delivered values and the graphed trends reduces high and low glucose events in the wearer by about half. It is important to note that all the current continuous glucose monitors are approved only for use with and alongside conventional glucose meters. This means that before acting on the information the continuous monitor provides, you should verify it by obtaining a reading with your regular monitor. Also, the two technologies provide similar but slightly different information. The conventional monitor measures blood glucose from the blood droplet resulting from the finger prick. The continuous meter does not use blood. Instead, it measures the glucose level in the fluid bathing the tissue under the skin. This is in fact derived from the blood plasma itself, but it takes several minutes to adjust to reflect the blood level. The available continuous meters need to be calibrated twice daily (Medtronic Guardian<sup>®</sup>, Dexcom 7<sup>®</sup>) with a conventional fingerstick reading, although the newer Abbott Freestyle Navigator<sup>®</sup> needs only four calibration readings

in a 5-day period. Once introduced, the sensor/transmitter can be worn for 3 (Guardian), 5 (Navigator), or 7 (Dexcom-7) days before the sensor must be changed. Features of an available continuous monitor are shown in **Figure 7** and **Table 12**.

The decision as to whether to get one of these monitors depends on the value to the wearer of knowing his or her



A: Applicator; R: Receiver; ST: Sensor-Transmitter

**Figure 7** A continuous glucose monitor.

Source: Dexcom.

**Table 12** Features of Two Available Continuous Glucose Monitors

Feature	Dexcom <i>ST5</i>	Medtronic <i>Guardian</i>
Sample site	Subcutaneous ISF	Subcutaneous ISF
Sensor life (days)	7	6
User age (years)	≥18	≥7
Set-up cost (\$)	800	1339
Clark Error Grid A&B	95.4%	96.0%
Probe gauge	25	22
Battery	Rechargeable	Disposable AAA
Initialization (minutes)	120	140
Calibration (hours)	2, 8, then q12	0.5 × 2, then q12
Alarms	High and low	High and low
Integratable	No	Can transmit to <i>Paradigm</i> insulin pump
Transmitter range (feet)	5	6
Transmitter waterproof	Yes	Yes
Graphs trends (hours)	1, 3, and 9	3 and 24



readings on a minute-by-minute basis. For people early in the course of diabetes, on oral medications, and in good control, they are probably not necessary. For people on insulin, with a history of low and high readings, especially if they are hard to predict or explain, the information provided by continuous glucose sensing may be very valuable. However, approval for insurance coverage is often limited to specific circumstances, such as the frequent occurrence of very high or low blood sugars that cannot otherwise be prevented.

### ***61. How accurate are glucose monitors?***

Glucose monitors are quite accurate in that any given reading on the same sample of blood should only vary by a few percentage points (i.e., 5–10). In order to obtain approval from the Food and Drug Administration, such medical devices have to show that they are both precise and accurate. This means that they will obtain a similar result under similar conditions and that the result will be close to the real true value, as best as we are able to ascertain it, i.e., according to the accepted gold standard, which is glucose measured in the laboratory. Furthermore, when such a device is compared to the gold standard measurement in clinical trials, a specified number of readings have to fall very close to the readings obtained by the gold standard device. This value is more than 95%. The rules for approval of such devices have been published by the FDA and can be viewed at <http://www.fda.gov/cdrh/oivd/guidance/1171.pdf>. Although users are often surprised by the variation in results that they will see upon obtaining a reading within a very short space of time from a prior reading, it has to be acknowledged that the variation is seldom such that a different course of action would be taken. For example, insulin would be given or not given or a low blood sugar level would be treated or not

treated. Actual numerical accuracy tends to be less when the glucose level is very low. However, since such a low value should always be treated, the accuracy of the actual reported number is not critical.

When a surprising glucose value that does not fit with the expected circumstances is obtained, it is always prudent to recheck that reading, on either the same or a different monitor. Also, it is advisable to check that the monitor is functioning well, by checking the low battery indicator, assuring that the correct coding has been entered and that the test strips are within date and inserted properly. Sometimes, variation in technique by the user accounts, at least partially, for variation in the result obtained. This can include liquid on the puncture site, contamination with glucose, excessive squeezing of the finger, and sweating.

## ***62. How does stress affect my blood sugars?***

Stress is a broad term that can have a number of meanings. For the purposes of this question, only emotional stress will be discussed. Emotional stress (whether its source is personal, professional, psychological, or social) can affect the blood sugar in a number of ways. The most frequent manifestation of stress is the result of the rise in the circulating level of stress hormones in the blood. The stress hormones, such as epinephrine or adrenaline and cortisol, release stored glucose into the blood, thus raising sugar levels. They also make the tissues resistant to insulin. The result is a rise in blood sugar levels, which often leads to a need for more insulin or other medication.

Stress can also affect blood sugar levels by its effect on eating behavior. When under stress, eating habits often change. This change may be predictable in a given

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*Stress can also affect blood sugar levels by its effect on eating behavior.*

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individual but is quite unpredictable in different individuals. It can vary from eating less and losing weight, to eating more or eating at different times, such as during the night. This can significantly alter one's pattern of blood sugar readings. Also, significant amounts of stress often interrupt established patterns of exercise and leisure sports, which can cause blood sugars to rise.

Furthermore, a person's adherence to a prescribed medical regimen often suffers during times of stress. The management of one's diabetes can consume a considerable amount of a person's time and attention and be a stress in itself. For this reason, people often reduce their frequency of glucose monitoring and sometimes the number of prescribed pills or injections that they actually take. Occasionally, this can have serious short-term consequences, but of significant concern is that people under prolonged stress who do not pay close attention to the management of their diabetes open themselves up to an increased risk of the serious long-term complications discussed in Part 4. Therefore, if you are a person with diabetes under stress, it is wise to focus on addressing and relieving that stress in the interests of your long-term health.

***63. Is there a link between lack of sleep or disturbed sleep and my blood sugars?***

There certainly can be. Studies have shown that sleep deprivation can have a negative effect on several aspects of metabolism, including blood sugar, blood pressure, and even cholesterol levels. Blood sugars can be increased by the stress of lack of sleep. What constitutes an adequate amount of sleep varies among individuals, so what may be a metabolic stress for one may not be so for another. The elevation in blood sugars will not necessarily occur upon awakening, but can occur anytime due to elevated levels of stress hormones throughout

the day. As described in Question 62, stress hormones tend to push the blood sugar level up. Sometimes several days of deprived sleep are necessary to have a measurable effect on the blood sugars.

Several other factors are worth noting. If the lack of sleep is associated with restless behavior (e.g., tossing and turning or arising and pacing), the increased physical activity may actually lower the blood sugars. A condition known as obstructive sleep apnea, or OSA, can occur in people with obesity and type 2 diabetes. This can cause frequent awakening at night, with daytime sleepiness and napping. The net amount of sleep may be more or less than normal in people with OSA. Generally, a bed partner will notice snoring and a disturbed breathing pattern. This condition is treatable and sometimes constitutes medical justification for surgical intervention to control obesity. You should inform your doctor if you suspect you have this problem. Finally, shortened sleep tends to be associated with weight gain, so that restoration of a satisfactory sleep pattern can actually aid in efforts to reduce weight, which will generally help to control blood sugars.

#### ***64. How can I avoid getting bruises or swellings on my stomach from my insulin shots?***

Bruises and swellings on the stomach (or more accurately the abdominal wall) due to insulin are caused by two distinct mechanisms and are not usually variations of the same thing. However, occasionally a bruise will be severe enough so as to cause an actual swelling.

Bruising is due to leakage of blood from small vessels penetrated at the time of the insulin injection. Some people are more likely to bruise than others, including

the elderly and those on anticoagulant or antiplatelet medications (blood thinners) such as warfarin, heparin, clopidogrel, ticlopidine, and others. Some people on routine doses of aspirin for protection from stroke and heart attack will note an increased tendency to bruise with their insulin injections, while others do not. Injection tools or technique may also play a role. Those with relatively small amounts of body fat on their abdominal walls (or thighs or arms if you use them) need to be sure to lift and gently pinch the skin and insert the needle at an angle in the middle of the pinched tissue. Injecting the needle directly and to the hilt may lead to an inadvertent injection into the muscle. This will change the pattern of action of the insulin and lead to a bruise or sometimes a painful bleed into the muscle itself. Some types of needle are more prone to cause bruising in some individuals than others. If you bruise easily, use the smallest diameter (gauge) of needle you can find. Remember that the higher number of gauge means a smaller diameter.

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*Injecting the needle directly and to the hilt may lead to an inadvertent injection into the muscle.*

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Swellings, especially if they are chronic, are often due to a property of the insulin itself. Insulin is one of the hormones responsible for growth and maintenance of our tissues including muscle protein and fat stores. If insulin is injected repeatedly in the same area, additional fat can become laid down in that spot. This takes on the appearance of a painless fatty mound (**lipohypertrophy**), which can be somewhat disfiguring. Fortunately, these fatty mounds will disperse if the insulin is no longer injected there, although it may take several weeks or months to remodel. To avoid these, the insulin injection sites should be rotated. Keeping a simple map of your abdominal wall, divided into a grid of 20 or 30 boxes and checking off a box after you have used it, will allow you to avoid using

#### **Lipohypertrophy**

A painless, but potentially disfiguring, fatty mound.

the same spot repeatedly within a 3- or 4-week period. Rarely, the opposite of lipohypertrophy may occur, i.e., loss of body fat in a localized or more generalized way. This is known as *lipoatrophy*. This is sometimes preceded by a viral infection, but more often the underlying cause cannot be identified.

Red or itchy areas at the site of injection may indicate an allergic reaction to the insulin or a component of it. This is quite rare with modern insulins, but will necessitate a process known as desensitization, which needs to be performed under the supervision of a specialist. Larger red or discharging swellings, which are shiny and tender, indicate an abscess due to infection and you should seek medical attention promptly.

***65. How will my diabetes affect my work?  
Are there any jobs I cannot do?***

Whether your diabetes will affect your work depends upon the nature of your diabetes and the nature of your work. Thus, the impact can be almost negligible to highly significant and life-changing. People with early or well-controlled type 2 diabetes, especially if they are not taking medications known to cause hypoglycemia, should be able to perform satisfactorily in almost any type of work that they wish to do. In situations in which personal or public endangerment is a possibility (e.g., transportation and heavy equipment operation) glucose monitoring should be performed periodically, especially when feeling unwell, as high blood sugars can be associated with impaired mental functioning and increase the risk of dehydration and dizziness or drowsiness.

If you have type 1 diabetes or insulin-requiring type 2 diabetes, or have type 2 diabetes but are taking pills known to cause low blood sugar (for a list of these, see

Table 4 in Question 41), then the performance of certain occupations which could potentially endanger yourself or others places a special burden of care and attention upon you. With regards to motor transportation, motor vehicle departments have regulations, which may vary from state to state, as to licensure requirements. They may involve, for example, producing records from the memory of a glucose monitor to show that you have checked your blood sugar at regular intervals prior to and during driving and have had no significant low blood sugar readings while doing so. With regard to flying, there are federal regulations and states may have additional requirements. If you are considering a military career and have diabetes, you will have to inform your recruiter, who will advise you of your eligibility.

A number of occupations are not covered by specific regulations, but you will generally be held to the standard of reasonable behavior if you cause harm to people or property wholly or in part as a result of your diabetes. If you did not know what a reasonable person might be expected to know, or act on the knowledge that you have as a reasonable person might be expected to act, you could be judged to have recklessly endangered the lives of others or negligently damaged the property of others and could be subject to legal penalties. If in doubt, therefore, discuss your diabetes with your doctor and your employer and seek advice from experts on regulations that might apply to you.

***66. I have heard that depression is more common in people with diabetes. Is this true?***

Yes, it is true that people with diabetes (and with other long-term illnesses) can experience higher rates

of depression. This can be due to factors relating to the diabetes itself, or it can be unrelated. There is no convincing evidence that the actual blood sugar level itself is reliably predictive of mood, even in those with a tendency to depression. The severity of the diabetes and its complications, as well as its impact upon a person's lifestyle and aspirations, can be an important predictor of depression. For some the impact may be major and for others much less so, even though the degree of severity of the diabetes is the same. It is important to remember that the vast majority of people in our society with treated diabetes (more than 15 million in the United States alone) are able to adjust to the disorder and have happy, productive, and rewarding lives. Some have even achieved astonishing things in all walks of life. Examples include the gold medal winning Olympic swimmer Gary Hall, the NBA basketball player Adam Morrison, and the actresses Halle Berry and Mary Tyler Moore and Supreme Court Justice Sonia Sotomayor, all of whom have lived with diabetes while achieving great success.

If you are experiencing unusual degrees of sadness, reduced enthusiasm or interest in life, or excessive stress that you perceive is related to your diabetes, your doctor or certified diabetes educator may be able to help you to identify resources that can help you cope. Some of these resources are discussed in Question 82. Many certified diabetes educators (CDEs) are trained to provide such psychosocial support. If you are truly suffering from depression, your diabetes may or may not be an underlying cause, even though it may seem that way. Your doctor or CDE will help you to identify whether expert professional psychological or psychiatric consultation is needed.



### ***67. How does the sugar in fruit drinks differ from the sugar in sodas?***

#### **Fructose**

A simple sugar found in honey, many fruits, and some vegetables.

The sugar in fruit juices is predominantly **fructose**, which is a disaccharide, meaning that it contains two molecules of glucose joined together and must be broken down to glucose in order to be absorbed, which may cause a delayed or muted effect on the blood sugar. Fruit juices will also contain a moderate amount of some vitamins and minerals. Sodas do not contain significant amounts of vitamins or minerals. The sugar in regular non-diet sodas is glucose, which is very readily absorbed and sweeter tasting. The amount of sugar in a standard 12-ounce can of regular soda is equivalent to about 9 teaspoons of table sugar (which is neither glucose nor fructose, but sucrose, another disaccharide) and therefore provides a large amount of calories, which can raise the blood sugar level very quickly. This is helpful if a low blood sugar reaction is being treated, but not a recommended part of the diabetic diet, as it causes a very sharp rise in blood glucose to levels above those recommended. This rise is hard to prevent with either pills or insulin, without giving doses that will later lead to low blood sugar levels.

### ***68. My doctor says I don't need to see a specialist for my diabetes. How do I know if my doctor is right?***

At the time of writing, there are estimated to be about 16 million adults in the United States who are aware that they have diabetes. There are, however, only about 4000 certified adult diabetes specialists in clinical practice and not all of these are in full-time practice. Some, perhaps one in four, do not see patients with diabetes at all. This translates to one diabetes specialist for every 5000 people with diabetes. Those who are

interested in learning more about the shortage of diabetes specialists in the United States can visit <http://www.endo-society.org/advocacy/legislative/upload/A-Stewart-US-Endo-Workforce-A-Supply-Demand-Mismatch.pdf>.

The average diabetes specialist carries a clinic census of several hundred active patients, each of whom he or she sees from two to several times per year. From these statistics, it is clear that the vast majority of people with diabetes will not be able to consult a specialist. However, not all people with diabetes need specialist input, and those who do will usually not require it for the majority of the course of the disease, especially in the case of type 2 diabetes. Much of the education necessary to effectively manage diabetes, especially that centering on glucose monitoring and diet and nutrition, is accessible by referral directly from your family doctor. Given its frequency, many family doctors see a considerable number of patients with diabetes and are competent in its routine management. They also generally make effective judgments as to when specialist consultation is advisable.

Some of the circumstances in which consultation with a diabetes specialist is often advisable are shown in **Table 13**.

***69. I don't want my friends or co-workers to know I have diabetes. How can I manage it discreetly in public places?***

It is sometimes surprising (and reassuring) to realize that, given the fact that about 1 in every 12 people in our society has diabetes, we encounter people with diabetes virtually every day in our daily lives and are quite unaware of it. This means that diabetes can

**Table 13** Circumstances in Which Persons with Diabetes Might Benefit from Seeing a Specialist

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1. Difficulty achieving target blood sugar control using routinely available medications with the best efforts of both the physician and the patient
  2. Diabetes in which microvascular complications (such as eye, kidney, or nerve) have occurred or are progressing
  3. Diabetes in which macrovascular complications (such as heart attack, heart failure, stroke, or other arterial disease) have occurred or are progressing
  4. Frequent or unexplained high or low blood sugars
  5. Pregnancy or planned pregnancy in a woman with diabetes
  6. The use of multiple daily injections of insulin or a pump
  7. Treatment of the diabetes complicated by other significant medical problems
  8. During or following a hospital admission for decompensated diabetes or a diabetes complication, e.g., foot ulcer
  9. When considering the decision to switch from pills to insulin
  10. When considering pancreas or kidney transplantation
  11. When a course of medium- or long-term oral steroid therapy is planned
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indeed be managed discreetly and privately without undue attention and alarm by the vast majority of those who have it. A renowned diabetes specialist recently wrote that the most important contribution of the diabetes specialist is to help patients build diabetes into their lives rather than to build their lives around diabetes\*. Thus, there are many ways in which management of diabetes can be built into our lives without unduly disrupting them.

Perhaps the two main challenges to discreet diabetes management are performing glucose monitoring and administering injectable medications, such as insulin, during the workday. The main challenge for many occurs in the middle of the day, when most people are at work and privacy is scarce. Many simply do not

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\*See Gale EAM. Who Needs the Diabetes Specialist Physician? *Diabetologia* 51:700–702, 2008.

check their blood sugar during the middle of the day and settle on a treatment regimen that avoids insulin shots during the day. Fortunately, some insulin treatment plans are designed to prevent this, as they entail use of one or two shots of longer-acting insulin and an injection of short-acting insulin before each main meal. Moreover, studies have shown that patients on insulin who do not check their blood sugar in the middle of the day achieve poorer control of their diabetes. Modern miniaturized glucose monitors and automated insulin pen devices are at least part of the answer for many people. Continuous glucose monitors (see Question 60) can offer a solution for others. Some glucose monitors, for example, the Lifescan One Touch Ultra Mini<sup>®</sup>, are little larger than a conventional tube of lipstick and will provide a reading within 5 seconds. Others, such as the Accucheck Compact Plus<sup>®</sup>, automatically produce a strip when switched on. While time is required to perform the finger (or arm) stick to obtain the drop of blood, the entire operation can be completed in about a minute, especially if the lancet was previously loaded into the spring-loaded autolancet device. Thus, this can be done at one's desk or in the restroom quite rapidly. Similarly, preloaded insulin pens can avoid the need to draw up insulin, or bring bottles and syringes. The dose can be dialed on the pen and given in seconds. Finally, continuous glucose monitors only require the wearer to check the readings they are displaying, much as we check our beepers and cell phones from time to time.

Remember that regular glucose monitoring during the day can help avoid unexpected low blood sugars, which can be the hardest to manage without attracting attention, especially if they are severe.



# *Diabetes and Special Situations*

I have diabetes and want to get pregnant.  
What should I do?

I will be traveling. How do I handle the time changes  
with my insulin shots?

My child has diabetes and is about to start school.  
What steps should I take and how will the school  
help to ensure that things go well?

*More . . .*

***70. I have diabetes and want to get pregnant. What should I do?***

When a woman of childbearing age has diabetes, it is very important to plan the pregnancy ahead of time for a number of reasons. The first reason is that studies have shown that the risk of birth defects (called congenital malformations) is much higher if the diabetes is not well controlled at the time of becoming pregnant. Improving control of the diabetes as quickly as possible after discovering the pregnancy will not fully reverse this risk, which in some studies has been found to be as high as one in five. Therefore, it is important to establish and confirm that your diabetes is in the best possible control before proceeding with a plan to become pregnant.

The second issue is that women with longstanding diabetes who suffer from its microvascular complications (see Questions 32, 33, and 34 for discussion of these) are more likely to have a complicated pregnancy and will need to be reassessed prior to and during the pregnancy. Of particular importance are the possibility of progression of retinopathy and nephropathy during the course of pregnancy.

Finally, it may be necessary to change the type of treatment during the pregnancy, and this may require some forward planning. For example, pills are generally not used during pregnancy. Therefore, a woman with type 2 diabetes will almost always need to learn how to take insulin and it may be more convenient to do this as part of pre-pregnancy planning.

***71. I am scheduled to have an operation. How do I prepare my diabetes for this?***

The extent to which you and your physician prepare for your operation depends on the extent of the

operation, the severity of the condition that has led to it, and the treatment that you are taking for your diabetes. The fact that your operation is planned means that it is not urgent nor an emergency. However, many people with diabetes will experience surgical emergencies for which no preparation is possible. In general, the outcome will depend on the underlying emergency, with the overall management being made somewhat more complex by management of the diabetes during and after the operation. However, in recent years, studies have shown that very careful management of the blood sugar is very important in the days immediately following an operation. However, there is less convincing evidence that blood sugar management prior to and during an operation is quite as important.

In general, your surgeon will request assurance from the medical doctor caring for your diabetes that your blood sugar is under fair overall control, especially in the days and weeks running up to the operation. The severity of any large vessel complications, such as heart and other vascular disease, will need to be evaluated. Your blood pressure will need to be well controlled, as high blood pressure (hypertension) is a frequent accompaniment to diabetes and can lead to surgical complications if unregulated. Of the small vessel complications of diabetes, your kidney function will need to be evaluated and the result taken into account, as abnormal kidney function can affect blood pressure, lead to retention of intravenous fluids, and alter the rate of removal of certain medications from the body.

If you are taking pills and the operation is relatively minor and brief and your diabetes is under good

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*In general, your surgeon will request assurance from the medical doctor caring for your diabetes that your blood sugar is under fair overall control, especially in the days and weeks running up to the operation.*

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control, not taking your medication on the night prior to and/or the morning of the operation may be all that is needed and the medication can be resumed after surgery, with your first main meal. People who are taking insulin will generally be instructed to take a reduced dose of the longer-acting insulin the night prior to surgery and to take no set dose of short-acting insulin after the last meal has been eaten before surgery. Upon arrival at the hospital, the glucose will be monitored frequently by the hospital staff and insulin will be given if you need it. This is especially true for longer and more complicated operations. In all cases, you should monitor your blood sugar carefully at home in the days leading up to your operation.

### ***72. Will having diabetes affect my ability to do my job?***

The extent to which your diabetes will impact upon your job will depend on the nature of the job, the severity and complications of your diabetes, and the treatment you are taking for it. Many types of work will be affected only in a minor way, if at all, by the fact that you have diabetes. However, work that has implications for public safety, such as commercial operation of a vehicle (such as a bus, taxicab, train, or airplane), heavy machinery (such as a crane or a wrecker), or weapons (such as military weaponry) will be significantly impacted if you experience severe or unpredictable low blood sugar episodes. These are a significant risk if you take insulin or the type of pills known as sulfonylureas or meglitinides. Therefore, licensing authorities or your employer may be empowered (or even obliged) to limit your ability to perform these types of jobs, or set a strict set of criteria that must be satisfied (such as frequent verifiable glucose

testing with a low frequency of low blood sugars) for you to do so.

Types of work where you are likely to place yourself, but not others, at higher risk are generally unregulated. Most involve a risk of falling from a height or self-injury with machinery. You should discuss with your doctor and/or diabetes educator the extent to which you are increasing your risk of injury and make an informed decision as to whether to pursue or continue this line of work. Examples of this type of job include roofing, commercial saw operation, and high-rise construction work.

### ***73. I will be traveling. How do I handle the time changes with my insulin shots?***

Traveling more than one or two time zones distant can temporarily throw off the timing of your injections and meals in relation to your previous injection pattern. This is further complicated by changes in your sleeping pattern, so that you may feel like eating at times other than set mealtimes or you may feel like sleeping when you would normally eat. Also, your daily pattern of hormonal changes (your diurnal rhythm), which can influence your blood sugars, may take several days to adjust to your new location. Moreover, travel these days can be quite stressful and your blood sugars can be affected by this, too. Therefore, some temporary disruption in your blood sugar control is to be expected, as many things are going on all at once.

If the journey is not too long and the stay will be relatively brief, some choose to adhere to their established meal and insulin injection pattern regardless of the time change and will take their shots and eat their

meals correspondingly earlier or later. For most of us, this is not feasible as we need to be social with others at our destination. The key is to transition to a new pattern while trying to avoid a knock-on or stacking effect from the change in timing of insulin shots. When traveling west, your day will be longer, and will probably involve an additional meal or wider spacing in time between meals. When traveling east, a meal may be missed, but the next day's first meal will come earlier. In general, it is preferable to accept some higher blood sugars, which if moderate and short-lived, are not dangerous, versus low blood sugars, which may be more difficult to treat in an unfamiliar environment where access to food may be unpredictable. If taking a meal earlier in relation to the prior meal than is usual for you, you will probably eat less, and therefore a modest reduction in your short-acting insulin shot is probably wise. If taking a meal later, then a snack between meals may be more important than usual. Of course, checking your blood sugars regularly is very important, and including a correction factor for the unpredictable factors that may affect your blood sugar (e.g., stress, fatigue) is very helpful. Cycling the long-acting insulin shots into a new pattern can be the most challenging. If the next scheduled injection is much earlier than usual, based on the new time zone, it may be reasonable to delay it to some degree, especially if it is a relatively peakless insulin, such as glargine or detemir. A combination of dose reduction and a delay in timing can help to avoid hypoglycemia, with the goal of gradually moving it forward to fit into the new time zone. Conversely, if the injection needs to be delayed, this can often be managed with an additional injection of short-acting insulin, together with a snack, if needed to bridge the gap. It is recommended that you talk to your doctor

about your travel plans and how to manage these. It is often helpful to keep your testing and meal schedule, when possible, on the time zone of the place from which you departed for the first 24 hours and then make adjustments when you are settled in the new location.

***74. I will be getting a course of steroid treatment. I heard this could throw my diabetes out of control. What should I do?***

Steroids are a type of medication based on compounds naturally produced by the body. Naturally occurring steroids are of several types, but one type, the glucocorticoids, have anti-inflammatory properties and are used to combat inflammation in a variety of conditions from asthma and allergic reactions to serious chronic diseases such as chronic bronchitis (COPD) and rheumatoid arthritis. Short courses of potent steroids, which can be given by mouth or injection, are generally effective and safe, but have the tendency to raise the blood sugar. Depending on the dosage, the potency of the steroid itself, and the underlying condition for which they are given, they can raise the blood sugar by a modest to a very marked degree. This will usually occur within a day of starting the course and will persist until the dosage is either lowered to levels normally produced by the body, or until a few days after discontinuing their use. In the case of a steroid injection given into an area of inflammation, such as the spine or a joint, the elevated blood sugars may persist for several days or even weeks, but are generally not as severe as when steroids are orally administered. In some people, administration of steroids may expose their tendency to diabetes for the first time.

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*Short courses of potent steroids, which can be given by mouth or injection, are generally effective and safe, but have the tendency to raise the blood sugar.*

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*Steroid-induced high blood sugars do not respond well to pills.*

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If you have diabetes and are either managed by pills or lifestyle adjustment alone, a course of high dose steroids may mean that you will need to take insulin for a period of time. This is because steroid-induced high blood sugars do not respond well to pills. Sometimes, when the course of steroids will be short, elevation of blood sugars, unless excessive, can be tolerated with the knowledge that it will resolve fairly rapidly when the medication is stopped. You should monitor your blood sugars regularly during a course of steroids and contact your doctor if the readings are climbing much above usual levels. Steroids taken in the morning often only have the tendency to raise the blood sugar in the afternoon and evening, with a return to your usual level by the next morning, so this is an expected pattern. If you already take insulin, you will probably need to raise your insulin dosage to combat rising blood sugars. Your doctor or diabetes educator can give you a strategy to do this, using supplemental insulin and possibly increasing your usual set doses, also.

### ***75. How can I manage my blood sugar during sports and exercise activities?***

Sports and exercise can affect the blood sugar in various ways. The use of energy by the body during the exercise will have the tendency to lower the blood sugar, as might be expected. If the exercise is vigorous, stressful to the body, or competitive, the release of stress hormones may occur, which will actually serve to raise the blood sugar. Also, so-called “**isometric**” exercise (meaning that tensing or rigidity of the muscle against forceful resistance is involved, such as in weight-lifting) tends to raise the blood sugar more than “**isotonic**” exercise (such as repeated movement against minimal resistance, such as jogging, swimming,

#### ***Isometric exercise***

Tensing or rigidity of the muscle against forceful resistance, such as in weight-lifting.

#### ***Isotonic exercise***

Repeated movement against minimal resistance, such as jogging, swimming, or dancing.

or dancing), which will generally tend to lower it. Finally, the management of the blood sugar in the aftermath of exercise, meaning from hours to as much as half a day later, may be as important and challenging as during the period of activity itself. This is because the replenishment of depleted glycogen (starch) into the muscle requires drainage of glucose from the bloodstream into the muscle as the building blocks for the starch.

Exactly how best to manage your blood sugar during and after exercise is somewhat unique to each individual and becomes clearer after you have performed the same activity several times. It helps to plan ahead for the calorie consumption that may occur during anything other than brief exercise. Taking additional calories prior to, and sometimes during, exercise is preferable to cutting or stopping your diabetes medication during or prior to exercise, although sometimes it can be beneficial to reduce the insulin dosage modestly when exercise is planned ahead. This planning is helped by knowledge of your blood sugar levels leading up to the exercise and sometimes during it and certainly after it. Finally, account for the replenishment of glycogen stores over the hours following significant exercise by eating a sustaining meal later in the day afterward. It is not unusual for the blood sugar to be significantly lower, occasionally seriously so, the morning after exercise the previous evening if this is not factored into meal consumption.

### ***76. What preparations should I make for traveling?***

Questions 73 and 77 address the traveling-related issues of changing time zones and avoidance of low

blood sugars when driving an automobile. General preparation for traveling may include some of the following considerations. Remember to take your glucose testing equipment and your diabetes medications. Take an extra supply of test strips and medication to allow for travel delays and changes in plans. Remember that not all of the medications that are available to you in your home town will be available to you in other countries if you should run out. It is a good idea to take your testing equipment and medications in your carry-on baggage when traveling by air, as your check-in baggage may get misdirected or lost. Most security and airport screening authorities recognize diabetes testing paraphernalia and insulin pens and syringes in industrialized countries, but cannot be relied on to do so in all parts of the world. It may be prudent to bring a note with you in the local language, if you do not speak it, that explains to authorities what these items are. If you are traveling to an exotic locale, where you are not sure of the local cuisine and your tolerance of it or your ability to accurately carbohydrate-count it, you may want to take a supply of familiar nonperishable food items with you to fall back on until you familiarize yourself with the local food or can locate a source of items that you recognize. If your diabetes is brittle or you have significant chronic complications, you may want to ask your physician or CDE for names of some local diabetes care providers that they can recommend in case you need them. This is especially valuable and important for students going away to college, who are likely to initially experience unpredictable lifestyle and diet adjustments and who will be away for lengthy periods. The farther away you are traveling, the less likely it is that your doctor or CDE will be able to identify resources for you at your destination. In this case, you may have to do your own

homework. For the United States and Canada, the American Diabetes Association (ADA) directory of professional members (for this, go to <http://www.diabetes.org>) contains the names of physician and non-physician professional members throughout the United States, Canada, and the world. You may be able to contact them prior to your departure. Other ADA travel recommendations can be viewed at <http://www.diabetes.org/pre-diabetes/travel/when-you-travel.jsp>.

***77. How can I prevent myself from having a low sugar reaction while driving?***

If you are on the type of diabetes medication that has a significant risk of causing a low blood sugar (for details of these, see Question 41), you should check your fingerstick glucose before driving. If your blood sugar is low, you should treat the low blood sugar much as you treat a low blood sugar reaction in general, for example, by eating a snack providing a readily available source of calories and then rechecking your blood sugar 20–30 minutes later. If you cannot delay your trip, take a snack and an ongoing source of sugar, such as Life Savers or other type of hard candy, that you can consume over time. You should make sure that you have a snack with readily available sugar in the car at all times. When driving, it is strongly recommended that you stop every 2 hours and check your blood sugar and eat your normally scheduled meals and snacks. Do not use your glucose meter while you are driving! You need to pull over and do the test while parked.

Remember that your vehicle is a very heavy object traveling at high speed and, when out of control even for only short periods, can be highly dangerous not only to you, but others around you. Also recall that



other factors that contribute to inattention and loss of control can be additive to the danger of low blood sugar while driving. These include fatigue and lack of sleep, alcohol and other drugs (prescription or recreational), physical illness, and mental stress.

***78. I have heard that wounds heal more slowly in people with diabetes. Is this true and should I be worried when I go in for an operation?***

In patients whose diabetes is under good control and who do not have complications from it, wound healing is generally fairly normal, especially in younger people. On the other hand, when diabetes is poorly controlled and when it is accompanied by chronic complications, wound healing can be significantly impaired. The long-term complications of diabetes (see Questions 32, 33, and 34 for detailed discussion of these) occur due to damage to the very small blood vessels nourishing the tissues and organs of the body. The skin is one of these organs and, although skin disorders due to diabetes are not common, they can and do occur. The body's ability to heal a wound depends upon a healthy blood supply, which is needed to deliver nutrients, on the cells that provide the protective defense against infection and those that cause inflammation. In this sense, inflammation is beneficial in that it leads to the mopping up and removal of dead and damaged tissue, which paves the way for its replacement by new healthy healing skin and underlying tissue. Second, short-term high blood sugar paralyzes these blood and tissue defenses, so that their infection-fighting and inflammatory actions are much weaker. Finally, insulin itself stimulates healing and regenerative actions in body tissues. If the diabetes is poorly controlled, this suggests that

insulin is insufficient or ineffective, which can further impair healing.

For these reasons, your doctor will try to help you get your diabetes under the best possible control before you go in for a nonemergency operation. If you have chronic complications of your diabetes, special attention should be paid to measures that will help your surgical wound to heal, such as ensuring adequate blood supply by keeping the area warm and not placing excessive pressure on it, and meticulous attention to the avoidance of infection. Your blood glucose will also be carefully controlled during the period immediately following surgery, with insulin if necessary.

***79. My child has diabetes and is about to start school. What steps should I take and how will the school help to ensure that things go well?***

Nowadays, diabetes alone seldom prevents children from attending and participating fully in school activities, although special attention is required in certain circumstances. Fortunately, most children at the age of school entry have, by virtue of their age, not had diabetes for very long. Therefore, they rarely have chronic complications and their glucose control is more straightforward. The American Diabetes Association and other authoritative bodies recommend less stringent control of blood sugar in young children in order to avoid hypoglycemia, which is the overriding concern.

In general, it is important to remember that each person, young or old, experiences diabetes differently. This is challenging and humbling for those of us who

see people with diabetes every day. For your child's teachers, whose primary role is education unrelated to diabetes, it can be a major challenge indeed. Therefore, preparation is the key. It is important to provide the school with a daily plan describing the way your child's diabetes is managed, so they know what to expect as routine. It is important to inform the school how things may present themselves when they go wrong. How does your child's diabetes respond when he or she is under the weather, under stress, or following strenuous sports activities? What behavior does he or she show when low blood sugar occurs? All these things should be written down and put in a folder for your child's school nurse and teacher. A meeting with the teacher prior to your child entering their class will help to smooth the way. There is also a document, known as a 504 plan, which is used to describe the expectations and roles of the parents and the school in the management of the diabetes and when things go wrong. Further details are beyond the scope of this book, but excellent sources of information, including sample 504 plans, can be found at various websites including those of the Juvenile Diabetes Research Foundation (go to <http://kids.jdrf.org/index.cfm> and click on *Your Life With Diabetes* and then select *To School*), American Diabetes Association (<http://www.diabetes.org/for-parents-and-kids/for-schools/diabetes-management.jsp>), and the National Institutes of Health (<http://ndep.nih.gov/diabetes/youth/youth.htm>).

# *Resources for People with Diabetes*

I am interested in participating in research studies on new treatments for diabetes. How do I go about it?

How can I find and join a diabetes support group in my area?

How do I find out about the latest developments for treatment and monitoring of diabetes?

*More . . .*

### ***80. Whom can I contact when I have questions about my diabetes?***

First and foremost, you can contact your family physician, internist, and, if you have one, your endocrinologist or diabetologist. You can also contact your certified diabetes educator (CDE) nurse educator, dietitian, or pharmacist for questions in their respective fields. All American Association of Diabetes Educators (AADE) certified diabetes educators, regardless of their underlying professional credentials, should have at least some knowledge in all the major areas of diabetes management. You can contact your local American Diabetes Association (ADA) or Juvenile Diabetes Research Foundation (JDRF) chapter. Contact information for the regional chapters (state and/or city) can be obtained through the website of the respective parent organizations. For ADA, go to <http://www.diabetes.org>, choose *Community Events and Local Programs*, and then select *What's Happening Locally* and enter your zip code or city. For JDRF, go to <http://www.jdrf.org> and select *JDRF in My Area* and enter your state. Many regional chapters will have affiliated support-type groups for people with either type 1 or type 2 diabetes. It is not usually necessary to become a member in order to attend and participate in these. There are a number of diabetes-related magazines and newspapers, both paper and online, that are published by these organizations. It is usually necessary to become a lay member in order to receive a subscription to these. There are also online and paper magazines that are independent. This is a changing and dynamic environment and the best way to find out which are currently available is to enter the term *diabetes magazine* into your favorite Internet search engine. The ADA website (see previous mention) will provide you with a link to its publications, many of which are directed

at people with diabetes, and include informative books on diet, nutrition, and medications, among others. Finally, your friends, colleagues, and relatives with diabetes can often be a great resource for local information and tips about managing your diabetes, although issues that fall into the realm of medical advice should only be provided by a licensed practitioner.

***81. I am interested in participating in research studies on new treatments for diabetes. How do I go about it?***

There are two main routes through which one can volunteer to participate in research studies involving diabetes. The first is to contact your local ADA or JDF affiliate, or their national website. Additionally, you can go to the <http://www.clinicalresearch.gov> and choose *Where Can I Find Clinical Trials?* where various links will direct you to a list of NIH-sponsored research projects in which you can participate. For clinical trials organized and sponsored by the pharmaceutical industry, you can go to <http://www.clinicalconnection.com> and select *Find Clinical Trials*, then enter *diabetes* as a keyword and enter your zip code.

Alternatively, you can contact your local medical center, teaching hospital, or university department of medicine, or your doctor, and ask for information on approved projects in the field of diabetes. Remember that clinical research studies must be approved by the local or central body that governs ethical conduct of such research, the Institutional Review Board or "IRB." Clinical research staff can only discuss projects that have already been approved by the IRB, with a view to recruiting you. Other studies, even though they may be planned or pending, can only be discussed

in general terms and no steps, such as qualifying blood tests, can be made at this stage. If you provide the clinical research contact person with your contact information and written permission, he or she will contact you if a suitable project becomes approved and available for enrollment.

No matter how ready, willing, and able you are to participate, it may well be the case that a study that is specifically tailored to your type of diabetes or type of treatment may not be available. Do not be discouraged, nor feel that your volunteerism is not appreciated. Clinical research investigators and their staff are always delighted to know of potential participants in clinical research and will certainly contact you if any appropriate study arises. Also, be sure to mention your interest in research participation to your doctor as well anytime you are considering a specific project. He or she can discuss with you whether it is advisable for you to participate, given your individual health issues.

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*Clinical research investigators and their staff are always delighted to know of potential participants in clinical research and will certainly contact you if any appropriate study arises.*

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## ***82. How can I find and join a diabetes support group in my area?***

A number of approved diabetes education programs have affiliated support groups for both type 1 and type 2 diabetes. The American Diabetes Association approves diabetes education programs and keeps a record of their locations and contact information. At <http://www.diabetes.org/communityprograms-and-localevents/whatslocal.jsp> you will be connected to the ADA site called *What's Happening Locally?* On this site there is a link to ADA-recognized education programs and a link to a message board on which you can post a question about local support groups or other activities, or you can call your local ADA affiliate. The

staff of your local diabetes center or clinic will also probably know contact information for their affiliated support groups. You may find that other people whom you know with diabetes are a good resource for this kind of information, although this is a somewhat hit-and-miss resource, as the majority of people with diabetes are not members of a support group. Your diabetes educator (or the diabetes educator your doctor generally refers to) is often involved in some way with the local support groups or will be aware of their existence and be able to provide you with contact information. If you are in a rural or isolated area, there may well be no local support group available. However, there is nothing to stop you from starting your own, if you have identified that there is a need for one!

### ***83. I want to be an advocate for diabetes.***

#### ***Where should I start?***

Advocacy for diabetes can have several meanings, from fundraising to raising public awareness in the media or political arena or working in the healthcare field with and on behalf of those with, or at risk for, diabetes. To assure your effectiveness as an advocate, bring your available experience, talents, and skills to the table and consider your commitment in time very carefully. Using your skills and experience will help to ensure that, when possible, you are doing on behalf of diabetes advocacy what you do successfully in your professional life and at which you are good. While it is not always possible to seamlessly blend your professional abilities with your work on behalf of diabetes, it is often possible to blend them quite well and this is true for those in all walks of life. It is a good idea to give very careful consideration to the time commitment that you are able to make and how you are able



to make it. If you are available in blocks of time intermittently, this might suit you for commitment to support individual events, whereas if you are available more or less continuously, you could take up a more permanent position in an organization. Do remember that, even though your commitment may be as a volunteer, the success of others around you may still depend on the performance of your assigned responsibility. Therefore, a smaller commitment in time that you can realistically and consistently provide is likely to be of more value than a commitment that you may not be able to fulfill reliably. It is also less likely to place a burden of stress upon your work and personal life and upon those around you and will, in the long run, be more sustainable and rewarding for you and for the cause you are supporting.

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*Advocacy can be done on an individual level, but is often more effective when combined with the efforts and energies of others.*

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Advocacy can be done on an individual level, but is often more effective when combined with the efforts and energies of others, especially as part of an established organization that has a track record of success in moving the cause of diabetes advocacy forward. Therefore, contacting your local chapter of such an organization is often a good place to start. Which organization you choose will depend on where your personal interest in the issue lies. You might be particularly interested in type 1 or type 2 diabetes, adults or children, prevention or cure, individual complications, availability of medications to those who need them, or pregnancy and healthcare coverage, just to name a few possibilities. The American Diabetes Association (<http://www.diabetes.org>) and the Juvenile Diabetes Foundation International (<http://www.jdrf.org>) are key organizations. Introduction through a friend who is already engaged in advocacy can often help to get you where you need to go, but almost always staff will welcome your interest and direct you to the right place.

***84. Are there exercise programs for patients with diabetes covered by insurance or that are tax deductible?***

Yes, although those that are tax deductible are not specifically aimed at diabetes and they are not government programs in themselves. Recently, in order to help to combat the growing amount of obesity and lack of exercise that now put Americans at risk of a number of diseases, including diabetes, the U.S. government has made provisions for a tax deduction on personal federal income tax for weight reduction programs when this is performed for specific medical indications. Losing a few pounds for your upcoming high school reunion (i.e., for your general appearance and overall health) is not included! Also, general gym or spa membership dues are not allowed under this credit. Although the program is specifically for weight reduction, exercise is an important component of weight maintenance and aids in weight reduction and is therefore included. The actual conditions of the program are contained in Internal Revenue Service (IRS) publication #502 that can be accessed at [http://www.hsainsider.com/pdf/treasurypublications/TreasuryPub\\_23.pdf](http://www.hsainsider.com/pdf/treasurypublications/TreasuryPub_23.pdf). Please see the information on pages 13 and 15 of this publication. It provides considerable detail on what is eligible for tax credit. This is a tax credit rather than a tax deduction, the important difference being that the entire cost of the program can be paid from your taxes. A very nice guide on how to actually prepare a submission to the IRS for the tax credit can be found at <http://ezinearticles.com/?I.R.S.-Tax-Credit-for-Weight-Loss-and-Smoke-Cessation-Programs&id=345917>. Of course, commonsense rules apply. The cost of a program of twice-weekly treadmill workouts or spinning sessions as part of a class at your local spa or health club is likely to be found to be acceptable, while the cost of membership in a darts or

pool league at your favorite local bar is not. Whether the exercise involved can reasonably be expected to lead to weight loss or improved physical fitness is the issue that can determine its eligibility for a tax deduction. However, the IRS will not ask you to prove that you actually lost weight or expect you to produce copies of your split times on the stopwatch at your local track! In addition to the information available from the IRS link noted above, you can also get information from your qualified tax preparer.

Some health insurance programs will, with supporting documentation from your doctor, cover the costs of certain approved exercise or fitness interventions for certain categories of members. Details of these can be obtained from the administrator of your company health plan or from the healthcare provider staff themselves. There is also increasing awareness among employers that a healthy, physically active staff is a more productive staff who require fewer days off work for health-related reasons. Such enlightened employers sometimes provide incentives for their staff to join local healthcare facilities and occasionally provide such facilities themselves. They may sponsor some employees to participate in competitive athletic events or activities, sometimes to a high level of accomplishment. Programs such as this will be unique to each company and you will need to make inquiries about them from your human resources department.

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*There is also increasing awareness among employers that a healthy, physically active staff is a more productive staff who require fewer days off work for health-related reasons.*

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***85. How do I access resources for people with diabetes from different cultures or creeds or who do not speak English?***

Diabetes disproportionately affects those in our society who are non-Caucasian minorities and often it is harder to ensure that high quality care is provided. For

example, only half as many Hispanic Americans with diabetes are currently achieving treatment goals for diabetes set by the American Diabetes Association as are achieved by Caucasian Americans. In some cases the reasons are cultural, in others economic, and in other cases they result from language and communication barriers. There is increasing interest in providing tools and resources to overcome these barriers and rectify these disparities. Many guides and booklets, such as diabetic recipe books, are also published in Spanish and other common languages. A number of diabetic cookbooks are available for different types of cuisine. Your local medical center will often provide translation services for visits with the doctor, nurse educator, or dietitian. These professionals often have materials in different languages to give you. Your local chapter of the American Diabetes Association or Juvenile Diabetes Foundation is generally a good place to start, as they often respond with commitment and energy to support the needs of particular groups who are represented in their local area. The website [http://www.lacountyparks.org/cms1\\_033139.pdf](http://www.lacountyparks.org/cms1_033139.pdf) also provides a listing of diabetes resources available for non-English-speaking people, while the Joslin Diabetes Center offers an innovative Chinese-English diabetes website at <http://aadi.joslin.harvard.edu/>.

Pharmaceutical representatives often provide tremendous support to the efforts of healthcare professionals in identifying resources to improve patients' access to care. Their commitment to patient care frequently extends beyond ensuring the availability of their companies' medications and they will usually go to great lengths to obtain helpful information. If you are taking a particular branded medication, it is not unreasonable to suggest to your doctor or diabetes educator that the

representative of that company might help to find the information or resources that you need. They are often very happy to do so upon request.

***86. How do I find out about the latest developments for treatment and monitoring of diabetes?***

There are a number of resources that are available to inform people with diabetes and others who are interested about diabetes and the latest developments in treatment. These range from published magazines, periodicals, and newsletters to online e-zines and updates. It is important to ensure that the source of information is well informed and reliable. Therefore, it is advisable to start with a nationally or internationally recognized and respected organization. For diabetes in the United States, these include the American Diabetes Association (<http://www.diabetes.org>), the Juvenile Diabetes Foundation, and the International Diabetes Federation (IDF). Their websites all show links to helpful information on a variety of subjects. Each puts out publications for the lay person, such as *Diabetes Forecast* (ADA) and *Countdown* (JDRF). There are also a number of high quality independent newsletters, including *Diabetes-in-Control*, *DDN On Line*, *Diabetic LivingOnLine*, and *Diabetes Digest*. A listing of online diabetes publications for those with diabetes can be found at <http://www.diabetesmonitor.com/journals.htm>.

The local chapter of the ADA and JDF will be able to direct you to resources unique to your area. Their contact information can usually be found within the website of the parent national organization. Your local hospital, clinic, or doctor's office will generally have, or

have access to, a diabetes education program, staffed by certified diabetes educators who are usually nurse practitioners, nurses, pharmacists, or registered dietitians. As a rule, CDEs are well informed on recent developments and on how to find out more about them and are happy to provide this information.

***87. Where can I find out about interactive programs and games that make learning about diabetes fun for children and teenagers?***

The American Diabetes Association recently unveiled a new interactive learning feature for young people with diabetes, which can be accessed at <http://www.diabetes.org/for-parents-and-kids/resources.jsp> and then by clicking on the link to *Youth Zone Games*. These are interactive short programs that hold children's attention by responding with an outcome to a specific set of choices relating to health and diabetes.

Pharmaceutical companies often provide educational resources. An example of a new interactive program for diabetes education is now offered by Merck Inc. It is called *Journey For Control* and uses a system of Conversation Maps for interactive education and decision making. The program and a video describing the conversation maps can be accessed at <http://www.journeyforcontrol.com> and then clicking on the link to the *Conversation Map Program*.

If sufficient resources were to be invested, very sophisticated interactive video games could be developed that could combine an educational message with a genuinely interesting and exciting adventure activity. However, since these types of programs are very

expensive and unlikely to recoup their costs commercially, they will probably remain relatively short and simple until costs come down.

***88. I am interested in a professional career in the field of diabetes. Where can I find out the various options and the prerequisites to apply?***

Opportunities for a career in diabetes can be as diverse as the opportunities to be an advocate for diabetes (see Question 83), a caregiver in the diabetes medical field, or to work in the field of developing new technologies for diabetes care. However, building a career around your commitment to diabetes is complex, since you will almost certainly want and need to be paid for your work. Careers requiring higher professional qualifications, such as adult pediatric endocrinologists or diabetologists, physicians specializing in diabetic eye, kidney, or nerve diseases, diabetes nurse educators, and dietitians, generally require several years of planning and preparation to achieve and require a great deal of commitment due to the many demands placed upon them. Sometimes a person not previously involved in diabetes care may have skills, knowledge, or credentials that can be adapted to the field of diabetes, such as dietitians or nurses, who can take additional training, even in the middle of their careers, and specialize in the area of diabetes care. The same is true of qualified and experienced laboratory research professionals, who will use many of the same skills in the field of diabetes research that they used in other areas of medical or pharmaceutical research.

There are many other ways to develop a career committed to diabetes. Most medical institutions and

industry or university research or clinical care organizations require the same administrative and technical support staff to ensure smooth and successful operations that other business organizations do. Even if you are working behind the scenes and do not have a job that allows direct interaction with patients or medical care, doing a job that helps to ensure smooth and successful running of an organization is a very important part of ensuring the overall success of the patient-related efforts. Therefore, it is recommended that you bring your skills to the table and contact organizations that you know are involved in some way with clinical care, education, research, or advocacy for diabetes and ask if they have openings for somebody with your skills. Be assured that sooner or later, doors will open!

***89. What educational programs for diabetes are covered by Medicare and other governmental and private insurance plans? Who qualifies?***

Medicare covers the cost of group diabetes education for eligible people with diabetes who fulfill certain criteria. Examples of these include people with newly diagnosed diabetes, poorly controlled diabetes, or the need to change from pills to insulin. Presently, Medicare will support up to 8 hours of diabetes education performed in a center that is recognized as qualified. This means that their educational programs must be certified as meeting the required standard by the American Diabetes Association. A further hour of follow-up education can be provided in the first year to determine the success of the program. Unfortunately, most state medical care programs do not provide significant support for diabetes education, but provide a limited selection of medications and some support



materials, such as a particular type of glucose testing meter.

Upon request, most private insurance providers will cover diabetes education upon the same, or similar, conditions. Also, most insurance companies will cover the cost of individual diabetes education by a certified diabetes educator. This includes dietary instruction, use of glucose meters, giving insulin injections, etc. As each healthcare plan varies, specific information on who qualifies is not realistic here, but it is recommended that you contact your healthcare plan to find out more details.

# *When a Family Member or Loved One Has Diabetes*

What should a parent, spouse, partner, or caregiver know about diabetes in order to provide support to a loved one?

My child has diabetes. What can I do when he or she is sick to help prevent the diabetes from going out of control?

My spouse/partner has diabetes and we are planning a family. What is the risk that our children will develop diabetes?

*More . . .*

***90. My partner/child/parent does not follow his or her doctor's advice on management of his or her diabetes. How can I help to improve things?***

This is a very difficult question and is one that can be extended beyond diabetes to many aspects of a loved one's life where their behavior is apparently either endangering themselves or likely to lead to short- or long-term negative consequences. Sometimes it can be immensely frustrating for a caring parent/partner/friend or relative to experience lack of commitment to good healthcare practices on the part of someone they care about. Moreover, the knowledge that much of the burden of the consequences may fall on others can lead to anger and resentment.

There is no easy answer that can be applied universally, as everyone is different and their circumstances are unique. It is important to remember that, except in the case of a minor child, you must yield the control of the problem to the person who has it. For example, your spouse/partner owns his or her diabetes and must be empowered (except in very special circumstances) to make his or her own decisions on how to manage it. He or she is more likely to take advice if it is sought out than if it is given uninvited. They are likely to believe that they are giving as much attention to their diabetes as possible, whether or not it seems obvious to others that this is not the case. Frequent pressure to do more may engender a sense of failure and actually lead to doing less. Motivation through fear is generally not successful unless the object to be feared is immediately present. People with diabetes generally do not see or feel the consequences of the neglect of their diabetes on a day-to-day basis. When they finally do, it is too

late to reverse them. For example, if you get too near the log fire in your living room, soon you realize that you do not want to get closer but should move away. There is no such warning before touching a hot iron or a burner on the stove. Thus, household cooktop and iron burns are much more common than burns from touching the blazing logs in the fireplace!

Perhaps the best that one can do is to help to ensure that our loved ones have access to high quality education about diabetes and its consequences, ensure that they are given the tools to do what is needed to take care of it, and to support them in that effort to the extent that they are willing to participate. After that, their autonomy must be respected, even though it may have some negative consequences for others. It is important to remember that you are not obliged to join your loved one in dangerous or destructive behaviors nor must you unquestioningly accept the consequences. Whether you choose to do so will depend on several factors, including your personal belief system.

***91. What should a parent, spouse, partner, or caregiver know about diabetes in order to provide support to a loved one?***

The more informed a spouse, partner, or caregiver is about diabetes, the better source of support he or she can be to the affected person in their lives. Thus, the answer can be very open-ended. To be practical, let us focus on a few key issues that are especially important. If you are the main food preparer for the loved one in question, knowledge of diabetic diets and nutrition is very helpful (see Question 40 for more information). The appropriate type of diet for a person with diabetes

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*It is important to remember that you are not obliged to join your loved one in dangerous or destructive behaviors nor must you unquestioningly accept the consequences.*

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is generally not complex, time-consuming, or expensive. Attending diabetes education with your loved one's dietitian is probably the most useful and important thing you can do. Getting to know as much as you can about diabetic meal preparation is very important, especially when there may be special requirements relating to kidney complications (nephropathy—see Question 34) or high blood pressure.

Knowing how to treat a low blood sugar reaction, whether moderate or severe, is very valuable. The mental alertness and coordination of the person with diabetes can be impaired with moderately severe low blood sugar reactions and he or she may not have insight into what is going on or how to treat it. In the case of severe low blood sugar reactions, the affected loved one may be drowsy or unconscious and prompt action on your part is very important. Knowing how to check the blood sugar with their machine and how to treat a moderate low blood sugar, or how to use a glucagon kit to treat a severe low blood sugar, is very helpful indeed. This is addressed in detail in Question 92.

Finally, knowledge of how to manage sick days is very helpful. The body's response to illness can be somewhat unpredictable. In the case of an infection such as gastroenteritis or influenza, blood sugars may be high or low, depending on whether the body's stress reaction pushes the blood sugar higher or the failure to eat pushes it lower. Either way, during anything other than a minor illness, it is important to monitor the blood sugar frequently, and treat low or high sugars (the latter with insulin if necessary) and to ensure that your loved one is well hydrated, as dehydration will rapidly make the situation worse. Most important is to know when you are unable to keep pace, meaning that the blood

sugar is rising in spite of your best efforts and your loved one is unable to take in fluids or is becoming drowsy. In this case, ensuring that he or she gets prompt medical attention is the most valuable thing you can do.

There are, of course, many other ways in which you can help by your knowledge of diabetes, but these are three of the most important.

***92. How do I know when my relative with diabetes is having a low blood sugar reaction? What should I do to help?***

The signs of a low blood sugar reaction can range from fairly obvious to quite subtle and hard to detect. The very young and the elderly are less likely to spontaneously complain of symptoms, but more often just slip into hypoglycemia. Those who have had diabetes for a long time, generally more than 10 years, may lose their ability to perceive hypoglycemia and fail to make complaints or take action to prevent seriously low blood sugar from occurring. This is much more common in longstanding type 1 diabetes than it is in type 2 diabetes. Those who are aware that something is wrong and who are able to voice their concerns will complain of a combination of hunger, headache, shakiness, sweating, palpitations (a sensation of fluttering in the chest), blurred vision, and inability to think straight or coordinate their actions, especially fine motor actions such as writing, typing, or dialing phone numbers. The very young, the elderly, or those with unawareness of low blood sugar will often exhibit confusion or bizarre behavior, shakiness, sweating, drowsiness, or restlessness in the earlier stages. Bizarre behavior can take many forms, from inappropriate laughing or crying, aggression, staring blankly, to making

repetitive movements or inappropriate verbal responses to questions. Most people with diabetes will have their own individual pattern of behavior that tends to repeat itself each time their blood sugar is low. Therefore, familiarity is very helpful for recognition of low blood sugar in loved ones or colleagues.

If the low blood sugar is severe, loss of consciousness and seizures will occur. This is of course very worrisome to the observer and necessitates prompt action. Loss of consciousness can result from both very high and very low blood sugar. It comes on much more rapidly with low blood sugar than with high blood sugar and is usually more rapidly reversible if treated promptly and effectively. However, unless the circumstances unmistakably indicate high blood sugar, or a fingerstick glucose reading is available, the safest treatment is to administer sugar or glucose or use a glucagon injection kit. Additional glucose is unlikely to worsen in the short term the already serious situation of a coma due to high blood sugar, but could be lifesaving to a person with coma due to a very low blood sugar. Therefore, when in doubt, glucose or household sugar administration is the best route to take. Fortunately, the body has powerful mechanisms to prevent the blood sugar from becoming fatally low and these are generally intact in those with diabetes. For this reason, severely low blood sugar, while it is an emergency, is seldom fatal, considering how often it occurs.

***93. My child has diabetes. What can I do when he or she is sick to help prevent the diabetes from going out of control?***

Certain forms of illness are more likely to throw the diabetes out of control than others. Generally, those illnesses that provide quite intense stress to the body

are more likely to cause the diabetes to go out of control than those that result in disability without general body stress. Illnesses associated with fever, infection, rapid heart rate, loss of appetite, and disordered bodily functions such as diarrhea, vomiting, breathlessness, etc. are often associated with loss of glucose control. It is important to remember that when a child is not eating due to a generalized illness, he or she may require as much or more insulin than he would take with a meal if he were eating. This is often very surprising to people with diabetes and their caregivers. When the body is under stress, it produces a variety of hormones that serve to counteract the stress, in part by raising the blood sugar. In those without diabetes, this response is generally beneficial. However, in those with diabetes it can be counterproductive. Therefore, the key to helping the sick child with diabetes from losing glucose control is to check the blood sugar frequently, such as every 2 hours, and to administer insulin according to the blood sugar level if the blood sugar level continues to rise and without regard to the intake of food. More insulin will be needed if the child is able to eat. Dehydration is a key contributor to worsening high blood sugar and therefore every attempt should be made to keep hydration up, with fluids that are not high in sugar (avoiding colas or juices, for example) as long as the blood sugar is high. Fluids that contain electrolytes, such as Pedialyte® or a similar product, are preferable to water alone in preventing dehydration. Remedies to reduce the severity of the illness, or the symptoms from it, can also help to keep glucose levels under control, such as sponging or antifever medications to lower a high temperature, antinauseants, or antidiarrheals to reduce intestinal disturbances. Reducing or minimizing psychological stress can also play a significant part, so this would not be the time to



emphasize the homework that is not getting done or the test that might be missed!

It is important to remember that some illnesses are severe enough that they will throw the diabetes out of control in spite of a parent's best efforts to do everything to prevent it. Therefore, if the blood sugar is climbing in spite of frequent testing and administration of additional insulin or if it is clear that dehydration is occurring, professional help should be sought without any sense of guilt or failure.

***94. Can my child with diabetes participate in all sports in school or are there some that he or she should avoid?***

If your child has type 2 diabetes, which is now not uncommon in children and has recently become more common in adolescent girls than type 1 diabetes, then participation in school sports is an excellent idea, as it will help to control weight and reverse insulin resistance. The only caveat would be concerning his or her medication and how it would be affected by exercise. Most children with type 2 diabetes do not require insulin, but some do take sulfonylureas (see Questions 41 and 52 for more details). Both of these therapies can cause low blood sugar in the face of energetic exercise, especially if prolonged. Therefore, the glucose should be checked prior to significant exercise and periodically during the exercise if greater than an hour or two at a stretch. If the glucose is well controlled before exercise, it is a good idea to provide calories prior to and sometimes during the event, in an amount designed to be readily available and commensurate with the amount of energy consumed during the sporting event. Your CDE can help with planning of

calorie intake prior to, during, and after sporting events.

If your child has type 1 diabetes, the issues noted above also apply, but tend to be more critical, since children with type 1 diabetes are generally more susceptible to low glucose during physical activity and are on insulin therapy. Interestingly, competitive sports may actually result in increased glucose levels, even though the same amount, or more, of energy is expended as in non-competitive sports. This is because the levels of a number of hormones are raised in the heat of competition and these hormones tend to increase blood sugar levels. This is further discussed in Question 75.

***95. My spouse/partner has diabetes and we are planning a family. What is the risk that our children will develop diabetes?***

This depends on whether your spouse/partner has type 1 or type 2 diabetes. In the case of type 1 diabetes, in general the risk of type 1 diabetes is 10 times as great in a first-degree relative compared to the risk in the population at large. A first-degree relative is your parent, sibling, or child. The general population risk of type 1 diabetes is about one-third to one-half of 1%, i.e., about 1 in 200 to 250 people. In a first-degree relative of someone with type 1 diabetes, this increases to about 1 in 20 to 25 people or about a 4% or 5% chance. Most people consider that this is not a sufficiently high risk to deter them from having a family, but that is of course a personal and individual decision. The likelihood of developing type 1 diabetes declines with age, about 90% of cases being diagnosed younger than age 35.

In the case of type 2 diabetes, the risk is considerably higher and a general rule is that if both parents have type 2 diabetes, about two out of three of their children will develop it. If one parent has type 2 diabetes, about one out of three of their children will be affected. Decision making using these rough estimates is difficult. Most people destined to develop type 2 diabetes will not do so in their child-bearing years. Therefore, it is not really possible to estimate risk to the future children when it is as yet unknown whether the parents will get diabetes. Although type 2 diabetes is a highly inherited disorder, the risk of developing it can be very powerfully changed by an individual's lifestyle. Even people with a high hereditary risk may not get type 2 diabetes if they maintain a healthy weight and exercise regularly. However, if your spouse/partner has type 2 diabetes, you can factor in your own parents' health history in the risk to your future children. If either of your parents has type 2 diabetes, this increases the risk to your child to more than one in three. Of course, in contrast to type 1 diabetes, type 2 diabetes tends to develop later in life, so children at risk are still most likely to have a healthy childhood and diabetes-free youth.

# *What Does the Future Hold for People with Diabetes?*

What is the likelihood of a cure for type 2 diabetes?  
What form will it take and when will it be available?

When and how will we be able to prevent  
type 1 diabetes?

How can we stop the dramatic increase in diabetes  
presently occurring throughout the world?

*More . . .*

***96. What is the likelihood of a cure for type 1 diabetes? What form will it take and when will it be available?***

A true cure is likely to be some years off. Although pancreas transplants and islet transplants can lead to independence from insulin treatment and have resulted in dramatic improvement in quality of life for some, they remain a limited proposition for most, in view of the need for risky and expensive antirejection drugs and the late failure that tends to occur. In addition, donor tissues are in short supply. Manipulation of stem cells (early forms of cells that have the potential to develop into an array of different cell types) into pancreatic islet cells that produce insulin has a great deal of potential, but there are a number of operational issues that need to be addressed before this will become an accepted clinical therapy.

Even in a person with established type 1 diabetes, the use of an efficient closed-loop pump system would revolutionize management of the diabetes. Closed-loop means that detecting the blood glucose level and responding to it by injecting the right amount of insulin are both handled by the pump automatically, without the need for decision-making input from the patient. While this is actually more of a management tool than a cure, it would so effectively relieve the patient of the burden of their diabetes that it is for practical purposes almost as good. A number of companies are, as you might expect, actively working on this approach.

Since type 1 diabetes is an immunologic disorder, effective cure may result from manipulation of the immune system, especially if performed early in the course of the disease. An immunologic disorder in

this case means one in which a person's own immune system attacks his or her tissues in error. Type 1 diabetes results from an attack of the immune system on the insulin-producing cells of the pancreas, ultimately destroying most of them. Therapies aimed at slowing, halting, or reversing this attack are currently in clinical trials. They are limited by the fact that the diabetes needs to be in an early stage for the treatment to be effective, that manipulating the immune system can cause a number of undesirable side effects, and that it tends to be a lengthy and complicated form of treatment, requiring admission to the hospital.

The latter approach in some form or another is likely to offer the best chance of cure for type 1 diabetes, as it addresses the root cause. Although the fact that clinical trials are ongoing is certainly encouraging, this option remains some way off.

While type 1 diabetes is a lifelong disorder that requires continuous attention and work by those affected, it is important to keep in mind that any cure must be safer and more effective than currently available treatments, which are continually improving and already allow the majority of people with type 1 diabetes to lead healthy and productive lives with few limitations.

***97. What is the likelihood of a cure for type 2 diabetes? What form will it take and when will it be available?***

The likelihood of a cure for type 2 diabetes arising from a single drug or therapy is quite small. Many factors are involved in the development of the disorder

and it can almost be considered to arise from the body being under a generalized form of environmental and genetic stress—the stress being, in this case, the environmental stress of being overweight, lacking exercise, and other less well-recognized and understood factors. Most type 2 diabetes are predicated to some degree or another on being overweight (although this varies considerably from ethnic group to ethnic group) and therefore a medication or intervention that reverses or prevents obesity and overweight would be expected to have the additional benefit of preventing or curing type 2 diabetes. Indeed this has been conclusively shown to be true for bariatric surgery, which is a type of surgical operation that leads to weight reduction by either restricting the intake of food into the intestine, or leading to it being poorly absorbed from the intestine. Certain types of bariatric surgical procedures may lead to up to 90% reversal (we do not yet use the word *cure* here) of established type 2 diabetes and effective prevention of progression from prediabetes to frank diabetes. Surgical intervention of this kind is at present reserved for those at highest risk and is not feasible for everyone. There are some risks due to complications of the procedures themselves. Fortunately these are quite uncommon. There are also some subsequent side effects, such as a risk of inadequate balanced nutrition or vitamin deficiency with the bypass type of procedure as well as low blood sugar and diarrhea. However, this means of achieving effective weight loss can prevent or cure type 2 diabetes and a medication that leads to safe, durable, and effective weight reduction could achieve the same result. Possibly environmental adjustment on a social level to promote healthier lifestyles may achieve similar benefits for society as a whole, but this is notoriously difficult!

### ***98. When and how will we be able to prevent type 1 diabetes?***

There are a number of approaches that might reasonably lead to the prevention of type 1 diabetes in the foreseeable future. Although hereditary factors are involved in a person's risk of getting type 1 diabetes, it is clear that there is an important trigger in the environment. For example, if one of a pair of identical twins has type 1 diabetes, the chance of the other twin getting the disease is smaller than 50%. Definite identification of a major risk factor (such as an infectious agent, nutrient, or other chemical) could lead to effective protection against exposure or immunization against it. Whatever the trigger may be, the process that ultimately leads to type 1 diabetes is caused by the body's immune system, which activates a destructive attack on the insulin-producing cells of the pancreas. There are a number of ways in which this destructive process can be slowed or suppressed. Earlier efforts were either ineffective or led to a general suppression of the body's immune system, increasing the risk of infections. However, clinical trials of drugs that specifically target the self-destructive process in the pancreas are presently underway. These treatments require prolonged administration into the blood vessels over several days and often have unpleasant side effects. Also, to be truly preventive, they must be given when early evidence of future diabetes is discovered, but before the actual onset of diabetes, by which time intense and often irreversible destruction of the insulin-producing cells has already occurred. It is probable that it will be several years before any of these drugs is readily available. There is a great deal of investigation currently ongoing into the development of stem cells for use as replacements for



lost insulin-producing cells. Stem cells are a small proportion of cells in tissues and organs that have not yet developed into final form. As such, when treated in a certain way, they can be persuaded to commit themselves to developing into one specific desired type of cell. There are a lot of questions remaining to be answered regarding the safety, effectiveness, and durability of stem cell treatments and there remains the issue that the immune system problem that destroyed the original insulin-producing cells might also destroy their replacements. However, clinical trials are underway in other diseases which, if successful, could accelerate interest in the use of stem cells for type 1 diabetes.

***99. When and how will we be able to prevent type 2 diabetes?***

The prevention of type 2 diabetes in global terms depends upon the prevention of overweight and obesity and the performance of healthy amounts of exercise. These two factors are responsible for the overwhelming majority of cases of type 2 diabetes in the world today, especially those in younger people. However, it is not clear that this can be achieved by individual education. Most adults who are overweight are aware that they overeat and take insufficient exercise, yet few are able to address these issues successfully in a long-term way. This is not because they are lazy or weak-minded, but because humans, and other species, have been conditioned throughout their evolution to defend themselves against starvation and backbreaking labor, both of which are injurious to survival. It is not surprising therefore that strong drives exist within us to take in as much food energy as we can to

protect us against impending famine, and to seek a life of ease to protect us from injury and environmental exposure. It is only within the past century or two that sufficient food to lead to overweight has been available year-round for all but a fortunate few. Not surprisingly, therefore, human conditioning has not yet been able to adjust to this very recent change.

It is likely that significant reductions in weight and increases in exercise will come from social changes that build these into our environment and lifestyles. Some of these are already beginning to occur. Many states and school districts are increasing the amount of exercise in the core school curriculum and removing ready access to snacks and sweetened beverages on campus. Urban planners are considering new ways to make walking to school, work, and local shops appealing and limiting the access of automobiles to the inner city. Restaurant chains are attempting, with some success, to offer alternatives to calorie-dense high fat food items. It is important that such alternatives are appealing in taste and satisfying to hunger, or they will not be chosen.

Of course, modern medicine has a role to play in the prevention of type 2 diabetes, by developing safe and effective medications to suppress appetite or prevent weight gain. Also, drugs that can be taken by people at high risk to prevent early abnormalities in blood sugar from developing into full-blown diabetes will be valuable. However, since type 2 diabetes is largely a disease of the industrialized urban world, the healthiest and most generally effective way to prevent it will be to make the environment of the future less conducive to those habits that lead to its occurrence.

***100. How can we stop the dramatic increase in diabetes presently occurring throughout the world?***

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*While individual counseling and education are worthwhile and effective in some cases, a broader approach will be necessary to impact favorably upon weight and exercise in population terms.*

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Although both type 1 and type 2 diabetes are increasing in frequency throughout the world, it is type 2 diabetes that has shown the explosive rise in occurrence in the past couple of decades. Since this rise is most clearly associated with weight gain and lack of exercise brought on by our current lifestyle, this trend will probably only be stopped, or reversed, by addressing these two factors, as discussed in Question 99. While individual counseling and education are worthwhile and effective in some cases, a broader approach will be necessary to impact favorably upon weight and exercise in population terms. Interventions such as increasing the amount of exercise in the core school curriculum, provision of healthy school meals, and improved policies on the access of snack food vendors to school premises are among measures that are already taking hold and will hopefully have a favorable impact on our youth. The engineering of the workplace and social areas to encourage physical activity, such as removing automobile access to the inner city, providing convenient and pleasant walkways and bicycle paths through frequently traveled areas of town, and probably financial disincentives from excessive automobile use should help to mobilize us. Countries with emerging economies are particularly affected by the switch to urban industrialized living, in terms of rising numbers of people with diabetes, yet they have perhaps the best opportunity to effect change. They are in the planning and growth stages and can make social and environmental decisions to improve the future before diabetes becomes an overwhelming problem.

# Glossary

**Antidiuretic hormone (ADH):** A hormone that is responsible for maintaining the normal volume and concentration of our urine. Also called arginine vasopressin (AVP).

**Arginine vasopressin (AVP):** A hormone that is responsible for maintaining the normal volume and concentration of our urine. Also called antidiuretic hormone (ADH).

**Asymptomatic:** Having no complaints or symptoms.

**Autoantibody:** An antibody that an organism produces against any of its own tissues or cells.

**Autoimmunity:** A predisposition to produce autoantibodies.

**Bariatric surgery:** Weight loss surgery.

**Basal insulin:** The insulin required to control your blood sugar in the absence of food intake.

**Beta cells:** The insulin-producing cells of the pancreas.

**Body mass index (BMI):** A clinical means of relating weight to height by

a formula. To calculate your own BMI, divide your weight in pounds by the square of your height in inches (i.e., your height multiplied by itself) and then multiply the answer by 703.

**Bolus insulin:** The insulin required to remove the energy derived from a meal from the bloodstream and into the tissues to replenish energy stores. Bolus insulin can also be given when the blood sugar is too high.

**Borderline diabetes:** A condition in which plasma glucose falls in-between normal and standard accepted definitions for diabetes. “Prediabetes” is another term commonly used for the same condition.

**Calorie:** A unit used to express heat or energy value of food.

**Carbohydrates:** Substances composed of long chains of oxygen, hydrogen, and carbon molecules. Carbohydrates in food (for example, sugar and starch) provide energy for the body and, if present in excess, are stored as fat.

**Cataracts:** Opacity of the lens of the eye.

**Cholesterol:** A fatty substance normally present in blood.

**Counterregulatory hormones:** Naturally occurring hormones that prepare the body to combat stress.

**Decompensation:** A serious deterioration in a medical condition.

**Deficiency:** A lack or shortage, especially of something essential to health.

**Diabetes insipidus:** Increased urine production caused by inadequate secretion of vasopressin by the pituitary gland or by resistance of the kidney to its actions.

**Diabetes mellitus:** A condition characterized by inadequate production of insulin or resistance of the body's tissues to its actions, which results in excessive levels of glucose in the blood.

**Dyslipidemia:** Cholesterol and other blood fat abnormalities.

**Fasting:** Abstaining from eating food, usually for nine hours or more.

**Fiber:** The structural part of plants and plant products that consists of carbohydrates that are wholly or partially indigestible.

**Fructose:** A simple sugar found in honey, many fruits, and some vegetables.

**Gestational diabetes mellitus (GDM):** Diabetes detected in pregnancy.

**Glaucoma:** Increased pressure inside the eye.

**Glucose:** A basic sugar used to fuel body cells.

**Glycogen:** Starch, which comprises sugars linked together in a storage pattern.

**HDL:** High-density lipoprotein; "good cholesterol."

**Hemodialysis:** Blood filtering and removal of wastes through a machine.

**Hyperglycemia:** An abnormally high level of glucose in the blood; secondary symptoms include frequent urination and thirst.

**Hypertension:** High blood pressure.

**Hypoglycemia:** An abnormally low level of glucose in the blood; symptoms include shakiness, sweating, hunger, abdominal discomfort, palpitations, and confusion.

**Immune system:** The body's system that protects it from foreign substances, cells, and tissues. The immune system includes the thymus, spleen, lymph nodes, lymphocytes, B-cells and T-cells, and antibodies.

**Immunization:** The process of inducing immunity, usually through inoculation or vaccination.

**Inflammation:** Swelling, pain, tenderness, and disturbed function in an area of the body, usually as a result of injury.

**Insulin:** A hormone produced by the beta cells of the pancreas, which facilitates the entry of glucose and other substances into cells and which has several other functions.

**Intravenously:** Through a vein.

**Islet tissue:** Groups of cells found within the pancreas that produce and

release insulin, glucagons, and other substances.

**Isometric exercise:** Tensing or rigidity of the muscle against forceful resistance, such as in weight-lifting.

**Isotonic exercise:** Repeated movement against minimal resistance, such as jogging, swimming, or dancing.

**Libido:** Sexual interest.

**Lipohypertrophy:** A painless, but potentially disfiguring, fatty mound.

**Nephropathy:** Kidney damage.

**Neuropathy:** Nerve damage.

**Osteomyelitis:** Infection in the bone.

**Pancreas:** A gland deep in the abdomen, behind the stomach, that produces hormones (insulin, glucagon) and digestive enzymes.

**Peripheral nerve:** A nerve cell not contained in the brain or spinal column.

**Peripheral vascular disease:** Diseases of the vessels in the limbs.

**Peritoneal dialysis:** A process whereby wastes are exchanged into fluids introduced into the abdominal cavity.

**Prediabetes:** A condition in which abnormalities in plasma glucose levels lie in-between normal and standard accepted definitions of diabetes.

“Borderline diabetes,” “impaired fasting glucose,” and “impaired glucose tolerance” are other terms used to describe types of this condition.

**Protective sensation:** The perception of potential injury, such as awareness of sharp, rough, excessively hot or cold objects, or friction.

**Remission:** A temporary or permanent decrease of manifestations of a disease.

**Retina:** The inner lining of the eye.

**Retinopathy:** Eye damage.

**Septicemia:** Blood poisoning, due to infection, which is usually bacterial in origin.

**Type 1 diabetes:** Characterized by an almost complete deficiency of insulin due to the immune system erroneously attacking and destroying the insulin-producing cells in the pancreas.

**Type 2 diabetes:** Caused by a combination of body tissues becoming resistant to the action of insulin and the inability of the pancreas to make enough extra insulin to overcome it.

**Vasopressin:** Also called antidiuretic hormone (ADH) or arginine vasopressin (AVP) hormone. A hormone that is responsible for maintaining the normal volume and concentration of our urine.



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Health/Self-Help

# 100 QUESTIONS & ANSWERS

Michael Bryer-Ash, MD,  
FRCP (Lond), FRCP (C)

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