



Emergency Care for Children: Growing Pains

Committee on the Future of Emergency Care in the United States Health System

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Future of Emergency Care Series

Emergency Care for Children

Growing Pains

Committee on the Future of Emergency Care in the United States Health System

Board on Health Care Services

INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

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Willing is not enough; we must do.”*
—Goethe



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This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

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Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations nor did they see the final draft of the report before its release. The review of this report was overseen by **Enriqueta C. Bond**, Burroughs Wellcome Fund, and **Thomas F. Boat**, Children's Hospital Research Foundation and Department of Pediatrics, University of Cincinnati. Appointed by the National Research Council and Institute of Medicine, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

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FOREWORD

The state of emergency care affects every American. When illness or injury strikes, Americans count on the system to respond with timely and high quality care. Yet today, the emergency and trauma care that Americans receive can fall short of what they expect and deserve.

Emergency care is a window on health care, revealing both what is right and what is wrong with our delivery system. Americans rely on hospital emergency departments in growing numbers because of the skilled specialists and advanced technologies they offer. At the same time, the increasing use of the emergency care system also represents failures of the larger health care system—the growing numbers of uninsured Americans, the limited alternatives available in many communities, and the inadequate preventive care and chronic care management received by many. These demands can degrade the quality of emergency care and hinder its ability to provide urgent and life-saving care to seriously ill and injured patients wherever and whenever they need it.

The Committee on the Future of Emergency Care in the United States Health System, ably chaired by Gail Warden, set out to: examine the emergency care system in the United States; explore its strengths, limitations, and future challenges; describe a desired vision of the emergency care system; and recommend strategies required to achieve that vision. Their efforts build on past contributions, including the landmark National Research Council report, *Accidental Death and Disability: The Neglected Disease of Modern Society* in 1966, *Injury in America* in 1985, and *Emergency Medical Services for Children* in 1993.

The committee's task was to examine the full scope of emergency care, from 9-1-1 and medical dispatch, to hospital-based emergency and trauma care. The three reports in the series—*Hospital-Based Emergency Care: At the Breaking Point*, *Emergency Medical Services At the Crossroads*, and *Emergency Care for Children: Growing Pains*—provide three different perspectives on the emergency care system. The series as a whole unites the often-fragmented prehospital and hospital-based systems under a common vision for the future of emergency care.

As the committee prepared its reports, federal and state policymakers turned their attention to the possibility of an avian flu pandemic. Americans are asking, “Are we, as a nation, prepared?” The emergency care system is on the front lines of surveillance and treatment. The more secure and stable our emergency care system, the better prepared we will be to handle any possible outbreak. In this light, the recommendations presented in these reports take on urgency. The guidance offered here can assist all of the stakeholders in emergency care—consumers, policymakers, providers, and educators—to chart the future of emergency care in the U.S.

Harvey V. Fineberg, M.D., Ph.D.
President, Institute of Medicine
June 2006

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PREFACE

Emergency care has made important advances in recent decades: emergency 9-1-1 service now links virtually all ill and injured Americans to immediate medical response; organized trauma systems transport patients to advanced, life-saving care within minutes; and advances in resuscitation and life-saving procedures yield outcomes unheard of just two decades ago. Yet just under the surface, a growing national crisis in emergency care is brewing. Emergency departments (EDs) are frequently overloaded, with patients sometimes lining hallways and waiting hours and even days to be admitted to inpatient beds. Ambulance diversion, in which overcrowded EDs close their doors to incoming ambulances, has become a common, even daily problem in many cities. Patients with severe trauma or illness are often brought to the ED only to find that the specialists needed to treat them are unavailable. The transport of patients to available emergency care facilities is often fragmented and disorganized, and the quality of emergency medical services (EMS) is highly inconsistent from one town, city, or region to the next. In some areas, the system's task of caring for emergencies is compounded by an additional task: providing non-emergent care for many of the 45 million uninsured Americans. Furthermore, the system is ill prepared to handle large-scale emergencies, whether a natural disaster, an influenza pandemic, or an act of terrorism.

This crisis is multifaceted and impacts every aspect of emergency care—from prehospital EMS to hospital-based emergency and trauma care. The American public places its faith in the ability of the emergency care system to respond appropriately whenever and wherever a serious illness or injury occurs. But while the public is largely unaware of the crisis, it is real and growing.

The Institute of Medicine's Committee on the Future of Emergency Care in the United States Health System was convened in September 2003 to examine the emergency care system in the United States, to create a vision for the future of the system, and to make recommendations for helping the nation achieve that vision. The committee's findings and recommendations are presented in the three reports in the *Future of Emergency Care* series:

- ***Hospital-Based Emergency Care: At the Breaking Point*** explores the changing role of the hospital ED and describes the national epidemic of overcrowded EDs and trauma centers. The range of issues addressed includes uncompensated emergency and trauma care, the availability of specialists, medical liability exposure, management of patient flow, hospital disaster preparedness, and support for emergency and trauma research.
- ***Emergency Medical Services At the Crossroads*** describes the development of EMS over the last four decades and the fragmented system that exists today. It explores a range of issues that affect the delivery of prehospital EMS, including communications systems; coordination of the regional flow of patients to hospitals and trauma centers; reimbursement of EMS services; national training and credentialing standards; innovations in triage, treatment, and transport; integration of all components of EMS into disaster preparedness, planning, and response actions; and the lack of clinical evidence to support much of the care that is delivered.
- ***Emergency Care for Children: Growing Pains*** describes the special challenges of emergency care for children and considers the progress that has been made in this area in the 20 years since the establishment of the federal Emergency Medical Services for Children (EMS-C) program. It addresses how issues affecting the emergency care system generally have an even greater impact on the outcomes of critically ill and injured children. The topics addressed include the state of pediatric readiness, pediatric training and standards of care in emergency care, pediatric medication issues, disaster preparedness for children, and pediatric research and data collection.

THE IMPORTANCE AND SCOPE OF EMERGENCY CARE

Each year in the United States approximately 114 million visits to EDs occur, and 16 million of these patients arrive by ambulance. In 2002, 43 percent of all hospital admissions in the United States entered through the ED. The emergency care system deals with an extraordinary range of patients, from febrile infants, to business executives with chest pain, to elderly patients who have fallen.

EDs are an impressive public health success story in terms of access to care. Americans of all walks of life know where the nearest ED is and understand that it is available 24 hours a day, 7 days a week. Trauma systems also represent an impressive achievement. They are a critical component of the emergency care system since approximately 35 percent of ED visits are injury-related, and injuries are the number one killer of people between the ages of 1 and 44. Yet the development of trauma systems has been inconsistent across states and regions.

In addition to its traditional role of providing urgent and life-saving care, the emergency care system has become the “safety net of the safety net,” providing primary care services to millions of Americans who are uninsured or otherwise lack access to other community services. Hospital EDs and trauma centers are the only providers required by federal law to accept, evaluate, and stabilize all who present for care, regardless of their ability to pay. An unintended but predictable consequence of this legal duty is a system that is overloaded and underfunded to carry out its mission. This situation can hinder access to emergency care for insured and uninsured alike, and compromise the quality of care provided to all. Further, EDs have become the preferred setting for many patients and an important adjunct to community physicians’ practices. Indeed, the recent growth in ED use has been driven by patients with private health insurance. In addition to these responsibilities, emergency care providers have been tasked with the enormous challenge of preparing for a wide range of emergencies, from bioterrorism to natural disasters and pandemic disease. While balancing all of these tasks is difficult for every organization providing emergency care, it is an even greater challenge for small, rural providers with limited resources.

Improved Emergency Medical Services: A Public Health Imperative

Since the Institute of Medicine (IOM) embarked on this study, concern about a possible avian influenza pandemic has led to worldwide assessment of preparedness for such an event. Reflecting this concern, a national summit on pandemic influenza preparedness was convened by Department of Health and Human Services Secretary Michael O. Leavitt on December 5, 2005, in Washington D.C., and has been followed by statewide summits throughout the country. At these meetings, many of the deficiencies noted by the IOM’s Committee on the Future of Emergency Care in the United States Health System have been identified as weaknesses in the nation’s ability to respond to large-scale emergency situations, whether disease outbreaks, naturally occurring disasters, or acts of terrorism. During any such event, local hospitals and emergency departments will be on the front lines. Yet of the millions of dollars going into preparedness efforts, a tiny fraction has made its way to medical preparedness, and much of that has focused on one of the least likely threats—bioterrorism. The result is that few hospital and EMS professionals have had even minimal disaster preparedness training; even fewer have access to personal protective equipment; hospitals, many already stretched to the limit, lack the ability to absorb any significant surge in casualties; and supplies of critical hospital equipment, such as decontamination showers, negative pressure rooms, ventilators, and intensive care unit beds, are wholly inadequate. A system struggling to meet the day-to-day needs of the public will not have the capacity to deal with a sustained surge of patients.

FRAMEWORK FOR THIS STUDY

This year marks the fortieth anniversary of the publication of the landmark National Academy of Sciences/National Research Council report, *Accidental Death and Disability: The Neglected Disease of Modern Society*. That report described an epidemic of automobile-related and other injuries, and harshly criticized the deplorable state of trauma care nationwide. The report prompted a public outcry, and stimulated a flood of public and private initiatives to enhance highway safety and improve the medical response to injuries. Efforts included the development of trauma and prehospital EMS systems, creation of the specialty in emergency medicine, and establishment of federal programs to enhance the emergency care infrastructure and build a research base. To many, the 1966 report marked the birth of the modern emergency care system.

Since then, the National Academies and the Institute of Medicine (IOM) have produced a variety of reports examining various aspects of the emergency care system. The 1985 report *Injury in America* called for expanded research into the epidemiology and treatment of injury, and led to the development of the National Center for Injury Prevention and Control within the Centers for Disease Control and Prevention. The 1993 report *Emergency Medical Services for Children* exposed the limited capacity of the emergency care system to address the needs of children, and contributed to the expansion of the Emergency Medical Services for Children program within the Department of Health and Human Services. It has been 10 years, however, since the IOM examined any aspect of emergency care in depth. Furthermore, no National Academies report has ever examined the full range of issues surrounding emergency care in the United States.

That is what this committee set out to do. The objectives of the study were to (1) examine the emergency care system in the United States; (2) explore its strengths, limitations, and future challenges; (3) describe a desired vision for the system; and (4) recommend strategies for achieving this vision.

STUDY DESIGN

The IOM Committee on the Future of Emergency Care in the United States Health System was formed in September 2003. In May 2004, the committee was expanded to comprise a main committee of 25 members and three subcommittees. A total of 40 main and subcommittee members, representing a broad range of expertise in health care and public policy, participated in the study. Between 2003 and 2006, the main committee and subcommittees met 19 times; heard public testimony from nearly 60 speakers; commissioned 11 research papers; conducted site visits; and gathered information from hundreds of experts, stakeholder groups, and interested individuals.

The magnitude of the effort reflects the scope and complexity of emergency care itself, which encompasses a broad continuum of services that includes prevention and bystander care; emergency calls to 9-1-1; dispatch of emergency personnel to the scene of injury or illness; triage, treatment, and transport of patients by ambulance and air medical services; hospital-based emergency and trauma care; subspecialty care by on-call specialists; and subsequent inpatient care. Emergency care's complexity can also be traced to the multiple locations, diverse professionals, and cultural differences that span this continuum of services. EMS, for example, is unlike any other field of medicine—over one-third of its professional workforce consists of volunteers. Further, EMS has one foot in the public safety realm and one foot in medical care, with nearly half of all such services being housed within fire departments. Hospital-based emergency care is also delivered by an extraordinarily diverse staff—emergency physicians, trauma surgeons, critical care specialists, and the many surgical and medical subspecialists who provide services on an on-call basis, as well as specially trained nurses, pharmacists, physician assistants, nurse practitioners, and others.

The division into a main committee and three subcommittees made it possible to break down this enormous effort into several discrete components. At the same time, the committee sought to examine emergency care as a comprehensive system, recognizing the interdependency of its component parts. To this end, the study process was highly integrated. The main committee and three subcommittees were

designed to provide for substantial overlap, interaction, and cross-fertilization of expertise. The committee concluded that nothing will change without cooperative and visionary leadership at many levels and a concerted national effort among the principal stakeholders—federal, state, and local officials; hospital leadership; physicians, nurses, and other clinicians; and the public.

We hope that the reports of the Future of Emergency Care Series stimulate increased attention and reform to the emergency care system in the United States. I wish to express my appreciation to the members of the committee and subcommittees and the many panelists who contributed input to the meetings, and to the IOM staff for their time, effort, and commitment to the development of these important reports.

Gail L. Warden
Chair

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The Future of Emergency Care series benefited from the contributions of many individuals and organizations. The Committee and IOM staff take this opportunity to recognize and thank those who helped during the development of the reports.

A large number of individuals assembled materials that helped the committee develop the evidence base for its analyses. The committee appreciates the contributions of experts from a variety of organizations and disciplines who gave presentations during committee meetings or authored papers that provided information incorporated into the series of reports. Authors of commissioned papers are listed in Appendix D. The full list of presenters is provided in Appendix E.

Committee members and IOM staff conducted a number of site visits throughout the course of the study to gain a better understanding of certain aspects of the emergency care system. We appreciate the willingness of staff from the following organizations to meet with us and respond to questions: Beth Israel Deaconess Medical Center, Boston Medical Center, Children's National Medical Center, Grady Memorial Hospital, Johns Hopkins Hospital, Maryland Institute for EMS Services Systems, Maryland State Police Aviation Division, Richmond Ambulance Association, and Washington Hospital Center.

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Summary

Children represent a special challenge for emergency and trauma care providers, in large part because they have unique medical needs in comparison with adults. Respiratory rates, heart rates, and blood pressure levels all change as children grow, so vital signs that would be normal for an adult patient may signal distress in a child. Special care is necessary when providers intubate a child to accommodate a shorter trachea and higher larynx. Medication doses must be carefully calculated specifically for each pediatric patient based on his or her weight. Providers must also know how to handle children's emotional reactions to illness and injury, which vary by age. Children may not be old enough to communicate what is wrong with them or how they became injured, making triage more difficult. It is not surprising, then, that many emergency providers feel stress and anxiety when caring for pediatric patients.

For decades, policy makers and providers have recognized the special needs of children, but the emergency and trauma care system has been slow to develop an adequate response to those needs. This is in part due to inadequacies of the broader system. The emergency and trauma care system is highly fragmented, with little coordination among prehospital emergency medical services (EMS), hospital services, and public health. Use of emergency departments (EDs) has grown considerably even as many EDs have closed, contributing to crowded conditions in those that remain open. Ambulance diversion has become a daily occurrence in many cities around the country. Key specialists needed to treat emergency and trauma patients are increasingly difficult to find, resulting in longer waits and more distant prehospital transport for critically injured patients. Emergency care providers on the front lines of safety net care encounter patients with intractable social problems. Much of the service provided to these difficult patients is compensated poorly or not at all. This situation places tremendous financial pressure on safety net hospitals, some of which have closed or are in danger of closing as a result.

The problems faced by children in the current emergency care system are even more daunting. Although children represent 27 percent of all ED visits, many hospitals are not well prepared to handle pediatric patients. For example:

- Only about 6 percent of EDs in the United States have all of the supplies deemed essential for managing pediatric emergencies; only half of hospitals have at least 85 percent of those supplies.
- Of the hospitals that lack the capabilities to care for pediatric trauma patients, only half have written transfer agreements with other hospitals.
- Although pediatric skills deteriorate quickly without practice, continuing education in pediatric care is not required or is extremely limited for many prehospital emergency medical technicians (EMTs).
- Many medications prescribed to children are “off label,” meaning they have not been adequately tested or approved by the Food and Drug Administration (FDA) for use in pediatric populations.
- Disaster preparedness plans often overlook the needs of children, even though their needs differ from those of adults in the event of a disaster.
- Evidence indicates that pediatric treatment patterns vary widely across emergency providers, many providers do not properly stabilize seriously injured or ill children, many providers undertreat children in comparison with adults, and many cases of child abuse go unrecognized by emergency care providers.

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- Many of these shortcomings are exacerbated in rural areas, where dedicated, well-intentioned prehospital and ED providers often make do without the specialized pediatric training and resources that most of us would expect to be in place.

As a result of the above problems, many children with an emergency medical condition do not receive appropriate care under the current system. Many urban areas have children's hospitals or hospitals with pediatric EDs staffed by pediatric emergency medicine specialists and equipped with the latest technologies for the care and treatment of children. However, the vast majority of ED visits made by children are not to children's hospitals or hospitals with a pediatric ED, but to general hospitals, which are less likely to have pediatric expertise, equipment, and policies in place for the care of children.

The Committee on the Future of Emergency Care in the United States Health System was formed in September 2003 to examine the emergency care system in the United States; explore its strengths, limitations, and future challenges; describe a desired vision of the system; and recommend strategies for achieving that vision. The committee was also tasked with taking a focused look at the state of pediatric emergency care, prehospital emergency care, and hospital-based emergency and trauma care. This report is one in a series of three that presents the committee's findings and recommendations in these areas. Summarized below are the committee's findings and recommendations for improving pediatric emergency and trauma care. In addition, this report serves as a follow-up to the 1993 Institute of Medicine report *Emergency Medical Services for Children*, which represented the first comprehensive look at pediatric emergency care in the United States. That report, which documented shortcomings in a number of areas, received considerable attention from emergency care providers, professional organizations, policy makers, and the public. Over the past 13 years, the federal Emergency Medical Services for Children (EMS-C) program, a grant program that assists states in addressing pediatric deficiencies within their emergency care systems, has been actively addressing the deficiencies identified in that report. The committee's findings and recommendation regarding the EMS-C program are summarized below as well.

ACHIEVING THE VISION OF A 21ST-CENTURY EMERGENCY CARE SYSTEM

As noted above, emergency care for children cannot be improved until some of the long-standing problems within the overall emergency care system are addressed. To that end, the committee developed a vision for the future of emergency care that centers around three goals: coordination, regionalization, and accountability. Many elements of this vision have been advocated previously; however, progress toward achieving these elements has been derailed by deeply entrenched political interests and cultural attitudes, as well as funding cutbacks and practical impediments to change. Concerted, cooperative efforts at all levels of government—federal, state, regional, local—and the private sector are necessary to finally break through and achieve optimum emergency care.

Coordination

One of the most long-standing problems with the emergency care system is that services are fragmented. EMS, hospitals, trauma centers, and public health have traditionally worked in silos. For example, public safety and EMS agencies often lack common radio frequencies and protocols for communicating with each other during emergencies. Similarly, emergency care

providers lack access to patient medical histories that could be useful in decision making. Only about half of hospitals have pediatric interfacility transfer agreements. Moreover, planning is fragmented; often pediatric concerns are overlooked entirely, or planning for adult and pediatric care occurs independently.

The committee envisions a system in which patients of all ages and in all communities receive well-planned and coordinated emergency care services. Dispatch, EMS, ED providers, public safety, and public health should be fully interconnected and united in an effort to ensure that each patient receives the most appropriate care, at the optimal location, with the minimum delay. From the standpoint of the patient and parents, delivery of emergency care services should be seamless. Inclusion of pediatric concerns during planning can help the system meet the needs of children to the best of its ability.

Regionalization

Because not all hospitals within a community have the personnel and resources to support the delivery of high-level emergency care, critically ill and injured patients should be directed specifically to those facilities with such capabilities. That is the goal of regionalization. There is substantial evidence that the use of regionalization of services to direct such patients to designated hospitals with greater experience and resources improves outcomes and reduces costs across a range of high-risk conditions and procedures. A few states have taken steps to regionalize pediatric emergency care, allowing advanced life support ambulances to bring such patients only to hospitals designated as having pediatric capabilities. However, a state-by-state analysis shows that many states still have not formally regionalized pediatric intensive or trauma care.

Thus the committee supports further regionalization of emergency care services. However, use of this approach requires that EMTs as well as parents and caregivers, be clear on which facilities have the necessary resources. Just as trauma centers are categorized according to their capabilities (i.e., level I–level IV/V), a standard national approach to the categorization of EDs that reflects both their adult and pediatric capabilities is needed so that the categories will be clearly understood by providers and the public across all states and regions of the country. To that end, **the committee recommends that the Department of Health and Human Services and National Highway Traffic Safety Administration, in partnership with professional organizations, convene a panel of individuals with multidisciplinary expertise to develop an evidence-based categorization system for EMS, EDs, and trauma centers based on adult and pediatric service capabilities.** The use of national definitions will ensure that they are understood by providers and by the public across all states and regions of the country.

This information, in turn, could be used to develop protocols that would guide EMTs in the transport of patients. However, more research and discussion are needed to determine under what circumstances patients should be brought to the closest hospital for stabilization and transfer instead of being transported directly to the facility with the highest level of care, if that facility is farther away. Debate also continues over what procedures are effective for the care of children in the field. Therefore, **the committee also recommends that the National Highway Traffic Safety Administration, in partnership with professional organizations, convene a panel of individuals with multidisciplinary expertise to develop evidence-based model prehospital care protocols for the treatment, triage, and transport of patients, including children.**

Accountability

Without accountability, participants in the emergency care system need not accept responsibility for failures and can avoid making changes to improve the delivery of care. Accountability has failed to take hold in emergency care to date because responsibility is dispersed across many different components of the system, so it is difficult even for policy makers to determine where system breakdowns occur and how they can subsequently be addressed. When hospitals lack pediatric transfer agreements, when providers receive no continuing pediatric education, and when pediatric specialists and on-call specialists are not available, no one party is to blame—it is a system failure.

To build accountability into the system, **the committee recommends that the Department of Health and Human Services convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency care system performance, including performance of pediatric emergency care.** Because of the need for an independent, national process with the broad participation of every component of emergency care, the federal government should play a lead role in promoting and funding the development of these performance indicators. The indicators developed should include structure and process measures, but evolve toward outcome measures over time. These performance measures should be nationally standardized so that statewide and national comparisons can be made. Measures should evaluate the performance of individual providers within the system, as well as that of the system as a whole. Measures should also be sensitive to the interdependence among the components of the system; for example, EMS response times may be related to EDs going on diversion.

Using the measures developed through such a national, evidence-based, multidisciplinary effort, performance data should be collected at regular intervals from all hospitals and EMS agencies in a community. Public dissemination of performance data is crucial to driving the needed changes in the delivery of emergency care services. Dissemination can take various forms, including public report cards, annual reports, and state public health reports. Because of the potential sensitivity of performance data, they should initially be reported in the aggregate rather than at the level of the individual provider organization. But individual provider organizations should have full access to their own data so they can understand and improve their performance, as well as their contribution to the overall system. Over time, individual provider organization performance information should become an important part of the public information on the system.

Achieving the Vision

States and regions face a variety of different situations, including the level of development of adult and pediatric trauma systems; the effectiveness of state EMS offices and regional EMS councils; and the degree of coordination among fire departments, EMS, hospitals, trauma centers, and emergency management. Thus no single approach to enhancing emergency care systems will achieve the goals outlined above. A number of different avenues should be explored and evaluated to determine what types of systems are best able to achieve the three goals. **The committee therefore recommends that Congress establish a demonstration program, administered by the Health Resources and Services Administration, to promote regionalized, coordinated, and accountable emergency care systems throughout the country, and appropriate \$88 million over 5 years to this program.** Grants should be targeted

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at states, which could develop projects at the state, regional, or local level; cross-state collaborative proposals would also be encouraged. Over time, and over a number of controlled initiatives, such a process should lead to important insights about what strategies work under different conditions. These insights would provide best-practice models that could be widely adopted to advance the nation toward the committee's vision for efficient, high-quality emergency and trauma care. It will be essential for the federal granting agency and grant recipients to consider explicitly the implications of proposed projects for both adult and pediatric patients.

Furthermore, the fragmented responsibility for emergency care at the federal level must be reduced. Responsibility is widely dispersed among multiple federal agencies within DHHS, DOT and DHS. The scattered nature of federal responsibility for emergency care makes it difficult for the public to identify a clear point of contact, limits the visibility necessary to secure and maintain funding, and creates overlaps and gaps in program funding. **The Committee recommends that Congress establish a lead agency for emergency and trauma care within 2 years of the publication of this report. The lead agency should be housed in the Department of Health and Human Services, and should have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. Congress should establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency and trauma care.**

ADDRESSING SPECIFIC PEDIATRIC CONCERNS

In addition to the above reforms to the broader emergency care system, the delivery of optimum pediatric emergency care will require addressing a number of concerns specific to pediatric populations. It will be necessary to strengthen the capabilities of the emergency care workforce to treat pediatric patients, improve patient safety, exploit advances in medical and information technology, foster family-centered care, enhance disaster preparedness, and improve the evidence base.

Strengthening the Workforce

Ideally, because of the unique way in which pediatric patients should be triaged and treated, all children should be served by emergency care providers with formal training and experience in pediatric emergency care. In reality, providers' levels of pediatric emergency care training vary considerably. Residency programs, medical schools, nursing schools, states, EMS agencies, and hospitals have varying requirements for initial and continuing pediatric emergency care education and training. In some cases, the training is intensive; however, emergency medicine or pediatrics training often represents only a small part of a provider's total training time. Of particular concern are emergency providers who rarely encounter pediatric patients, making it difficult to maintain pediatric skills. This is a long-standing problem that has improved somewhat over time, but naturally has led to continued concern about the ability of the

emergency care workforce to care properly for pediatric patients. To reduce the consequences of illness and injury, the workforce must have the knowledge and skills necessary to provide appropriate pediatric emergency care. The committee believes all emergency care providers should possess a certain level of competency to deliver emergency care to children. Therefore, **the committee recommends that every pediatric and emergency care–related health professional credentialing and certification body define pediatric emergency care competencies and require practitioners to receive the level of initial and continuing education necessary to achieve and maintain those competencies.**

Treatment patterns of providers in emergency care for pediatric patients differ not only because of differences in training, but also because of the lack of evidence-based clinical practice guidelines for many different types of conditions. This is troubling since the use of such guidelines has been shown to improve the quality of care. **The committee recommends that the Department of Health and Human Services collaborate with professional organizations to convene a panel of individuals with multidisciplinary expertise to develop, evaluate, and update pediatric emergency care clinical practice guidelines and standards of care.** The committee believes these guidelines should be evidence-based, developed through use of an evidence evaluation process. That process should include individuals from different disciplines and different types of emergency care organizations to promote consensus and uniformity.

Simply recommending more training and the development of guidelines is not enough, however. Someone must be responsible at the provider level for ensuring that continuing education opportunities are available and exploited. Similarly, the development of clinical guidelines is useless without widespread adoption by providers. Thus the committee believes that pediatric leadership is needed in each provider organization. **The committee recommends that EMS agencies appoint a pediatric emergency coordinator and hospitals appoint two pediatric emergency coordinators – one a physician – to provide pediatric leadership for the organization.** The pediatric coordinator position would not be a full-time position, but a shared role. Still, the coordinators would have a number of responsibilities, including ensuring adequate skill and knowledge among fellow ED or EMS providers, overseeing pediatric quality improvement initiatives, and ensuring the availability of pediatric medications, equipment, and supplies.

Improving Patient Safety

Emergency care services are delivered in an environment where the need for haste, the distraction of frequent interruptions, and clinical uncertainty abound, thus potentially posing a number of threats to patient safety. Children are, of course, at great risk under these circumstances because of their physical and developmental vulnerabilities and because of their need for care that may be atypical for providers used to treating adult patients.

The committee recommends that hospitals and EMS systems implement evidence-based approaches to reduce errors in emergency and trauma care for children. There is, however, a paucity of high-quality data on the epidemiology of medical errors in children, particularly within the emergency care system. Instead, there have been only a few, typically small, studies demonstrating that care delivered to children is compromised at several points during prehospital EMS care or an ED visit. Thus continued research is needed to determine the best strategies for improving patient safety in prehospital and ED pediatric care. At the same time, however, various hospitals and EMS agencies have had some success with several promising strategies that could be replicated by other organizations.

One type of medical error that is well documented to be common in both the EMS and ED environments is errors that occur during the prescribing, dispensing, and administration of medications. To address this problem for pediatric patients, **the committee recommends that the Department of Health and Human Services and the National Highway Traffic Safety Administration fund the development of medication dosage guidelines, formulations, labeling guidelines, and administration techniques for the emergency care setting to maximize effectiveness and safety for infants, children, and adolescents. EMS agencies and hospitals should implement these guidelines, formulations, and techniques.**

Perhaps the foremost problem associated with pediatric medication in the emergency care setting is the above-noted prescribing of medications for children off label. Medications designed for adults may not be suitable for children, yet once a drug has been approved by the FDA, further studies to determine its safety and efficacy in infants and children are rarely conducted. Moreover, emergency care professionals have few evidence-based guidelines and little information to assist them in the prescribing of medications for pediatric patients. As a result, emergency providers must prescribe medications for children without a full understanding of their risks, benefits, or implications for these patients. Therefore, **the committee recommends that the Department of Health and Human Services fund studies on the efficacy, safety, and health outcomes of medications used for infants, children, and adolescents in emergency care settings in order to improve patient safety.**

Exploiting Advances in Medical and Information Technology

Technology is likely to advance the way care is delivered in the prehospital and ED settings. New technologies designed to accelerate diagnosis and workflow—advanced imaging modalities, rapid diagnostic tests, laboratory automation, EMS technologies, patient tracking tools, and new triage models—are likely to be adopted. As these new technologies are introduced, it is critical to consider how they can help (and whether they may bring harm to) pediatric patients. While this may appear to be an obvious consideration, there have been many examples of medical technologies originally developed for adults, but used on children with unintended consequences.

A market for products designed specifically for pediatric patients has not been well developed. To this end, **the committee recommends that federal agencies and private industry fund research on pediatric-specific technologies and equipment for use by emergency and trauma care personnel.** To stimulate demand for pediatric-appropriate technologies, emergency providers should be made aware of the potential shortcomings of products designed for adults and adapted for children. Federal agencies and private industry also need to take a close look at technologies already in place and available for use on pediatric patients that have not been adequately tested for potentially harmful effects on these patients.

A similar issue exists in the development of information technologies. Hospitals, EMS systems, and government entities are beginning to make substantial investments in information technologies that may improve the quality and efficiency of emergency care delivery. Yet the safety, impact, and risks of these systems for pediatric patients have received little attention. Specific consideration of pediatric needs during the design of such systems is critical to ensure that they are appropriate for the pediatric patient. For example, electronic health records must be designed so that providers can record measurements with a granularity appropriate for newborns and infants, and computerized physician order entry tools must incorporate pediatric-specific dosing tables.

Fostering Family-Centered Care

One of the six aims for health care quality improvement proposed by the Institute of Medicine in its 2001 landmark report *Crossing the Quality Chasm: A New Health System for the 21st Century* was patient-centeredness, meaning that care should encompass the qualities of compassion; empathy; and responsiveness to the needs, values, and preferences of the individual patient. Parents are recognized as a pediatric patient's primary source of strength and support and play an integral role in the child's health and well-being. Increasing recognition of both the importance of meeting the psychosocial and developmental needs of children and the role of families in promoting the health and well-being of their children has led to the concept of family-centered care.

There are several definitions of family-centered care, but they all essentially recognize that providers should acknowledge and make use of the family's presence, skills, and knowledge of their child's condition when caring for the child. Indeed, a growing body of research demonstrates the importance of ensuring the involvement of patients and families in their own health care decisions, better informing families of treatment options, and improving patients' and families' access to information. A number of studies have found some evidence that family-centered care is associated with improved health outcomes, patient and family satisfaction, and provider satisfaction. Unfortunately, few EMS agencies and EDs have written policies or guidelines for family-centered care in place, and few providers are trained in family-centered approaches. Because such approaches to care can mutually benefit the patient, family, and provider, **the committee recommends that EMS agencies and hospitals integrate family-centered care into emergency care practice.**

Enhancing Disaster Preparedness

As noted earlier, because of their anatomical, physiological, developmental, and emotional differences, children are generally more vulnerable than adults in the event of a disaster. They also require specialized equipment and different approaches to treatment during such an event. For example, adult decontamination units cannot be used because rescuers need to be able to adjust water temperature and pressure to suit the needs of children (e.g., provide high-volume, low-pressure, heated water). Children also require different antibiotics and different dosages to counter many chemical and biological agents. As with the development of the emergency care system, however, the needs of children have traditionally been overlooked in disaster planning. A 1997 Federal Emergency Management Agency (FEMA) survey found that none of the states had incorporated pediatric components in their disaster plans.

Hurricane Katrina, which struck as this report was being written, highlighted the shortcomings of the nation's disaster planning at many levels. Katrina was extreme in its scope and impact, but even small disasters can present enormous challenges to a system that struggles to meet day-to-day patient needs. Though it is still too early to compile all of the lessons learned from Hurricane Katrina, we have learned enough from this and other disasters to recognize that improved planning for disasters is necessary, and that children must be a particular focus of such efforts. **The committee recommends that federal agencies (the Department of Health and Human Services, the National Highway Traffic Safety Administration, and the Department of Homeland Security), in partnership with state and regional planning bodies and emergency care provider organizations, convene a panel with multidisciplinary expertise to develop strategies for addressing pediatric needs in the event of a disaster. This effort should encompass the following:**

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- **Development of strategies to minimize parent–child separation and improved methods for reuniting separated children with their families.**
- **Development of strategies to improve the level of pediatric expertise on Disaster Medical Assistance Teams (DMATs) and other organized disaster response teams.**
 - **Development of disaster plans that address pediatric surge capacity for both injured and noninjured children.**
 - **Development of and improved access to specific medical and mental health therapies, as well as social services, for children in the event of a disaster.**
 - **Development of policies to ensure that disaster drills include a pediatric mass casualty incident at least once every 2 years.**

Improving the Evidence Base

Pediatric emergency care is a young field; even in the late 1970s, there were no pediatric emergency medicine textbooks or journals. Although the amount of research conducted in pediatric emergency care has increased considerably over the past 25 years, a significant information gap remains. Indeed, basic questions about the structure of the pediatric emergency care system and patient outcomes remain unanswered. Many of the treatments and management strategies that are widely practiced today are not supported by scientific evidence. A national commitment to emergency care research for children is needed.

Lack of adequate data and limited research funding are among the most important barriers to the advancement of research in pediatric emergency care. No single hospital or EMS agency is likely to have access to sample sizes large enough to answer important questions about critically ill or injured children. The use of research networks, in which researchers from different institutions pool data, has proven to be successful in addressing such challenges. The large number of patients included in the networks allows researchers to carry out trials designed to evaluate rare conditions or complications. If these networks receive the funding needed for sustainability, they not only generate important findings, but also help train and support the development of young investigators.

Since emergency care research is often not based on a single disease entity, a key characteristic of much of this research is its tendency to cut across multiple specialty domains. This has made it difficult for researchers in the field to obtain training grants from the siloed funding structure of the National Institutes of Health, the largest single source of support for biomedical research in the world. **The committee recommends that the Secretary of the Department of Health and Human Services conduct a study to examine the gaps and opportunities in emergency care research, including pediatric emergency care, and recommend a strategy for the optimal organization and funding of the research effort. This study should include: consideration of training of new investigators, development of multicenter research networks, involvement of emergency and trauma care researchers in the grant review and research advisory processes, and improved research coordination through a dedicated center or institute. Congress and federal agencies involved in emergency and trauma care research (including the Department of Transportation, Department of Health and Human Services, Department of Homeland Security, and Department of Defense) should implement the study's recommendations.**

Focused research attention is needed on pediatric injury, the leading cause of death and disability in children beyond the first year of life. National and state trauma registries, which are

used to collect, store, and retrieve data on trauma patients, allow researchers to study the etiologic factors, demographic characteristics, diagnoses, treatments, and clinical outcomes of pediatric trauma patients. However, no single trauma registry currently provides accurate estimates of the scope and characteristics of pediatric trauma. The American College of Surgeons' National Trauma Data Bank constitutes the world's largest repository of pediatric trauma data, but continued steps are needed to expand its pediatric capacity. **The committee recommends that the administrators of trauma registries, statewide and national, include standard pediatric-specific data elements and provide the data to the National Trauma Data Bank. Additionally, the American College of Surgeons should establish a multidisciplinary pediatric specialty committee to evaluate pediatric-specific data elements for the National Trauma Data Bank and identify areas for pediatric research on an ongoing basis.**

THE EMERGENCY MEDICAL SERVICES FOR CHILDREN PROGRAM

Despite its modest annual appropriation, the EMS-C program boasts many accomplishments. It has initiated hundreds of injury prevention programs; provided thousands of hours of training to EMTs, paramedics, and other emergency medical care providers; developed educational materials covering every aspect of pediatric emergency care; and established a pediatric research network. Still, as discussed earlier, certain segments of the emergency care system continue to be poorly prepared to care for children, and the work of the program continues to be relevant and vital.

Addressing some of the long-standing problems in pediatric emergency care, as well as the new concerns raised in this report, will require the leadership of a well-recognized, well-respected entity not just within pediatrics, but within the broader emergency care system. The EMS-C program, with its long history of working with federal partners, state policy makers, researchers, providers, and professional organizations across the spectrum of emergency care, is well positioned to assume this leadership role. But additional resources are necessary so the program will have the capacity to rapidly address the deficiencies in the pediatric emergency care system for children. **The committee recommends that Congress appropriate \$37.5 million each year for the next 5 years to the EMS-C program.**

The proposed 5 years is not intended as a limit on federal funding dedicated to improving pediatric emergency care; indeed, there will always be a need to monitor and study pediatric emergency care. However, the hope is that the various components of leadership in emergency care at the federal level will be better integrated in the future. Pediatric emergency care will always remain an important piece of that federal leadership, but may not require a separate, stand-alone program. After five years, it will be necessary to reevaluate how best to identify and fund pediatric emergency care objectives at the federal level. Future funding levels for the EMS-C Program must also be reevaluated.

CONCLUDING REMARKS

The quality of the U.S. emergency care system is of critical importance to all Americans. Regardless of income, insurance status, race, ethnicity, geography, or age, everyone relies on the emergency care system to provide needed care in the event of a critical illness or injury. Although the current system operates poorly in many respects, a more reliable system is

achievable. Change must be stimulated quickly, however, as millions of Americans continue to access this flawed system each week.

As reforms to the broader emergency care system are accomplished, policy makers at the federal, state, and local levels must not repeat mistakes made in previous decades by neglecting the special needs of pediatric patients. Consideration of those needs must be fully integrated into all aspects of emergency care planning. Individual providers (physicians, nurses, EMTs, and others), as well as provider organizations, also have an important role to play in stimulating improvements in pediatric emergency care. Indeed, they have a responsibility to ensure that care delivered to children meets the highest possible standards of quality.

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Introduction

In 2002, children under age 19 made more than 29 million visits to emergency departments (EDs) in the United States (2002 NHAMCS data, calculations by IOM staff). Approximately 20 percent of children make one or more visits to an ED each year; 7 percent make two or more visits (National Center for Health Statistics, 2005). Despite this heavy reliance on the emergency care system, the public typically gives little thought to the adequacy of the system for children. Yet they have lofty expectations. Parents and caregivers expect emergency and trauma care providers to deliver high-quality care to their children when it is needed. They expect the system to be agile, able to respond quickly at any hour of the day or night and handle any type of pediatric emergency appropriately (Harris Interactive, 2004). In reality, however, the public knows little about how well local emergency care and trauma systems perform, both absolutely and in comparison with other systems. In particular, there is little understanding of the major shortcomings of the emergency care system in the United States today.

Emergency care systems are largely local in nature, and they vary accordingly. State and local prevention laws, the training of prehospital emergency medical technicians (EMTs), and the availability of hospitals and pediatric emergency medicine physicians are but a few examples of such variations—key elements that have an important impact on the functioning of the emergency care system. Some areas of the country, particularly urban settings, have children’s hospitals and hospitals with pediatric EDs staffed by pediatric emergency specialists and equipped with the latest technologies for the care and treatment of children. In other areas, however, pediatric-specific resources are highly limited. Dedicated, well-intentioned prehospital emergency medical services (EMS) and ED providers make do without the resources that most would expect to be available for the care of children. For example:

- Only about 6 percent of hospitals have available all the pediatric supplies deemed essential by the American Academy of Pediatrics and American College of Emergency Physicians for managing pediatric emergencies, although about half of hospitals have at least 85 percent of those supplies (Middleton and Burt, 2006). Approximately 94 percent of pediatric ED visits are made to the former hospitals, while 63 percent are made to the latter (Personal communication, K. Middleton, February 2, 2006).
 - Of hospitals that do not have a separate pediatric inpatient ward, only about half have written transfer agreements with other hospitals (Middleton and Burt, 2006), which are necessary in case a critically ill or injured child arrives at a hospital that lacks pediatric expertise.
 - Although research shows that pediatric skills deteriorate after a short time without practice (Su et al., 2000; Wolfram et al., 2003), pediatric continuing education is not required or is extremely limited for many prehospital providers (Glaeser et al., 2000).
 - Many medications prescribed and administered to children in the ED are “off label,” meaning they have not been adequately tested in pediatric populations and therefore are not approved for use in children by the Food and Drug Administration (FDA).

- Disaster preparedness plans largely overlook the needs of children, even though children's needs in the event of a disaster often differ from those of adults (Dick et al., 2004; National Association of State EMS Directors, 2004).

The lack of preparedness carries a cost: many children with an emergency medical condition do not receive appropriate care under the current system. This conclusion is clear from a recent mock-drill conducted in 35 of North Carolina's EDs, including 5 trauma centers. Nearly all of the EDs in the study failed to stabilize seriously injured children properly during trauma simulations. Almost all failed to administer dextrose properly to a child in hypoglycemic shock (a life-threatening drop in blood sugar), correctly warm a hypothermic child or order proper administration of intravenous (IV) fluids (Hunt et al., 2006). Ongoing research suggests that these problems are not unique to North Carolina EDs. While data on pediatric emergency care outcomes are largely unavailable, data on practice patterns indicate shortcomings in the treatment and care of pediatric patients. Examples include high rates of pediatric medication errors (Selbst et al., 1999; Hubble and Paschal, 2000; Kozer et al., 2002; Fairbanks, 2004; Marcin et al., 2005), low rates of pain management for pediatric patients (Brown et al., 2003), and many missed cases of child abuse (Petrack and Christopher, 1997; Saade et al., 2002; Kunen et al., 2003; Trokel et al., 2006). Studies also indicate wide variation in practice patterns in the care of children (Glaser et al., 1997; Isaacman et al., 2001; Hampers and Faries, 2002; Davis et al., 2005), as well as an undertreatment of children in comparison with adults (Su et al., 1997; Gausche et al., 1998; Orr et al., 2006).

Providing quality pediatric emergency and trauma care is not just about having the right training and equipment. Indeed, the delivery of care should be built on a strong foundation in which emergency care is well planned and coordinated, care is based on scientific evidence, data are collected so providers can learn from past experience, and system performance is monitored to ensure quality. Moreover, since preventing an injury or illness is almost always better and more cost-effective than even the best emergency care, the emergency care system should promote prevention through surveillance, research, and patient education. Unfortunately, today's emergency care system generally does not function in this way.

STUDY CONTEXT

The Current Emergency Care System

While not new, the problems facing the nation's emergency care system that are reviewed in this report have been growing and have become more visible to the public. Critical stories have increasingly been appearing in the media regarding slow EMS response, ambulance diversions, trauma center closures, the medical malpractice crisis, ground and air ambulance crashes, and the alarming decline in on-call specialist coverage. The events of September 11, 2001, and more recent disasters, such as the train bombings in Madrid, the bus and train bombings in London, and Hurricane Katrina, have heightened the visibility of the issue. Although emergency care is a vital component of the nation's health system, to date there has been no comprehensive study of emergency care in the United States.

A study of the emergency care system is a logical extension of previous work conducted by the National Academy of Sciences and the Institute of Medicine (IOM). In 1966, the National Academies of Sciences (NAS) and the National Research Council (NRC) produced the landmark report *Accidental Death and Disability: The Neglected Disease of Modern Society* (NAS/NRC,

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1966), which helped focus attention on the lack of adequate trauma care in the United States and is widely recognized as the impetus for the development of the prehospital EMS system in place today. Other reports, such as *Emergency Medical Services at Midpassage* and *The Emergency Department: A Regional Medical Resource* (NAS/NRC, 1978), have also had a major impact in shaping the development of the emergency care system. More recently, several IOM studies on injury and disability have emphasized the need for skilled emergency care to limit the adverse consequences of illness and injury. Additionally, in 1993 the IOM produced the report *Emergency Medical Services for Children* (IOM, 1993), which focused a great deal of attention on the subject.

The emergency care system has reached a critical point in its development. The specialty of emergency medicine has achieved a substantial level of maturity; the capabilities of EMS have expanded dramatically; trauma systems in a few states are beginning to attain full development; technology offers the potential to revolutionize emergency care services; and the events of September 11, 2001, and subsequent disasters have lent new public visibility and urgency to emergency care planning. In contrast to these advances, the organization and delivery, regulation, and financing of emergency care remain in an outdated, politically entrenched mode that is resistant to change. As emergency care providers become increasingly stressed, timely access to quality emergency care is jeopardized for everyone.

Overview of Pediatric Emergency Care

Nearly 30 percent of all ED visits are made by children (see Figure 1-1). While the majority of pediatric ED visits involve children over age 5, there are 96.2 ED visits per 100 infants, more than twice the rate for all children under age 15 of 40.8 ED visits per 100 (see Figure 2-2 in Chapter 2) (McCaig and Burt, 2005). The most frequent diagnoses for young children (under age 10) in the ED are upper respiratory infection and otitis media (ear infection). Among older children (ages 10–17), the most common diagnoses are superficial injury/contusion and sprains and strains (2002 SEDD data supplied by AHRQ staff). Only 4 percent of all pediatric ED visits result in a hospital admission (2002 NHAMCS data, calculations by IOM staff; 2002 SEDD data supplied by AHRQ staff). Just 1 percent of children who visit the ED are transferred to another hospital (2002 NHAMCS data, calculations by IOM staff), presumably a higher-level facility.

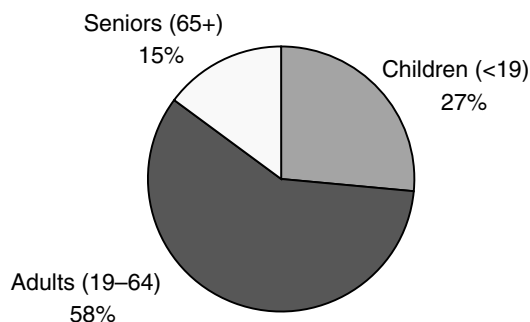


FIGURE 1-1 ED visits by age, 2002.

SOURCE: 2002 NHAMCS data, calculations by IOM staff

Children's hospitals are an important source of pediatric emergency care. They are the most specialized centers of care for children in the United States, and because they are focused solely on the care of children, they are the hospitals that tend to be best prepared for emergency pediatric visits in terms of expertise and pediatric resources (Gausche-Hill et al., 2004). However, children's hospitals represent only about 5 percent of all U.S. hospitals (NACHRI, 2005). According to one estimate, only 7 percent of ED visits made by children are to a children's hospital (Gausche-Hill et al., 2004). Some non-children's hospitals have a separate pediatric ED. Like children's hospitals, these hospitals tend to be better prepared for pediatric emergency visits in terms of pediatric expertise, equipment, and policies and procedures (Gausche-Hill et al., 2004). Taken together, it is estimated that only 18 percent of all pediatric visits are to pediatric EDs at either a children's or a general hospital (2002 NHAMCS data, calculations by IOM staff).

Thus, the vast majority of pediatric ED visits are made to general hospitals that treat adults and children in the same department. The quality of emergency care provided to children at these EDs is of concern because, as noted, they tend to be less well prepared for pediatric emergencies than dedicated pediatric EDs. While data on outcomes by facility type are largely unavailable, studies indicate that pediatric trauma patients treated at children's hospitals have lower mortality rates, lengths of stay, and charges than those treated at adult hospitals (Densmore et al., 2006). EDs that treat both children and adults are unlikely to have a pediatric emergency medicine physician on staff, and many lack basic pediatric equipment and supplies (Gausche-Hill et al., 2004; Middleton and Burt, 2006). Even more concerning, between 19 and 26 percent of all pediatric ED visits are to hospitals in rural and remote areas (Gausche-Hill et al., 2004; 2002 NHAMCS data, calculations by IOM staff). Many of those hospitals lack around-the-clock physician coverage, have relatively few pediatric visits, and lack a separate pediatric inpatient ward. Having a low volume of pediatric patients, lacking a separate pediatric ward, and being located in a rural area are hospital characteristics independently associated with lower levels of preparedness for pediatric ED patients (Gausche-Hill et al., 2004; Middleton and Burt, 2006).

While children make nearly 30 percent of all ED visits, their use of prehospital services is relatively limited (see Figure 1-2); in fact, children represent only 5–10 percent of all EMS calls (Seidel et al., 1984; Federiuk et al., 1993). The low proportion of pediatric EMS volume represents a challenge because it is difficult for EMTs to maintain pediatric skills when they encounter critically ill or injured pediatric patients so infrequently. In contrast to the situation with adults, about half of prehospital calls for children are for injuries, the other half for medical problems (Seidel et al., 1991). Similar to ED visits, medical complaints are more common in children under 5, while older children are more likely to be transported for injuries (Sapien et al., 1999). While the majority of pediatric EMS transports are appropriate (Foltin et al., 1998), many are medically unnecessary (Camasso-Richardson et al., 1997; Kost and Arruda, 1999; Hamilton et al., 2003).

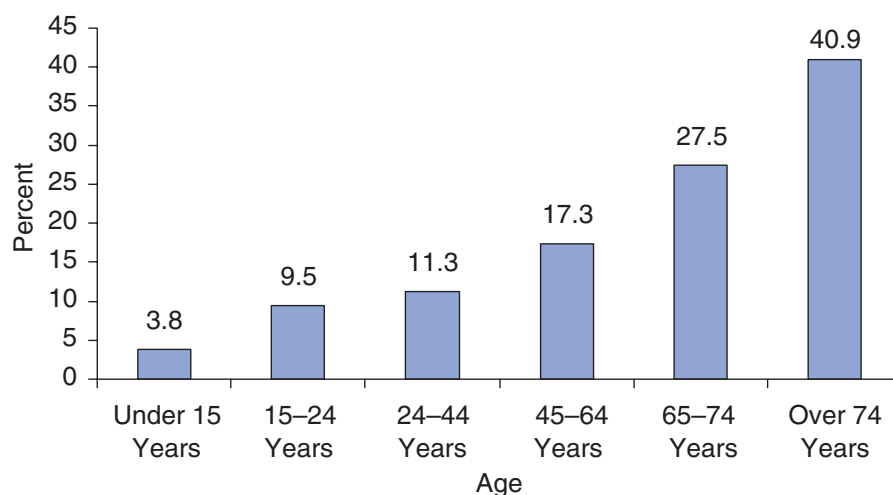


FIGURE 1-2 Percentage of patients that arrive at the emergency department by ambulance.
SOURCE: McCaig, 2005.

NEED FOR A SEPARATE REPORT ON PEDIATRIC EMERGENCY CARE

The statement “children are not little adults” is often used to convey the fact that children have unique medical needs relative to adults. In fact, the anatomical, physiological, developmental, and emotional attributes of children impact not only their susceptibility to illness and injury, but also the ways in which providers need to assess and treat them (see Table 1-1). Caring for sick and injured children requires that providers have specialized training and skills, as well as access to specialized equipment and supplies. However, the initial development of the nation’s emergency system largely overlooked the unique needs of children. The system was originally directed by physicians trained in adult medical specialties, many of whom had little experience with pediatric patients and the unique features of pediatric care. As a result, pediatric emergency care did not advance as quickly as adult emergency care, and performance and outcomes for children trailed those for adults (Seidel et al., 1984; Mishark et al., 1992; Boswell et al., 1995; Doran et al., 1995).

TABLE 1-1 Examples of Differences between Children and Adults and Implications for Care

	Pediatric Characteristic	Implications for Illness and Injury	Implications for Care
Anatomical Differences	Greater body to surface area to body mass ratio.	Greater risk of excessive loss of heat and fluids; children are affected by more quickly and easily toxins that are absorbed through the skin.	Increased body surface area makes children more susceptible to greater heat loss when they are exposed during resuscitation; the higher percentage of body surface area devoted to the head relative to the lower extremities must be taken into account when determining the percentage of body surface area involved in burn injuries.
	Smaller airways; tongue is large relative to the oropharynx; larynx is higher and more anterior in the neck; vocal cords are at a more antero-caudal angle; epiglottis is soft and shaped differently from that in adults.	A right main stem intubation can lead to iatrogenic complications; more susceptible to respiratory distress due to airway swelling from infection or inflammation.	Special equipment and training are needed for intubation; appropriately sized endotracheal intubation tubes, stylettes, and laryngoscope blades are necessary. A child's airway is more difficult to maintain and intubate. Children are at higher risk for a right mainstem bronchus intubation.
	Less protective muscle around internal organs.	Internal organs are more susceptible to traumatic forces.	Recognition of internal injury requires a high degree of suspicion, and such injury should not be ruled out based on the absence of external signs of trauma.

	Pediatric Characteristic	Implications for Illness and Injury	Implications for Care
	Small size.	More vulnerable to exposure and toxicity from agents that are heavier than air, such as sarin gas and chlorine, and that accumulate closer to the ground.	
	Less fat, less elastic connective tissue, and closer proximity of chest and abdominal organs.	Higher frequency of multiple organ injury.	
	Head is proportionally larger and heavier in children.	Head injury is common in young children.	Head size also makes children more susceptible to greater heat loss when they are exposed during resuscitation.
	More pliable skeleton; thoracic cage of a child does not provide as much protection of organs as that of adults.	More susceptible to fracture and other injuries from blunt trauma.	Orthopedic injuries with subtle symptoms are easily missed; hepatic or splenic injuries can go unrecognized and produce significant blood loss, leading to shock.
Physiological Differences	Respiratory and heart rates vary with age.	More susceptible to air pollutants.	Knowledge of normal and abnormal rates based on age is required; normal vital signs differ for children and adults. An increased heart rate is often the first sign of shock in a pediatric patient, versus blood pressure in an adult. Children maintain heart rate during the early phases of hypovolemic shock, creating a false impression of normalcy.

	Pediatric Characteristic	Implications for Illness and Injury	Implications for Care
	Higher metabolic rates.	More susceptible to contaminants in food or water; greater risk for increased loss of water and when ill or stressed.	Medication doses must be carefully calculated based on the child's weight and body size.
	Lower blood pressure levels than adults; levels vary with age.	Indicators of serious illness may not appear until the child is near collapse.	Vital signs are less reliable indicators of serious illness than in adults. Respiratory arrest is more common than cardiac arrest; cardiopulmonary arrest is signaled by respiratory arrest or shock, rather than by cardiac arrhythmias.
	Immature immunological systems.	Greater risk of infection; less herd immunity from infections such as smallpox.	
Developmental Differences	Communication barriers may exist in all pediatric age groups, but the nature of the barrier varies by age (i.e., infants and young children cannot articulate symptoms).		Assessment tools need to be tailored to reflect age-appropriate responses.
Emotional Differences	Greater, varying emotional needs based on developmental level.		Need for family-centered policies and a family-friendly environment in EDs. Depending on age, children require or prefer the presence of a parent during treatment.
	Higher sensitivity to environmental factors during treatment.	Age and developmental level of child, characteristics of event, and parental reactions play significant role in determining the child's reactions and recovery.	Providers must manage the mental health needs of pediatric patients and parents' reactions.

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The committee's vision for the future, outlined in Chapter 3 of this report, is that of a fully integrated emergency care system that appropriately meets the needs of both adult and pediatric patients. Under this system, pediatric concerns would be included in all aspects of emergency care planning, research, and evaluation. The committee's hope is that a separate report outlining basic shortcomings in the emergency care system's ability to meet the needs of pediatric patients will not be necessary in the future. Today, however, the key shortcomings reviewed below stand as impediments to the future system envisioned by the committee, and must be acknowledged and addressed if that vision is to be realized.

System Planning

No organization or individual is responsible for overseeing the operation or ensuring the quality of the nation's emergency care system. At the federal and state levels, the current system is largely fragmented and uncoordinated. This fragmentation is a particularly critical problem for pediatric emergency care because EMS agencies and hospitals tend to vary in capability, commitment, and training standards for pediatric emergency care. In many states, hospitals are not categorized according to their ability to care for critically ill and injured children. In the absence of such categorization, it is difficult for EMTs, much less parents, to identify which hospitals are most appropriate for a critically ill or injured child. Another example of the lack of planning is the absence of transfer agreements between hospitals (Middleton and Burt, 2006).

Provider Training

Table 1-1 shows some examples of the specialized pediatric knowledge required of emergency care providers when they encounter a sick or injured child. Emergency providers who lack pediatric training, experience, and treatment protocols may find it difficult to distinguish a critically ill or injured child from other children with less serious conditions. They may also have difficulty determining the proper course of treatment or deciding whether a higher level of care is needed. It is not surprising that emergency providers generally feel more stress and anxiety caring for pediatric patients than for adults (Federiuk et al., 1993; Glaeser et al., 2000; Frush and Hohenhaus, 2004). Despite its importance, many emergency physicians have little formal training in pediatric emergency medicine (Moorhead et al., 2002). Additionally, studies have shown that knowledge and skills gained through education and training deteriorate fairly quickly if not practiced and reinforced regularly. Yet continuing education requirements in pediatrics for EMTs vary from community to community and do not exist in many areas (Glaeser et al., 2000).

Disaster Preparedness

Children suffer disproportionately in the event of a disaster. For example, they are more vulnerable to a biological or chemical attack because they take more breaths per minute, and their breathing zone is closer to the ground. They also have thinner skin, which provides less protection and allows greater absorption of chemicals (American Academy of Pediatrics, 2002). Moreover, some antidotes available for the treatment of adults in the event of such an attack are not currently available for children (Markenson, 2005). Children are often more vulnerable to biological agents, as well as naturally occurring diseases, that produce vomiting and/or diarrhea because they have less fluid reserve than adults and can become dehydrated more rapidly (Illinois Emergency Medical Services for Children, 2005). If children sustain burns, they have a greater likelihood of life-threatening fluid loss and susceptibility to infection (Shannon, 2004). If

they sustain injuries that cause massive blood loss, they develop irreversible shock more quickly (American Academy of Pediatrics, 2002). Additionally, children are dependent on adults for everyday care; in the event that they are separated from their caregiver in a disaster, they lose their support system.

As noted above, initial efforts at disaster planning did not incorporate the needs of children. Even today, many states do not address pediatric issues in their disaster plans (National Association of State EMS Directors, 2004), and disaster drills frequently lack a realistic pediatric component (Mace and Bern, 2004; Dick et al., 2004; Maniece-Harrison, 2005). As a result, most communities are not as prepared as they should be for pediatric care in the event of a disaster. Additionally, local disaster plans often fail to address specific pediatric needs in the event of mass decontamination, sheltering, or evacuation.

Research Base

Pediatric emergency care is a relatively young field, so its research base is limited. Some significant advances have occurred in the research infrastructure in the field, including the development of a Pediatric Emergency Care Research Network (PECARN) and two national databases (National Hospital Ambulatory Medical Care Survey and Healthcare Cost and Utilization Project) that allow for analyses of pediatric emergency care in the ED. Nonetheless, many of the triage methods, treatment patterns, and prevention initiatives used for pediatric populations in the EMS and ED environments are not supported by scientific evidence. Additionally, little is known about patient outcomes and system performance. In the case of prehospital care, the knowledge gap is even greater. Some of the most basic questions, including how many children are served by the EMS system and what services are provided to pediatric patients, remain unanswered.

Quality of Care

Haste, uncertainty, and interruptions abound in the EMS and ED environments, increasing the risk of errors and adverse events for patients of all ages. Delivering care to children presents added challenges to quality care delivery: some children are preverbal and cannot self-report their symptoms; many children have multiple caregivers, which increases the likelihood that emergency care providers will be given an incomplete, inaccurate, or conflicting medical and medication history; and children are likely to be accompanied by parents suffering from great anxiety, which requires staff to attend to the parents while also staying focused on the needs of the child (Chamberlain et al., 2004).

Providing high-quality emergency care services to children requires an infrastructure designed to support care to pediatric patients. However, many of the advances made in emergency care have not been appropriate or well designed for pediatric emergency care. For example, studies to determine the safety and efficacy of emergency care medications for children are rarely conducted; thus, as noted above, medication is often prescribed to children off label (Rapkin, 1999). New medical technologies often are not designed with children in mind, but nevertheless are used on pediatric patients, sometimes with unintended consequences. One example is the infusion pump, which delivers medications and fluids intravenously; the original design of the pumps contributed to pediatric dosing errors (Reves, 2003). Information systems and provider decision-support systems that lack pediatric dosing information or those that prohibit providers from entering data on a scale small enough for children are of little benefit to pediatric patients. Additionally, despite the clear evidence on the effectiveness of family-

centered care, an approach to health care delivery that promotes the inclusion of family members in the child's care, many EMS agencies and EDs lack policies that support and implement such approaches to care in emergency settings (Loyacono, 2001; MacLean et al., 2003).

STUDY OBJECTIVES AND FRAMEWORK

The IOM's study of the future of emergency care in the U.S. health system was initiated in September 2003. Support for the study was provided by the Josiah Macy, Jr. Foundation, the National Highway Traffic Safety Administration (NHTSA), the U.S. Department of Health and Human Services' (DHHS) Agency for Healthcare Research and Quality (AHRQ), the Centers for Disease Control and Prevention (CDC), and the Health Resources and Services Administration (HRSA). The study was designed to build on previous work in the field by bringing together all of the key components of emergency care—prehospital EMS, hospital-based emergency care, trauma care, and injury prevention and control. The committee was charged with assessing the current emergency care system, identifying its strengths and weaknesses, creating a vision for the future system, and making policy recommendations for achieving that vision.

The committee was structured to balance the desire for a highly integrated systems approach to the study with an interest in focusing attention on pediatric, EMS, and hospital-based emergency care issues. The result was a main committee and three subcommittees representing those three focus areas (see Figure 1-3).

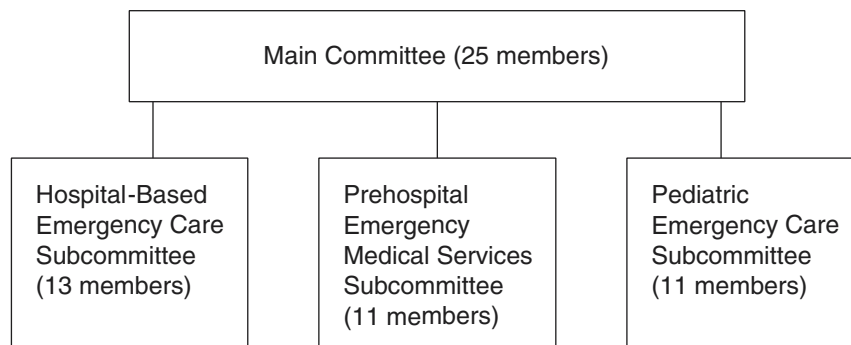


FIGURE 1-3 Committee structure.

The main committee guided the overall study process. The three subcommittees examined the unique challenges associated with the provision of emergency services to children; issues related to prehospital EMS; and issues related to hospital-based emergency and trauma care. The change to the pediatric subcommittee is shown in Box 1-1. The membership of the main committee and subcommittees overlapped—the 11-member pediatric subcommittee, for example, included 5 members from the main committee. Subcommittees met both separately—reporting their discussions and findings to the main committee—and in combined session with the main committee. Altogether, 40 individuals served on one or more of the four committees.¹ See Appendices A and B for a figure listing all committee and subcommittee members as well as biographical information for members of the main committee and subcommittee on pediatric

¹ One committee member, Henri R. Manasse, Jr., resigned from the original 41-member body during the course of the study.

emergency care. Three reports, one on each of the three subject areas, were developed. This report represents the committee's findings with regard to pediatric emergency care. A full list of the recommendations from the Future of Emergency Care series of reports appears in Appendix C.

A total of 17 main and subcommittee meetings were held between February 2004 and October 2005. The committee commissioned 11 technical papers (see Appendix D) and heard testimony from a wide range of experts (see Appendix E). Staff and committee members met with a variety of stakeholders and interested individuals, conducted site visits, and participated in public meetings sponsored by stakeholder groups and the study sponsors.

BOX 1-1 Subcommittee on Pediatric Emergency Care Services: Statement of Task

The objectives of this study are to: (1) examine the emergency care system in the U.S.; (2) explore its strengths, limitations, and future challenges; (3) describe a desired vision of the emergency care system; and (4) recommend strategies required to achieve that vision. In this context, the Subcommittee on Pediatric Emergency Care Services will examine the unique challenges associated with the provision of emergency services to children and families, and evaluate progress since the publication of *Emergency Medical Services for Children* (IOM, 1993). The subcommittee will consider:

- the role of pediatric emergency services as an integrated component of the overall health system;
- system-wide pediatric emergency care planning, preparedness, coordination, and funding;
- embedded pediatric training in professional education; and
- health services and clinical research.

KEY TERMS AND DEFINITIONS

To ensure clarity and consistency, the following terminology is used throughout this study's three reports. *Emergency medical services*, or *EMS*, denotes prehospital emergency medical services, such 9-1-1 and dispatch, emergency medical response, field triage and stabilization, and transport by ambulance or helicopter to a hospital or between facilities. *EMS system* refers to the organized delivery system for EMS within a specified geographic area—local, regional, state, or national—as indicated by the context.

Emergency care is broader than *EMS*, and encompasses the services involved in emergency medical care, including EMS, hospital-based ED and trauma care, and on-call specialty care. *Emergency care system* refers to the organized delivery system for emergency care within a specified geographic area. It is important to note that the committee's definitions of emergency care and emergency care systems may be narrower than other definitions, such as those used by the federal Emergency Medical Services for Children (EMS-C) program, which also encompass injury prevention and rehabilitation services.

Trauma care is the care received by a victim of trauma in any setting, while a *trauma center* is a hospital specifically designated to provide trauma care; some trauma care is provided in settings other than a trauma center. *Trauma system* refers to the organized delivery system for

trauma care at the local, regional, state, or national level. Trauma care is an essential part of emergency care.

The term *pediatric emergency medical services* denotes prehospital care for children, while *pediatric emergency care* refers to the full continuum of services involved in emergency medical care for children. Note that the term *emergency medical services for children* is used only in reference to the EMS-C program.

From a development perspective, there is no precise age at which childhood ends and adulthood begins. EMS agencies and hospitals use different age ranges to define pediatric patients. For the purposes of this report, however, a *child* is someone aged 18 or younger, while an *infant* is a child who is under age 1.

ORGANIZATION OF THE REPORT

This report presents the committee's findings and recommendations regarding pediatric emergency care.

Chapter 2 provides a brief history of the development of pediatric emergency care, as well as a look at the state of emergency care for children in 2006. The chapter examines some of the threats to children's health, as well as children's use of emergency care services. It also looks at the quality of those services and some of the funding challenges associated with delivering pediatric emergency care.

Chapter 3 sets forth the committee's vision for the emergency care system of the future, which encompasses three goals: improving the coordination of emergency care, expanding regionalization of emergency care services, and introducing accountability into the system. The chapter also offers a number of recommendations for achieving this vision.

Chapter 4 examines workforce issues. It describes the training that emergency care workers receive in pediatric emergency care and notes deficiencies. The importance of skill maintenance is emphasized since, as noted above, many emergency providers encounter critically ill or injured children infrequently.

Chapter 5 reviews the threats to pediatric patient safety in the prehospital and ED environments and the resources needed to address some of those threats. The chapter also describes new initiatives in pediatric emergency care, such as the promotion of family-centered approaches and the development of information technologies and medical devices designed with the needs of children in mind.

Chapter 6 addresses a particularly timely topic—the special needs of children in the event of a disaster. The discussion includes a look at children's medical and nonmedical needs after a major disaster, such as Hurricane Katrina, and suggests areas in which federal agencies and regional authorities could direct their attention to meet those needs.

Finally, Chapter 7 focuses on research needs in pediatric emergency care. It discusses the progress the field has made to increase its research base and the steps that should be taken to expand that base.

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2

History and Current State of Pediatric Emergency Care

Before laying out a vision for emergency care in the future, it is important to understand the system that exists today and how we got here. This chapter describes the development and current state of the emergency care system with respect to children.

The first part of the chapter provides a historical overview of pediatric emergency care. The field is surprisingly young and has trailed the development of the broader emergency care system by a decade or two. In the retrospective, we give focused attention to two important topics: (1) the creation, activities, and achievements of the Emergency Medical Services for Children Program, a federal program that aims to ensure essential emergency medical care for ill or injured children and adolescents and (2) the 1993 IOM report *Emergency Medical Services for Children*, which represented the first comprehensive look at the need for and effectiveness of pediatric emergency care services in the U.S. An understanding of the development of pediatric emergency care provides a sense of progress as well as greater insight into the system's resources, challenges, successes, and failures. In fact, many of the challenges facing the system today are the same ones that existed over a decade ago.

The second part of the chapter focuses on pediatric emergency care in 2006. We begin with an overview of illness and injury in children using the most recent national data available. We then discuss trends in emergency care use by children. The chapter continues with an assessment of how well the emergency care system works today. We conclude that while considerable progress has been made over the past two decades, the system falls short of consistently providing quality emergency care to children. Continued efforts are needed to address deficiencies. Finally, the chapter concludes with a look at financing of pediatric emergency care services. There are a number of issues surrounding reimbursement for pediatric services and/or reimbursement at children's hospitals that have become a growing problem for some providers.

DEVELOPMENT OF EMERGENCY CARE FOR CHILDREN

1940s–1960s: The Beginning of the Modern Emergency Care System

The modern emergency room developed at a time when the specialization of medical practice swept the nation after World War II. As the number of house calls from general physicians declined, patients increasingly turned to the local hospital for treatment. This was reinforced by the development of private insurance plans which geared payments toward hospitals and away from home visits (Rosen, 1995). The development of the emergency room also reflects the passage of the Hill-Burton Act of 1946, which provided states with federal grants to build hospitals, provided that the states met a variety of conditions including a community service obligation. Among other things, the community service obligation requires hospitals that received the federal funding to maintain an emergency room. This requirement applies to the vast majority of nonprofit US hospitals in operation today (Rosenblatt et al., 2001).

Emergency care as a field advanced due to several forces that drew attention to emergency care in the 1950s and 1960s. One was the new knowledge about the value of prompt prehospital

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treatment and transport derived from military experience in Korea. During that conflict, technical innovations, such as the creation of battalion aid stations and rapid transport by helicopter to mobile field hospitals were introduced and resulted in dramatically improved survival rates for battle-wounded soldiers. Experience from Vietnam led to advances in trauma care. Surgeons returning to the U.S. from the Korea and Vietnam recognized that the Army's developed systems of triage, transport, and field surgery could surpass anything available to civilians in the U.S. (Rosen, 1995). They believed that similar innovations could and should be applied to civilian care. Around the same time, advancements in cardiac care, such as the creation of "mobile coronary care units" improved the survival rate of patients prior to reaching the hospital (Pantridge and Geddes, 1967).

Another major turning point was the publication of the landmark NAS/NRC report, *Accidental Death and Disability: The Neglected Disease of Modern Society* in 1966. The report described the epidemic of injuries and deaths from automobile crashes and other causes in the U.S. and lamented the deplorable system for treating those injuries nationwide. In 1966, prehospital and hospital services were largely inadequate or nonexistent. Although at the time, a few communities provided ambulance services through their fire or police departments, it is estimated that morticians provided about half of such services. No specific training was required for ambulance attendants. Most emergency rooms could offer only advanced first aid and only a few hospitals appeared to have the infrastructure to provide complete care for the critically ill and injured.

The 1970s: Rapid Development of EMS Systems

The NAS/NRC report stimulated a flood of public and private initiatives to enhance highway safety and improve the medical response to accidental injury, including the development of the national trauma system, the creation of the specialty of emergency medicine, and the establishment of federal programs to enhance the nation's emergency care infrastructure and research base. Perhaps the most significant was the passage of the Emergency Medical Services Systems (EMSS) Act of 1973 (P.L. 93-154), which created a categorical grant program that led to the nationwide development of about 300 regional EMS systems (IOM, 1993). Despite these achievements, the need to treat pediatric emergencies in a unique way was not fully appreciated at that time. The EMSS Act led to the development of systems that were primarily focused on adult trauma and adult cardiac care while specialized pediatric needs received limited attention. At the time, only limited expertise in pediatric emergency medicine existed (Foltin and Fuchs, 1991).

However, some initial efforts were made in certain geographical areas to incorporate the needs of children into emergency medicine and EMS systems in the 1970s. Dedicated pediatric emergency departments began to develop, staffed by pediatricians who were willing to devote their full attention to emergency care. Also, some hospitals established pediatric intensive care units (PICUs) and began conducting research activities on pediatric emergency care. In 1975, Maryland established a regional pediatric trauma center, one of the first in the country. Physicians in Los Angeles along with local professional societies and the county EMS agency developed a pediatric-focused training curriculum for paramedics and management guidelines for pediatric emergency care (IOM, 1993). The level of sophistication of emergency rooms generally improved during this time, and the term shifted from "emergency room" to "emergency department" as emergency services became a full department within hospitals.

The 1980s: Pediatric Emergency Care in its Infancy

The budding EMS system hit a setback in 1981 when Congress passed legislation that indirectly resulted in a sharp loss of funding for state EMS activities. Whereas previously, categorical federal funding was dedicated to EMS, this was replaced by the Preventive Health and Health Services Block Grant program, which essentially shifted responsibility for EMS from the federal to the state level. Because the states were given greater discretion regarding the use of funds, and EMS was a relative newcomer without a significant political constituency, most states chose to spend the money in other areas of need. The immediate impact of the shift to block grants was a considerable reduction in total funding allocated for EMS (Office of Technology Assessment, 1989).

Conversely, attention to pediatric emergency care grew dramatically throughout the 1980s as initial data on pediatric emergency care became available. For example, studies indicated that children represented about 10 percent of all ambulance runs (Seidel et al., 1984), young children were likely to suffer from respiratory distress whereas older children were likely to need trauma care (Fifield et al., 1984), and that up to half of pediatric trauma deaths might be preventable (Ramenofsky et al., 1984). Studies also indicated that children's outcomes, given the same severity of injury, tended to be worse than those of adults (Seidel et al., 1984; Seidel, 1986). For example, a study of 88 general acute care hospitals in Los Angeles County found nearly twice as many deaths among children with serious traumatic injuries than among adults with similar injuries (Seidel et al., 1984). Most of the deaths occurred in areas lacking pediatric tertiary care centers. The studies also revealed that prehospital personnel generally had little training in pediatric care. Also, most lacked the appropriate equipment needed to treat children (Seidel, 1986).

Findings from these early studies led to a recognition of the need to address pediatric emergency care and that there is a distinct body of knowledge that should be applied to pediatric emergency care. This recognition stimulated action on several fronts. First, there were advancements in resources for care. In the 1980s, several cities designated pediatric trauma centers. Advocates for pediatric emergency care in Los Angeles developed a new, two-tiered approach for organizing pediatric emergency care. Under the system, seriously ill or injured children would be treated only at hospitals that were certified as having met a certain set of requirements and capabilities for pediatric care. Perhaps the most significant development for pediatric emergency care was the establishment in 1984 of the federal Emergency Medical Services for Children Program (EMS-C), a grant program that assists states in addressing pediatric deficiencies within their emergency care systems. The first federal funding for EMS-C was made available in 1985 and later authorizations continued to increase program funding. That program is discussed in more detail later in the chapter.

Second, there were also advancements in resources for information. In the early 1980s, the U.S. Department of Education, through the National Institute of Disability and Rehabilitation Research, funded the development of the National Pediatric Trauma Registry. The registry enabled researchers to identify the demographics of pediatric trauma. Data from the registry revealed that automobile crashes were the primary source of pediatric trauma, injuries were most often blunt, and that a child stood a 3 percent chance of dying. Data from the registry was also used to develop the Pediatric Trauma Score, which was a system used to help EMTs determine which institution an injured child should be transported (Harris, 1987).

Third, professional societies also began to give greater attention to pediatric emergency care. In the late 1970s, pediatricians who worked in the emergency departments began to discuss

issues in pediatric emergency care, which led to a section on pediatric emergency medicine within the American Academy of Pediatrics (AAP) in 1981 (Pena and Snyder, 1995; AAP, 2000). The American College of Emergency Physicians (ACEP) held an interspecialty conference on childhood emergencies in 1983 that led to the establishment of a joint AAP/ACEP Task Force on Pediatric Emergency Medicine the following year (AAP, 2000). ACEP also formed a member section on pediatric emergency medicine in 1998 (Pena and Snyder, 1995). In 1985, a Provisional Committee on Pediatric Emergency Medicine was created at the AAP; it became a full Committee in 1998 (AAP, 2000). Both the Emergency Nurses Association (ENA) and the National Association of EMS Physicians (NAEMSP) established pediatric sections by the end of the 1980s (IOM, 1993).

Fourth, there were important advances in pediatric emergency medicine. By the early 1980s, there was a recognition among many physicians that the emergency care for children was not as well advanced as adult emergency care and that specialized resources for the training of providers in pediatric emergency care were needed. The longest-running pediatric emergency medicine fellowship was established in 1980 (Pena and Snyder, 1995; Macias, 2005). Early experts in the field began to synthesize knowledge in this area and make it more widely available. The first pediatric emergency care textbook was published in 1983 and the first pediatric emergency care journal began in 1985.

A number of training courses were developed. In 1988, the American Heart Association and the AAP launched the Pediatric Advanced Life Support (PALS) course. The AAP and ACEP joint task force developed and sponsored the Advanced Pediatric Life Support (APLS) manual, published in 1989. Some courses were also developed locally. An example is the Pediatric Emergency Medical Services Training Program (PEMSTP) at Children's National Medical Center in Washington, DC, which prepared EMT instructors to teach pediatric aspects of emergency care. Progress continued in the early 1990's when the Emergency Nurses Association developed standardized training for emergency nurses with their The Emergency Nursing Pediatric Course (ENPC). All of these efforts helped develop an emergency care workforce with enhanced pediatric skills.

And finally, injury prevention efforts, which gained momentum in the 1970s, expanded greatly in the 1980s. The Poison Prevention Packaging Act of 1970 required manufacturers of toxic, corrosive or irritative substances to use child-resistant closures (Harborview Injury Prevention and Research Center, Accessed 2006). The first state law requiring use of child safety seats was enacted by Tennessee in 1978; however, by 1985, all states passed legislation requiring the use of child safety seats (Traffic Safety Center, 2002). Additionally, state and local laws were passed to establish requirements for the installation of smoke detectors, window guards, and pool fencing. Concern about prevention of injury and illness was reflected in the publication of national health promotion and disease prevention goals, first published in 1980, then updated in 1990 and 2000. The 1985 IOM report, *Injury in America*, highlighted the heavy toll of injuries and called for more research in prevention and improved care. Much as the NAS/NRC report, *Accidental Death and Disability* led to the passage of the Emergency Medical Services System (EMSS) Act of 1973, *Injury in America* led to the creation of an injury prevention program at the Centers for Disease Control and Prevention, which later became the CDC's National Center for Injury Prevention and Control (IOM, 1993).

As parents changed the sleep position of infants, the incidence of SIDS and pediatric cardiac arrest has declined (AAP, 1992; Willinger, 1995). Injury prevention efforts, such as the poison prevention packaging law, bicycle helmet requirements, child passenger restraint requirements,

smoke detector promotion programs and drowning prevention programs are beginning to decrease injury morbidity and mortality in children (Clarke and Walton, 1979; Rivara et al., 1997; Stenklyft, 1999; Haddix et al., 2001; Macpherson and MacArthur, 2002; Mittelstaedt and Simon, 2004). Many of these prevention efforts were spearheaded by programs like the National Safe Kids Campaign, which was founded in 1987.

In addition to injury, prevention efforts were also targeted at reducing pediatric illness. For example, in 1980, Starko and colleagues produced a study indicating that the use of aspirin may be associated with the onset of Reye's syndrome (Starko et al., 1980). Reye's syndrome is a deadly disease most common in children that affects all organs of the body and occurs after a viral infection, such as the flu or chickenpox (National Institute of Neurological Disorders and Stroke, 2006). As parents learned of the link between aspirin and Reye's syndrome, there was a decline in the use of children's aspirin as well as the number of Reye's syndrome cases reported to the Centers for Disease Control and Prevention (Arrowsmith et al., 1987; Belay et al., 1999).

Prevention efforts have successfully changed the scope of pediatric illness seen in the ED. For example, the *Hemophilus influenzae* (Hib) vaccine, introduced in 1990, has almost eliminated epiglottitis in children and markedly decreased the incidence of meningitis, sepsis, and septic shock (Subedar and Rathore, 1995; Stenklyft, 1999). The introduction of the PCV7 vaccine reduced the number of invasive pneumococcal infections among children (Kaplan et al., 2004).

The 1990s: Birth of a New Subspecialty

The number of pediatric emergency medicine fellowships began to rise, though most were developed at children's hospitals under the leadership of pediatricians. In the late 1980s, representatives from the American Board of Emergency Medicine (ABEM) and the American Board of Pediatrics collaborated to make sure that the fellowships were accessible to both pediatricians and emergency medicine physicians. Together, they submitted a proposal to the American Board of Medical Specialties for pediatric emergency care to be a recognized subspecialty (Pena and Snyder, 1995). The proposal was approved, and in 1992, the first subspecialty certifying exam in pediatric emergency medicine was administered (Stenklyft, 1999). In 1998, pediatric emergency medicine fellowships became accredited. Most fellowship programs are now three years in duration and involve a research component (Stenklyft, 1999). By 1999, the nation had approximately 1000 board certified subspecialists in pediatric emergency medicine.

In 1993, the IOM released findings from its comprehensive study on the need for and effectiveness of pediatric emergency care. Despite the advances in pediatric emergency care that occurred through the 1980s and early 1990s, the study identified gaps in several major areas including education and training, appropriate equipment and supplies, communications, funding, and planning, evaluation and research. In response to these findings, the MCHB and the NHTSA published a 5-year plan for pediatric emergency care in 1995. That plan was revised and updated in 2000.

Additionally, ACEP and AAP published recommended equipment guidelines for prehospital units and emergency departments (Guidelines for Pediatric Equipment, 1996; AAP, 2001).

Pediatric Emergency Care in 2006

If there is one word to describe pediatric emergency care in 2006 it is uneven. As mentioned in Chapter 1, the specialized resources available to treat seriously ill or injured children vary

greatly based on location. Some children have access to children's hospitals and hospitals with separate pediatric inpatient capabilities, which tend to be well-prepared for pediatric emergencies; other children must rely on hospitals with limited pediatric medical expertise and equipment (Middleton and Burt, 2006). State requirements for pediatric continuing training for EMTs vary greatly across states. Some states and communities have organized trauma systems and designated pediatric facilities while others do not. As a result, not all children have access to the same quality care. While data on system performance is not routinely collected, it appears that where a child lives has an important impact on whether a child can survive a serious illness or injury.

The day-to-day presentation of pediatric patients is challenging enough for emergency care systems in some areas. Addressing new and emerging threats to children's health may be beyond the abilities of the current system. Experience has shown that the outbreak and management of contagious diseases, such as new strains of influenza and SARS can have a major disruption on the emergency care system (Augustine et al., 2004). The effect of these new health threats on children is not well understood yet. Several case studies on SARS have been published but most of the clinical, laboratory, and radiologic information available is drawn from adult patients (Bitnun et al., 2003). Some case studies suggest that, while children are susceptible to SARS, symptoms may be more mild in young children as compared to adolescents and adults (Leung et al., 2004; Fong et al., 2004). However, these studies are based only on a very small sample. The efficacy of pediatric treatment for SARS requires additional evaluation; indeed, no pediatric treatment regime for SARS currently exists (Leung et al., 2004).

The avian flu is another example of an emerging threat, one that could put children at particular risk. Children may be more susceptible due to their increased proximity to one another when socializing at schools and day care centers. They may also be more likely to come into contact with poultry or bird fecal matter while playing. It is unknown whether immunity differences in children have any significance, since it is presumed that the vast majority of humans have no immunity against the H5N1 virus (U.S. Department of State, 2006).

Development of Pediatric Trauma Care

Trauma represents a particular kind of pediatric medical emergency. It is typically defined as having a physical wound caused by force or impact, such as a fall or automobile accident. Burns and other severe wounds are also considered a form of trauma. Other life threatening medical conditions caused by pre-existing conditions are generally not considered trauma. Trauma care is distinguished from care received in a general emergency department by the specialized diagnostic and treatment procedures necessary to care for the traumatically injured child. Ideally, traumatically injured patients are cared for in a pediatric trauma center. These are facilities that have the personnel, equipment, space, and other resources necessary to care for an injured patient 24 hours a day, 7 days a week (Ramenofsky, 2006).

The American College of Surgeons (ACS) Committee on Trauma defined the term "pediatric trauma center" by categorizing centers into levels based on their capabilities. A Level I Trauma center, the highest level, is given to children's hospitals and adult center with pediatric expertise (Ramenofsky, 2006). Trauma centers are designed to meet the complex surgical demands of critically ill patients immediately. In order to qualify as a trauma center, a hospital must have a number of capabilities, including a resource intensive emergency department, a high quality intensive care ward, and an operating room that is functional at all times.

Given that pediatric emergency care has lagged adult emergency care in its development, it is surprising that the first pediatric trauma center was established in 1962—five years before the first adult trauma center was established (Ramenofsky, 2006). In 1970, the American Pediatric Surgical Association (APSA) was founded; two years later, one of the members requested greater emphasis on trauma and the Association established a Committee on Trauma, which continues today. Also in 1972, the APSA joined the American Medical Association, American College of Surgeons, the American Academy of Orthopedic Surgeons, and the American Association for the Surgery of Trauma in sponsoring the American Trauma Society (ATS) (Personal communication, M. Stanton, March 12, 2006). The ATS, established in the late 1960s, was an advocate for the EMS Act of 1973. Today, the ATS is a spokes organization for trauma care and trauma prevention. It serves as an advocate for trauma victims and their families and for optimal care for all trauma victims (American Trauma Society, Accessed 2006).

However, advanced resources for the care of the pediatric trauma patient were largely unavailable until the 1980s. In 1982, the *Journal of Trauma* published the first document describing resources necessary to treat the injured child. Others followed. In 1984, the American College of Surgeon (ACS) Committee on Trauma included an appendix on Pediatric Trauma Care in their standards manual, which was the first to define the standards of care necessary to treat trauma patients. A chapter on pediatric trauma appeared in the ACS resource manual in 1987 (Ramenofsky, 2006).

Today, most regions have dedicated trauma facilities, board certified surgeons have training and experience in trauma care and pediatric surgery, and most states have organized trauma systems. Injuries are no longer seen as “accidents” but predictable events that can be prevented through the application of harm reduction strategies (Cooper, 2006). However, as detailed later in the chapter, unintentional injury continues to be the leading cause of death in children over age 1 (see Table 2-4) and an important source of ED visits (Table 2-5). While this report is focused on the emergency care system and the pediatric experience within that system, the committee notes that there should be greater effort to build a comprehensive injury control strategy or system to reduce injuries to both children and adults.

The Emergency Medical Services for Children (EMS-C) Program

The creation of the federal Emergency Medical Services for Children (EMS-C) Program in 1984 grew at least in part from policymakers’ personal experiences with the pediatric emergency care system. Several congressional staff members had disturbing experiences with the emergency care system’s ability to care for their children. Their experiences highlighted serious shortcomings of a typical emergency department’s ability to care for children in crisis. Around the same time, emergency physicians began approaching federal lawmakers, expressing that children were arriving at the ED in worse condition than adults. As a result, Senators Daniel Inouye (D-HI), Orrin Hatch (R-UT), and Lowell Weicker (R-CT) sponsored the creation of the EMS-C demonstration grant program under the Health Services, Preventive Health Services, and Home Community Based Services Act of 1984 (IOM, 1993; CPEM, 2001).

The goal of the EMS-C Program is to reduce child and youth morbidity and mortality resulting from severe illness or trauma by supporting injury prevention programs and improvements in the quality of medical care children receive. The program aims to ensure: (1) state-of-the-art emergency medical care for ill or injured children and adolescents; (2) that pediatric services are well integrated into an emergency medical services system backed by optimal resources; and (3) that the entire spectrum of emergency services – including illness and

injury prevention, acute care, and rehabilitation – is provided to children and adolescents as well as adults (Perez, 1998). While this committee is focused on EMS and hospital-based pediatric emergency care, the EMS-C Program covers a broader continuum of care, from illness and injury prevention, bystander care, dispatch, prehospital EMS, definitive hospital care, rehabilitation, and return to the community (Figure 2-1). The EMS-C Program is the only federal program that specifically supports essential emergency medical care for ill or injured children and adolescents. EMS-C is jointly administered by HRSA and NHTSA.



FIGURE 2-1 EMS-C continuum of care.

The program initially focused on providing grants to states and accredited schools of medicine for needs assessments and demonstration projects (Advocates for EMS, Accessed 2004; Krug and Kuppermann, 2005). Its original authorization provided \$2 million in funding for fiscal year 1995 (IOM, 1993). That funding supported four State Partnership demonstration projects that created some of the first strategies for addressing important pediatric emergency care issues, such as disseminating education programs for prehospital and hospital-based providers, establishing data collection processes to identify significant pediatric issues in the EMS system, and developing tools for assessing critically ill injured children (CPEM, 2001).

Growth of the EMS-C Program

The EMS-C Program's authorization has grown since its inception, as has the number and types of initiatives funded. Reauthorization of the program in 1988 lifted the initial limit of four grants per year and provided funding of \$3 million for FY 1989, \$4 million for FY 1990, and \$5 million for FY 1991 (IOM, 1993). By 1990, EMS-C had funded projects in all 50 states, the District of Columbia, and five territories (Krug and Kuppermann, 2005).

The program underwent several changes in 1991. The focus of the state grants shifted from demonstration projects to implementation projects (IOM, 1993). The objective of

implementation projects is to put into place what is known to work (HRSA, 1994). Second, the program introduced new Targeted Issues Grants. These grants target specific issues related to the development of pediatric emergency care capacity, with the intent of providing potential national models. Examples of Targeted Issue Grants awarded included an investigation of the psychosocial impact of emergencies on children and the development of new pediatric information systems (IOM, 1993).

States that receive EMS-C grants are expected to share ideas or products with other interested states, and the EMS-C National Resource Center was created to assist with knowledge sharing. The Center also assists states in coalition building, public policy initiatives, injury prevention, and long term planning for post-grant funding (HRSA, 1995). Its library contains more than 850 EMS-C products, including protocols, training courses, guidelines, and procedures that address illness and injury prevention, patient care training and safety, equipment guidelines, medical direction, and public policy (HRSA, 2002). Additionally, the National EMS-C Data Analysis Resource Center (NEDARC) in Salt Lake City, UT, specializes in providing technical assistance on data collection and analysis to grantees (Perez, 1998).

The program continued to expand and mature in the mid-1990s. In response to the recommendations from the 1993 IOM report, *Emergency Medical Services for Children*, the HRSA and NHTSA sponsored a meeting to help convert the IOM committee recommendations into objectives and action steps. The result was the EMS-C 5-Year Plan, a comprehensive, long-range strategy for 1995–2000 for the EMS-C Program. That plan was updated in 2000 and continued to guide the program through 2005. The program has partnered with a number of professional organizations in order to address the objectives in the 5 Year Plan (Krug and Kuppermann, 2005).

In recent years, EMS-C has also supported the infrastructure for pediatric emergency care research efforts. In 2001, the program collaborated with HRSA's Maternal and Child Health Bureau (MCHB) to fund the Pediatric Emergency Care Applied Research Network (PECARN), the first federally-funded multi-institutional network for research in pediatric emergency medicine. PECARN consists of four cooperative agreements with academic medical centers. The goal of PECARN is to conduct meaningful and rigorous multi-institutional research into the prevention and management of acute illnesses and injuries in children and youth across the continuum of emergency medicine health care (Pediatric Emergency Care Applied Research Network, Accessed 2004). PECARN provides leadership and infrastructure to promote multi-center studies, support research collaboration among EMSC researchers, and encourage information exchange between pediatric emergency care investigators and providers (U.S. Department of Health and Human Services, 2004).

Congress should be commended for recognizing the importance of the program and supporting its development.¹ But despite the program's growth, it continues to be funded at a relatively modest level. Fiscal year 2005 program funding for the EMS-C program was \$19.86 million² and details on the program's expenditures are provided in Table 2-1. Note that the program's administrative expenses are low in part because the two-full time staff overseeing the

¹ Congress has supported the continuation of funding for the EMS-C Program even after the proposed elimination of the program in the President's budget for FY 2006. The program is also eliminated in the President's budget for FY 2007. At the time of this writing, Congress had not yet voted on FY 2007 for the program.

² The EMS-C Program FY 2005 appropriation was \$19.86 million. However, the program is required to contribute approximately 5 percent of its appropriation to HRSA for administrative purposes, such as program accounting and evaluation. The EMS-C program had \$19.07 million in real dollars for operations.

project at the national level are not funded out of the EMS-C Program’s budget, but rather the Maternal and Child Health Bureau’s Program Management Fund.

TABLE 2-1 EMS-C Program Expenditures for Fiscal Year 2005

Program Component	Description	Approximate FY 05 Funding
State Partnership Grants	<ul style="list-style-type: none"> Grants to all states, the District of Columbia and X Territories to institutionalize pediatric EMS Improvements Grantees receive \$100,000 to \$115,000 per year 	\$5.6 Million
Network Development Demonstration	<ul style="list-style-type: none"> Infrastructure Support for PECARN 5 Cooperative Agreements at \$700,000 each 	\$3.5 Million
Targeted Issue Grants	<ul style="list-style-type: none"> Grants to demonstrate the effectiveness of a model system that may be helpful to the field 16 grants funded at \$200,000 per year 	\$3.1 Million
National Resource Center	<ul style="list-style-type: none"> Contract with Children’s National Medical Center in Washington, D.C. to establish a national internet-based clearinghouse to identify resources available for EMSC activities, and provide technical assistance to program staff 	\$2.2 Million
National Data Analysis Resource Center (NDARC)	<ul style="list-style-type: none"> NDARC collects and analyzes data from grantees and communicates findings, develops research designs, and provides technical assistance to grantees 	\$1.2 Million
Interagency Agreements	<ul style="list-style-type: none"> Funding to the Centers for Disease Control and Prevention for a pediatric emergency care data collection effort associated with the National Hospital Ambulatory Medical Care Survey Funding to the National Highway Traffic Safety Administration to support projects that include the development of the National EMS Research Agenda and the National EMS Information System (NEMSIS) Funding to the Indian Health Service for activities that include the training of EMS professionals in Native American and Alaskan populations. 	\$800,000
Regional Symposiums	<ul style="list-style-type: none"> Grants to support coordinating, exchanging and dissemination knowledge that leads to reducing child and youth disability and death due to severe illness and injury Six, relatively small grants 	\$239,000
Other Activities	<ul style="list-style-type: none"> One-time or irregular program expenditures. 	\$2.4 Million

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Program Component	Description	Approximate FY 05 Funding
	Examples include sponsoring a workshop at the National Association of EMS Physicians Meeting, grants to support the development of clinical practice guidelines in two areas and grants to the Maternal and Child Health Bureau Research Division.	

Impact of the EMS-C Program

In 2005, the EMS-C Program celebrated its 20th anniversary. The accomplishments of the EMS-C Program are numerous even with its modest level of appropriations. The program has broadly advanced the state of pediatric emergency care across the country. It has improved the availability of child-size equipment in ambulances and emergency departments, initiated hundreds of programs to prevent injuries, and provided thousands of hours of training to EMTs, paramedics, and other emergency medical care providers. Education materials covering every aspect of pediatric emergency care have been developed under the EMS-C Program, and a formal partnership has been forged (EMS-C Partnership for Children Stakeholder's Committee) with numerous national and professional organizations to help implement the program's goals (MCHB, Accessed 2005). Findings from targeted issue grants have enhanced the use of ketamine and analgesia for pediatric orthopedic emergencies (Graff et al., 1996) and led to improved understanding of pediatric intubation in the prehospital environment (Gausche-Hill et al., 2000) and pediatric airway management (MCHB, 2004b).

The EMS-C Program's guidance and resources have led to important changes in pediatric emergency care at the state level. For example:

- 12 states have adopted and disseminated pediatric guidelines that characterize acute care facilities with the equipment, drugs, trained personnel, and facilities necessary to provide varying levels of pediatric emergency care;
- 20 states have pediatric emergency care laws or pediatric emergency care-related rules or regulations;
- 27 states, tribal reservations, or federal territories have conducted a pediatric emergency care needs assessment within the previous five years;
- 36 of the 42 states having statewide computerized data collection systems now produce reports on pediatric emergency medical services using statewide data;
- 41 states utilize pediatric guidelines for acute care facility identification, ensuring that children get to the right hospital in a timely manner
- 44 states employ pediatric protocols for online medical direction of emergency medical technicians and paramedics at the scene of an emergency;
- And 48 states identify and require all EMS-C essential pediatric equipment on ALS ambulances (Advocates for EMS, 2003; MCHB, 2005).

While the program is focused on pediatric emergency care, many of the programs' initiatives serve to benefit patients of all ages. An example is an interagency agreement with NHTSA to support the development of the National EMS Research Agenda and the National EMS Information System and the infrastructure for the National Association of State EMS Officials.

The 1993 IOM Report on Emergency Medical Services for Children

The activities of the EMS-C Program received considerable congressional interest during the program's first decade. In response to this interest, in 1991 HRSA requested that the IOM undertake a study of pediatric emergency medical services to look at the issue more broadly than the individual demonstration projects under EMS-C could (IOM, 1993). Previously the National Academies and IOM had conducted several other studies related to emergency care, but few had given much attention to pediatric emergency care. The findings and recommendations of the committee were published in the 1993 report, *Emergency Medical Services for Children*. The committee developed recommendations in five areas: education and training; essential tools; communication and 9-1-1 systems; planning, evaluation, and research; and federal and state agencies and funding.

The 1993 report received considerable attention from emergency care providers, professional organizations, policymakers, and the public. Since its release, progress has been made in each of the recommendation areas, yet the committee's list of concerns has not been fully addressed. There are, in fact, several examples:

Education and Training

Concern in 1993 regarding emergency providers' knowledge about the proper care of pediatric patients remains salient today. Maintenance of skills is a challenge because many providers have infrequent contact with critically ill and injured children; only rarely do they perform advanced life support interventions on children. Surveys indicate that prehospital providers find the birth to age three age group most concerning and support increased continuing education for pediatrics (Glaeser et al., 2000). Additionally, the majority of pediatric visits occur at general EDs (Gausche et al., 1995) which are less likely to have providers specifically trained in pediatric emergency medicine. Anecdotes of physicians expressing doubt about their skills to care for a critically ill or injured child are not uncommon (Frush and Hohenhaus, 2004). Additional information on the abilities of emergency providers to address the needs of children is discussed in Chapter 4.

Essential Tools

The committee was concerned by reports that emergency providers did not have the necessary equipment to properly care for children and recommended that pediatric equipment and supplies be made more widely available. Since the release of the 1993 report, professional organizations continue to update guidelines on essential and recommended equipment and supplies and many states have used funding from the EMS-C Program to purchase pediatric equipment. While some progress has been made, deficiencies in pediatric equipment and supplies remain a problem for some providers. The average ED has about 80 percent of the recommended pediatric supplies and only six percent of the nation's EDs are fully supplied to care for children (Middleton and Burt, 2006). Some data suggest no increase in the availability of pediatric equipment in EDs between 1998 and 2002 (Middleton, 2005).

Research on the availability of the suggested pediatric supplies and equipment for prehospital providers has been primarily limited to studies of regions or states, and no recent data are available. A 1993 study of EMS ambulance agencies in Oklahoma found that deficiencies in equipment for pediatric emergencies were common (Graham et al., 1993). A 1998 study of compliance with the guidelines recommended by the Committee on Ambulance Pediatric

Equipment and Supplies in Kansas revealed that only five percent of the ambulance services reported compliance with essential equipment on all vehicles; 92 percent of agencies failed to achieve compliance on any vehicle. The most frequently missing pediatric BLS items were stethoscope (58%), traction splint (53%), and nonrebreather mask (45%). The most frequently missing pediatric ALS items were nasogastric tubes (75%), monitor electrodes (50%), and Magill forceps (41.7%) (Moreland et al., 1998). Again, there is scant evidence regarding the impact of having all essential pediatric equipment on patient outcomes; however, it is an essential element of preparedness.

The 1993 report also recommended that states address the issue of categorization and regionalization in overseeing the development of pediatric emergency care. But in many states, hospitals are not categorized based on their ability to care for critically ill or injured children. Additionally, many hospitals lack transfer agreements in case a critically ill or injured child arrives at a hospital that lacks pediatric expertise (Middleton and Burt, 2006). This issue is discussed further in the next chapter.

Planning, Evaluation and Research

One great success of the EMS-C program has been that all states have an EMS-C coordinator, whose job it is to oversee EMS-C grant funding received. In many states, the coordinator is a full-time position and involves other activities, including making sure that the state EMS system considers children's needs. However, there are still signs that pediatric planning is lacking in the development of trauma planning and disaster planning (MCHB, 2004a; National Association of State EMS Directors, 2004). As mentioned earlier, about half of hospitals that lack a separate pediatric ward also lack written interfacility transfer agreements (Middleton and Burt, 2006). Also, despite the fact that most state disaster plans discuss the need for pediatric equipment and medications at hospitals, only six states report that hospitals have those resources in place (National Association of State EMS Directors, 2004).

Certainly there has been some expansion of pediatric emergency care research since 1993, but efforts at tracking patient outcomes have been hampered by the absence of an infrastructure for the systematic collection of a uniform set of data elements and by the inability to link data sets of different providers (prehospital, ED, others) as recommended in the 1993 report. Research dollars for pediatric emergency care are also very limited. It is notable that the entire EMS-C Program's annual appropriation is less than the annual cost of some single large scale NIH clinical trials (National Center for Complementary and Alternative Medicine, 2002; National Cancer Institute, 2005). As a result of the dearth of funding for emergency care research, many emergency medical interventions that are regularly provided to children have not been subjected to rigorous scientific trials. This issue is discussed further in Chapter 7.

PEDIATRIC EMERGENCY CARE IN 2006

The next section of this chapter is devoted to discussing the emergency care system for children in 2006—specifically, the need for and use of pediatric emergency care.

Threats to Children's Health

Data from the CDC's National Health Interview Survey indicate that children in the U.S. are generally in good health. Approximately 83 percent of parents described their children as being in "excellent" or "very good" health. Not surprisingly, children in two-parent families, families with higher incomes, and those covered by private insurance tended to be in better health than children living with their mothers only, children from poor families, and children who are uninsured (Dey and Bloom, 2005).

Threats to children's health and safety remain prevalent in our society. Injuries are the leading cause of death among children ages 1-19 and rates of childhood injury in the U.S. are considerably higher than those in other developed countries (United Nations Children's Fund, 2001; Centers for Disease Control and Prevention, 2004). Illnesses, particularly asthma and infectious disease, imposes a high burden on American children and their parents. In fact, approximately 20 million children in the U.S. suffer from at least one chronic condition, leaving them more susceptible to medical emergencies (AHRQ, 2002). And sadly, violence in our society remains prevalent; many children are witness to or directly exposed to violence in their families and/or communities. The result is that millions of American children and parents rely on the emergency medical system to care for children when they need it most.

Injury

Statistics on childhood injury are available from a variety of sources, but perhaps the most comprehensive are from the CDC's National Vital Statistics Reports and the American College of Surgeon's National Trauma Data Bank (NTDB). The CDC collects data on injury deaths by cause and that data is displayed in Table 2-2. Data from the NTDB are displayed in Table 2-3. The NTDB data are somewhat different because the NTDB includes not only deaths, but all injured patients that were seen at one of the 474 participating trauma centers in 43 states (Fildes, 2005).

TABLE 2-2 Number of Deaths from Selected Causes, by Age

Cause of Death	Age in years				Total Deaths
	Under 1	1–4	5–14	15–24	
Injury					
Unintentional Injury	946	1,641	2,718	15,412	20,717
Motor Vehicle Accidents	123	610	1,614	11,459	13,806
Accidental Poisoning/Exposure to Noxious Substances	26	31	43	1,679	1,779
Drowning	63	454	321	629	1,467
Exposure to Smoke, Fire, or Flames	36	221	253	193	703
Falls	16	37	42	247	342
Firearm Discharge	1	11	48	210	270
Homicide	303	423	356	5,219	6,301
Suicide	NA	NA	264	4,010	4,274

SOURCE: National Vital Statistics Reports, 2004.

TABLE 2-3 Percent of Total Pediatric Patients Presenting at a Trauma Center, by Mechanism of Injury

Mechanism of Injury	Percentage of Total Patients
Motor Vehicle Traffic	43.3
Fall	19.7
Struck by, against	7.4
Transport, Other	6.4
Firearm	5
Pedal cyclist, other	3.7
Fire/burn	3.1
Cut, pierce	3.1
Natural/environmental	1.3
Unspecified	1.2
Machinery	0.6
Pedestrian, other	0.5
Drowning/submersion	0.5
Poisoning	0.3
Overexertion	0.3
Suffocation	0.2
Other	3.4

NOTE: The data include patients that were seen at one of the 474 trauma centers in 43 states that participate in the National Trauma Data Bank.

SOURCE: American College of Surgeons, 2004.

Both sets of data show what has been true for many years: the most common source of injury death and injury visits to trauma centers is motor vehicle crashes. According to NHTSA, over half of the children ages 0-14 who were killed in auto crashes in 2003 were not restrained (CDC, 2005). More than a quarter of occupant deaths among children ages 0-14 involve a driver who was drinking (Shults, 2004).

Other threats to safety vary based on age group. Young children ages 1-4 are at great risk of injury as they explore their environment. They are more likely to fall into a pool and drown or

swallow pills unintentionally. Indeed, drowning is the second leading cause of death at this age. Young children also lack coordination, which make them more susceptible to falls. There were approximately 2.4 million cases of human poison exposures reported to poison control in 2003; 44 percent of those cases occurred in children between ages 1 and 4 (Watson et al., 2003). Additionally, they may be at much higher risk of abuse (inflicted injuries) or neglect at this age, particularly because of their dependency and because they lack the ability to communicate the abuse (National Center for Injury Prevention and Control, 2001).

Children ages 5–14 are often injured because of their impulsiveness and inability to judge the safety of a situation. They may run into the street without looking or give unwanted attention to animals (2.5 percent of children are bitten by a dog each year). They are also susceptible to bicycle crashes. In fact, 140,000 children are seen in the ED each year for traumatic brain injuries sustained while riding a bicycle; one-third of all bicyclists killed in crashes are children. Small size contributes to their risk of injury – motorists may not be able to see children in the road. The risk of violence, including child sexual abuse, is high in this age group. Emotional stress and social changes may contribute to the increased risk of suicide attempts and completed suicides involving adolescents (National Center for Injury Prevention and Control, 2001).

Teenagers and young adults between the ages of 15 and 19 are involved in violence more than any other age group. They are also at high risk for suicide. Developmental factors that result in impulsiveness and risk-taking behaviors may contribute to these risks. The risk of motor vehicle crashes is highest among teen drivers, particularly during the first year behind the wheel; teen drivers are more likely to speed, ride with an intoxicated driver, or drive after using alcohol or drugs (National Center for Injury Prevention and Control, 2001).

Although childhood injury is prevalent, trend data indicate improvement over time for unintentional injuries and some categories of intentional injuries. The unintentional injury death rate among children 0-14 declined 41 percent between 1987 and 2001. Death rates fell for motor vehicle injury, bicycle injury, pedestrian injury, drowning, fire and burn injury, poisoning, and fall injury during that time period (National Safe Kids Campaign, 2004). This improvement is likely the result of prevention efforts, such as laws and campaigns for increased use of child safety seats, bicycle helmets, and smoke alarms.

Rates of intentional injury, homicide, suicide, and firearm,-related fatalities among teens all dropped from the mid-1990s through 2002 (the most recent year of data available). Between 1973 and 1993, the homicide rate for teenagers had doubled from 8.1 to 20.7 deaths per 100,000, but has since declined, falling to 9.3 in 2002. The rate of adolescent suicides also rose dramatically between 1970 to the mid-1990s (from 5.9 to 11.1 deaths per 100,000), but it has since fallen to 7.4 (Child Trends Databank, 2004).

Trends in child abuse are more difficult to discern because of underrecognition and underreporting. There has been a slight increase in the number of child abuse cases reported to child and protective services (Peddle and Wang, 2002) and child abuse fatalities reported by the National Child Abuse and Neglect Data System (National Clearinghouse on Child Abuse and Neglect Information, 2004), but it is unclear whether the increase is a result of improved reporting or an increase in abuse. Regardless, child abuse and neglect remains a serious problem.

Illness

Children suffer from a myriad of illnesses. But not all types of illnesses necessarily lead to an experience with the emergency care system. For example, congenital abnormalities and birth-related conditions are among the leading causes of death among infants, yet they are rarely the

cause of an ED visit (Table 2-4). Data from AHRQ's Healthcare Cost and Utilization Project (HCUP) State Emergency Department Databases (SEDD) contain information on the most frequent diagnoses for all pediatric ED visits in 12 states. Table 2-5 shows the primary diagnosis for treat and release ED visits for different pediatric age groups. But approximately four percent of all ED visits result in admission to the hospital (2002 NHAMCS data, calculations by IOM; 2002 SEDD data provided by AHRQ staff). Table 2-6 shows the primary diagnosis for ED visits that lead to hospital admission.

TABLE 2-4 Ten Leading Causes of Death in Children and Number of Deaths, by Age, 2002

	Less than 1	Ages 1–4	Ages 5–9	Ages 10–14	Ages 15–24
1.	Congenital Anomalies 5,623	Unintentional Injury 1,641	Unintentional Injury 1,176	Unintentional Injury 1,542	Unintentional Injury 15,412
2.	Short Gestation 4,673	Congenital Anomalies 530	Malignant Neoplasms 537	Malignant Neoplasms 535	Homicide 5,219
3.	SIDS 2,295	Homicide 423	Congenital Anomalies 199	Suicide 260	Suicide 4,010
4.	Maternal Pregnancy Complications 1,708	Malignant Neoplasms 402	Homicide 140	Congenital Anomalies 218	Malignant Neoplasms 1,730
5.	Placenta Cord Membranes 1,028	Heart Disease 165	Heart Disease 92	Homicide 216	Heart Disease 1,022
6.	Unintentional Injury 946	Influenza & Pneumonia 110	Benign Neoplasms 44	Heart Disease 163	Congenital Anomalies 492
7.	Respiratory Distress 943	Septicemia 79	Septicemia 42	Chronic Lower Respiratory Disease 95	Chronic Lower Respiratory Disease 192
8.	Bacterial Sepsis 749	Chronic Lower Respiratory Disease 65	Chronic Lower Respiratory Disease 41	Cerebrovascular 58	HIV 178
9.	Circulatory System Disease 749	Perinatal Period 65	Influenza and Pneumonia 38	Influenza and Pneumonia 53	Cerebrovascular 171
10.	Intrauterine Hypoxia 583	Benign Neoplasms 60	Cerebrovascular 33	Septicemia 53	Diabetes Mellitus 171

SOURCE: Centers for Disease Control and Prevention, 2004.

TABLE 2-5 Top 10 Diagnoses for Treat and Release ED Visits (First Listed DXCCS1), by Age Group

	Less than 1	Ages 1–4	Ages 5–9	Ages 10–14	Ages 15–17
1.	Other upper respiratory infections (18%)	Other upper respiratory infections (14%)	Other upper respiratory infections (13%)	Superficial injury, contusion (12%)	Sprains and strains (13%)
2.	Otitis media (14%)	Otitis media (13%)	Superficial injury, contusion (9%)	Sprains and strains (11%)	Superficial injury, contusion (11%)
3.	Fever of unknown origin (8%)	Open wounds of head, neck and trunk (8%)	Open wounds of head, neck and trunk (7%)	Other upper respiratory infections (9%)	Other upper respiratory infections (6%)
4.	Viral infections (6%)	Superficial injury, contusion (6%)	Otitis media (6%)	Fracture of upper limb (7%)	Open wounds of extremities (5%)
5.	Acute bronchitis (5%)	Fever of unknown origin (6%)	Fracture of upper limb (5%)	Open wounds of extremities (6%)	Abdominal pain (4%)
6.	Noninfectious gastroenteritis (3%)	Viral infections (5%)	Open wounds of extremities (4%)	Other injuries due to external causes (5%)	Other injuries due to external causes (4%)
7.	Nausea and vomiting (3%)	Other injuries due to external causes (4%)	Other injuries due to external causes (4%)	Open wounds of head, neck and trunk (4%)	Fracture of upper limb (3%)
8.	Other gastrointestinal disorders (3%)	Noninfectious gastroenteritis (3%)	Sprains and strains (4%)	Abdominal pain (3%)	Open wounds of head, neck and trunk (3%)
9.	Other injuries due to external causes (3%)	Asthma (3%)	Viral infections (4%)	Asthma (3)	Urinary tract infections (2%)
10.	Superficial injury, contusion (3%)	Pneumonia (2%)	Asthma (3%)	Otitis media (3)	Headache, including migraines (2%)

SOURCE: Healthcare Cost and Utilization Project (HCUP) 2002 State Emergency Department Databases. Agency for Healthcare Research and Quality and HCUP Partners (www.hcup-us.ahrq.gov/home.jsp). Percentages represent the percent of discharges in each age group. Diagnostic groups listed are based on the Clinical Classifications Software (CCS) (www.hcup-us.ahrq.gov/tools.jsp). Data provided by AHRQ staff.

TABLE 2-6 Top 10 Diagnoses for Admissions that Begin in the ED (First Listed DXCCS1), by Age Group

	Less than 1	Ages 1–4	Ages 5–9	Ages 10–14	Ages 15–17
1.	Acute bronchitis (23%)	Pneumonia (15%)	Asthma (14%)	Appendicitis (13%)	Mood disorders (12%)
2.	Pneumonia (8%)	Asthma (15%)	Pneumonia (9%)	Mood disorders (8%)	Appendicitis (7%)
3.	Other perinatal conditions (8%)	Fluid and electrolyte disorders (10%)	Appendicitis (7%)	Asthma (7%)	Fracture of lower limb (4%)
4.	Fluid and electrolyte disorders (6%)	Acute bronchitis (6%)	Fluid and electrolyte disorders (5%)	Fracture of lower limb (4%)	Intracranial injury (4%)
5.	Fever of unknown origin (5%)	Epilepsy, convulsions (6%)	Fracture of upper limb (4%)	Pneumonia (3%)	Poisoning by other meds and drugs (3%)
6.	Urinary tract infection (4%)	Other upper respiratory infections (4%)	Epilepsy, convulsions (4%)	Diabetes mellitus with complications (3%)	Crushing injury or internal injury (3%)
7.	Viral infections (4%)	Intestinal infection (4%)	Fracture of lower limb (3%)	Fracture of upper limb (3%)	Asthma (3%)
8.	Other upper respiratory infections (3%)	Urinary tract infection (2%)	Urinary tract infections (3%)	Sickle cell anemia (3%)	Diabetes mellitus with complications (3%)
9.	Asthma (3%)	Noninfectious gastroenteritis (2%)	Skin and subcutaneous tissue infections (2%)	Intracranial injury (3%)	Urinary tract infections (2%)
10.	Intestinal infection (3%)	Skin and subcutaneous tissue infections (2%)	Sickle cell anemia (2%)	Abdominal pain (2%)	Other complications of pregnancy (2%)

SOURCE: Healthcare Cost and Utilization Project (HCUP) 2002 State Inpatient Databases. Agency for Healthcare Research and Quality and HCUP Partners (www.hcup-us.ahrq.gov/home.jsp). All data are percent of discharges in each age group. Diagnostic groups listed are based on the Clinical Classifications Software (CCS) (www.hcup-us.ahrq.gov/tools.jsp). Data provided by AHRQ staff.

The illnesses most frequently responsible for ED visits tend to be rather minor. Among children treated and released from the ED, the most frequent non-injury related diagnosis for all age groups is upper respiratory infection (not including asthma, acute bronchitis, or pneumonia), which includes conditions such as the common cold, croup, and sinusitis. Otitis media, or ear infection, is another common illness driving many ED visits for younger children. Three out of four children experience the condition by the time that they reach age three (National Institute on Deafness and Other Communication Disorders, 2002).

Among the more serious ED visits, those that result in hospital admission, the illnesses vary considerably based on age group. Younger children tend to be hospitalized for serious upper respiratory infections including acute bronchitis, pneumonia, and asthma. Infants and young children tend to have greater vulnerability to these illnesses than older children and non-elderly adults. Children whose parents or siblings smoke are especially susceptible to these three conditions (MayoClinic.com, 2005).

Of note, mood disorders were the most frequent diagnosis for children ages 15–17 admitted from the ED. It was the second-most frequent diagnosis for children ages 10–14. Mood disorders cover a wide variety of behavioral issues but are generally classified into two categories: depression and bi-polar (or manic-depressive) (Beers and Berkow, 2005).

Certain types of illnesses, particularly asthma and diabetes, become exacerbated and result in hospital admission when children have health care needs that go unmet. Failure to obtain timely care can affect health status and functioning in the near and long term and can affect the propensity to seek services at an ED. Data from the National Health Interview Survey from the mid-1990s indicate that unmet health care needs are prevalent among children. Near poor and poor children were three times as likely to have unmet health care needs than non-poor children, and uninsured children were three times as likely to have unmet needs as privately insured children (Newacheck et al., 2000).

Children with Mental Health Problems

Mental health disorders in children and adolescents deserve special mention because of their growing prevalence in EDs as well as the difficulty that patients with mental illness present to emergency providers. It is estimated that 20 percent of U.S. children have a mental disorder with at least mild functional impairment; 5 to 9 percent of children ages 9 to 17 have a serious emotional disturbance (U.S. Department of Health and Human Services, 1999). While these problems contribute to difficulties at home, school and in relationships with peers, untreated mental health problems in children can lead to consequences such as suicide, failure in school, involvement in the juvenile or adult criminal justice system, and higher health care costs as adults.

Over 200,000 children present to the ED with mental health problems each year (Melese-d'Hospital et al., 2002) and research has shown that pediatric ED visits for mental health problems is on the rise (Santucci et al., 2000; Sullivan and Rivera, 2000; Sills and Bland, 2002); at one pediatric emergency department, mental health-related visits rose 59 percent between 1995 and 1999 (Santucci et al., 2000). Not only is utilization rising, but patients are getting younger and younger. Depression, bi-polar disorder, and anxiety are now being identified in children of elementary school age (Scheck, 2006).

Studies have pointed to shortcomings in the effectiveness of the emergency care system to handle children with mental health problems. A mid-1990s survey of hospitals revealed that formal mental health services for children are unavailable in most EDs (U.S. Consumer Product

Safety Commission, 1997). In a study of pediatric mental health cases from 10 hospitals, researchers found that evaluation of patients varied by presenting classifications. Three-fourths of emotionally disturbed children received an evaluation by a mental health professional compared to 69 percent who had attempted suicide and 35 percent identified with drug use (Melese-d'Hospital et al., 2002). Other studies also indicate that proper management of adolescent suicide attempts in the ED is lacking. While the importance of follow-up psychiatric treatment has been demonstrated, psychotherapy is recommended to less than half of adolescent suicidal patients evaluated in the ED (Piacentini et al., 1995). Additionally, adolescents with somatic complaints are infrequently screened for depression (Porter et al., 1997).

These findings should not be surprising considering that ED providers often lack the training, skills, and resources to effectively deal with mentally ill patients. Standardized psychiatric training is not required of emergency medicine and pediatric emergency medicine residents. Less than one quarter of EM residency programs provide formal psychiatric training for residents (Santucci et al., 2003). Surveys of nurses—even those working in designated pediatric emergency departments—show that pediatric psychiatric emergencies are among the conditions that they feel the least comfort and have the least amount of knowledge to manage (Fredrickson et al., 1994). ED physicians may not have the time to perform a thorough mental health evaluation and many rely on psychiatrists, psychologists, or social workers to perform the evaluation. When that assistance is not available, patients may not receive an evaluation at all. The ED setting also makes it difficult to care for a mentally ill patient. The lack of privacy and the noisy, high stimulus environment may make it uncomfortable for patients to participate in a mental health evaluation (Hoyle and White, 2003).

The psychiatric resources available within EDs vary greatly across hospitals. For example, teaching hospitals use psychiatric residents to provide consultations to patients with psychiatric problems. Other hospitals use a pool of mental health professionals, including clinical nurse specialists, to provide such services, though they may not be available around the clock. Still, in some hospitals, nurses from inpatient units evaluate psychiatric patients in EDs (Falsafi, 2001). Other hospitals may have no psychiatric resources available to ED staff.

Children with mental health problems represent a real challenge to emergency care providers. Some children present to the ED with very disruptive behaviors, antagonizing health workers and showing signs of rage. This disruptive behavior can mask the underlying diagnosis of a mental illness (Scheck, 2006). Another major challenge is that specialized psychiatric resources to assess and treat these patients are very limited; children in need of psychiatric services often cannot be immediately accommodated. Pediatric psychiatric patients are more likely to require admission than non-psychiatric patients (Khan et al., 2002). However, in many hospitals, because of the lack of available psychiatric treatment services, children spend extended lengths of time in the ED or general pediatric inpatient unit, waiting for an available psychiatric treatment slot. This is particularly problematic in the 16-18 year old age group, who often do not meet the age criteria for adolescent or adult treatment services. In one study 33 percent of pediatric patients in the ED in need of psychiatric admission were admitted to a pediatric medical floor and waited a day or several days before being transferred to a psychiatric facility (Mansbach et al., 2003). While assessing the adequacy of mental health resources is beyond the scope of this committee, it is clear that there is a crisis in the mental health system that is having a profound affect on the emergency care system. While an examination of the resources for mental health services is beyond the scope of this committee, it is clearly an issue that must be addressed.

Children with Special Health Care Needs

Children with special health care needs (CSHCN) are “those who have or are at increased risk of having chronic physical, developmental, behavioral, or emotional conditions and who also require health and related services of a type or amount beyond that required by children generally” (CMS, 2004). Between six and 35 percent of U.S. children meet the definition of a child with special health care needs, depending on which types of disabling conditions are included in the definition (AAP, 2002). The number of CSHCN has been growing as medical advances improve the quality and length of life of children with complex medical conditions. In fact, CSHCN are the most rapidly growing subset of pediatric patients (Sacchetti et al., 2000).

CSHCN have complicated, often multiple and life-long disabilities, and many are dependent upon assistive technologic devices and require a specialized approach to assessment, management and treatment (Spaite et al., 2000; Kastner, 2004). They are also relatively heavy consumers of health care services. Studies of emergency care services for CSHCN in Utah and Los Angeles found that CSHCN were more likely than other children to be admitted to the hospital, use EMS for transfer between health care facilities, and receive prehospital procedures such as intravenous therapy (Gausche-Hill, 2000; Suruda et al., 2000). Emergency care providers are increasingly likely to encounter CSHCN (Singh et al., 2003); however, CSHCN represent a challenge to emergency providers who feel uncertain about their ability to meet these patients’ needs (Deschamp and Sneed, 1997) and many EMS agencies do not address CSHCN in their treatment protocols (Singh et al., 2003).

There have been several efforts by states, communities, and hospitals to develop notification programs for prehospital providers to alert them to children with special health care needs in the area. One of the first was a program called EMS Outreach, developed in 2000 at the Children’s National Medical Center in Washington, DC and supported by the EMS-C Program. Under the program, parents and health care providers complete a one-page form with the child’s medical information. The form is then faxed to the EMS agency where the information is entered into the 9-1-1 call center’s computers. The EMS stations closest to the child’s home also receive the information. The program expanded to provide each child with a vinyl index card containing their medical information so that the children have the information with them when they are away from home. The program also encourages prehospital providers to make home visits so that the providers can become familiar with the children’s special needs and establish relationships with the children and their parents. In its first year, EMS Outreach enrolled 450 special needs children. (Smith et al., 2001).

There similar projects in other areas. An EMS-C State Partnership Grant in Guam was used to develop the Special Needs Identification Project (SNIP). Resources developed from the project are now available online to other states through the EMS-C Program’s clearinghouse (Emergency Medical Services for Children Program, 2003). Certainly as electronic health records advance in the coming years (discussed briefly in Chapter 5 and in more depth in the committee’s companion report, *Hospital Based Emergency Care: At the Breaking Point*), special needs identification projects will also advance.

Use of Emergency Care Services by Children

Prehospital Services

9-1-1 call centers field approximately 200 million emergency calls each year (National Emergency Number Association, 2004); that number includes calls for medical, police, and fire needs. There is no reliable data on the number of pediatric medical calls made to 9-1-1 each year. (The dispatch system is discussed in depth in the committee's companion report, *Emergency Medical Services At the Crossroads*.) However, there is some data available on the use of prehospital EMS services by children, and in general, their use is relatively low compared to adults. The vast majority of pediatric patients under age 15 come to the ED by private vehicle or public transportation and therefore do not receive prehospital emergency care. In 2003, only 3.8 percent of pediatric ED patients under age 15 arrived by ambulance, compared to 11 percent of patients between the ages of 24 and 44 and 41 percent of patients over age 74 (McCaig and Burt, 2005).

Although pediatric patients account for approximately 27 percent of all ED visits, studies suggest that only 5 to 10 percent of all prehospital transports are for pediatric patients (Seidel et al., 1984; Federiuk et al., 1993). One important source of variation in that percentage is the different definitions of "child" that studies use. National data on prehospital calls are not presently collected; therefore, our understanding of pediatric calls is based on studies of individual EMS systems. One of the largest studies of pediatric EMS calls covering four states found that most were for boys (56 percent) and most occurred in the evening and daylight hours. Children were transported in 89 percent of the cases, and care was refused by the patient or parents in approximately eight percent of cases (Joyce et al., 1996). Data from one EMS agency indicate that utilization rates of EMS varies by pediatric age group. In a study of children under age 15 who used the Kansas City, MO EMS system between 1993 to 1995, researchers found that infants under age one had the highest rate of use (47.4 children transported per 1,000 persons), followed by those aged 1-4 years (26.2), 10 to 14 years (17.5) and 5 to 9 years (17.3) (Murdock et al., 1999).

Approximately half of pediatric prehospital runs are for injury; the rest are for a wide range of medical problems. A 1991 analysis of 10,493 pediatric calls in four California EMS agencies found that 57 percent of calls were for injuries. The most common injuries included head trauma (19 percent of calls), lacerations (16 percent), and contusions (14 percent). Medical calls accounted for the remaining 43 percent, which included knee pain (12 percent), seizures (8.5 percent), neck or back pain (9 percent), ingestions (7 percent), respiratory distress (5 percent), and abdominal pain (5 percent) (Seidel et al., 1991).

But these statistics mask important differences in prehospital calls across different pediatric age groups. A study of almost 18,000 transports of children under 21 in Albuquerque, NM, showed that the most prevalent chief complaints varied by age. Medical complaints predominated in children under five, while the leading cause of transports among children ages five to ten was motor vehicle crashes. Assault was a leading case for transport among patients older than 11 years old (Sapient et al., 1999).

A number of small studies have investigated the appropriateness of pediatric ambulance transports. These studies generally reveal that the majority of pediatric prehospital runs are not critical cases (Hamilton et al., 2003), though, in general, they are appropriate transports. Foltin and colleagues (1998) developed a tool to evaluate the appropriateness of pediatric ambulance utilization. Applying the tool to patients arriving at two New York City hospitals, the researchers

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found that the majority of requests for ambulances were appropriate and that dispatchers called for the appropriate level of care the majority of the time (Foltin et al., 1998).

Still, there are many pediatric ambulance transports that are unnecessary. A study of pediatric ambulance transports in Delaware found that 28% of patients that arrived at a hospital by ambulance used the ambulance transport unnecessarily. Of the unnecessary transports, 60 percent were insured by Medicaid. In fact, several studies have shown that children covered by Medicaid have higher rates of EMS transport than other children (Murdock et al., 1999) and higher rates of in appropriate EMS transport (Kost and Arruda, 1999). A study of pediatric ambulance transports in Cleveland that excluded patients needing immediate resuscitation or trauma care found that the 82 percent of ambulance transports made by children covered by Medicaid were medically unnecessary based on pediatric emergency physicians' judgment. Of all medically unnecessary transports, just over half of the caregivers cited no other means of transportation (Camasso-Richardson et al., 1997). However, determining whether an ambulance transport is medically necessary or not is much easier to do in retrospect of the event. Some parents may view ambulance transport as "necessary" if they lack alternatives for transportation to an emergency department (Camasso-Richardson et al., 1997).

Children's Use of the ED

Data from the CDC's National Hospital Ambulatory Medical Care Survey (NHAMCS) allow a fairly comprehensive picture of pediatric ED visits. In 2002, there were approximately 29 million pediatric ED visits for children under age 1), representing almost 27 percent of all ED visits. Data from the National Center for Health Statistics shows that the number of pediatric visits to the ED for children under age 15 has been climbing since 1997 (Figure 2-2). In fact, the number of pediatric ED visits increased close to 20 percent between 1997 and 2003. The majority of pediatric ED visits (92%) are to non-children's hospitals (Gausche-Hill et al., 2004); however some general hospitals have specialized pediatric emergency departments.

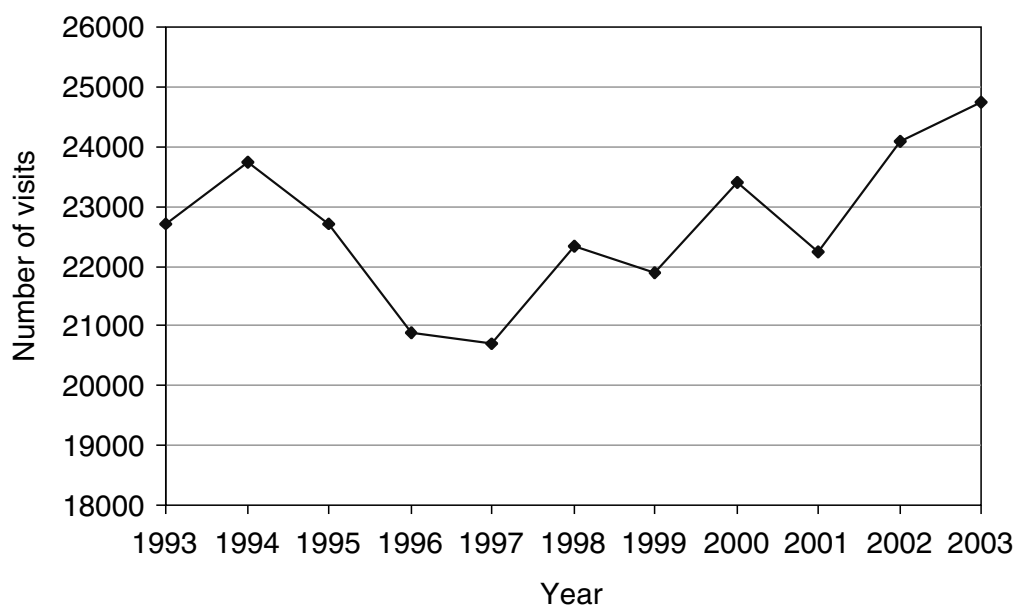


FIGURE 2-2 Number of ED visits for children under age 15 in thousands.

SOURCE: National Hospital Ambulatory Medical Care Survey, ED Summaries for 1993–2003.

Though the majority of pediatric ED visits are for children over age 5, infants (children under age 1) make up a disproportionately large percentage (13%) of all pediatric ED visits (Figure 2-3). In fact, infants have a visit rate of 96.2 visits per 100 persons, which is much higher than the rate for all children under age 15 (40.8 visits per 100 persons) (McCaig and Burt, 2005). African American children have relatively high rates of ED use—62 visits per 100 children under 15 compared to 39 visits per 100 children for white children. Research on ED utilization for all ages has shown that African Americans had some of the largest increases in ED utilization between 1992 and 1997 (McCaig et al., 2002). Hispanic and other non-English speaking children also utilize the ED at higher rates than white children.

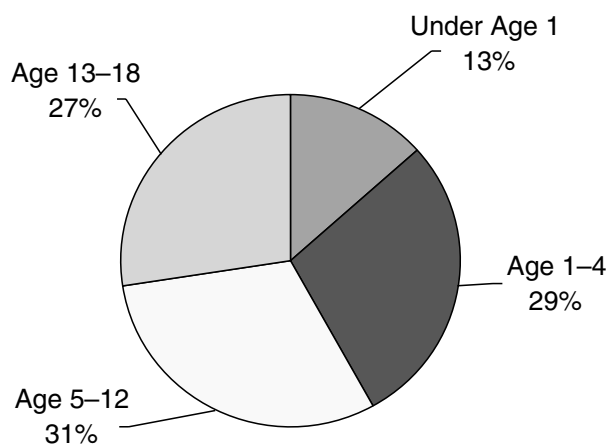


FIGURE 2-3 Percent of ED visits for children under 18.
SOURCE: 2002 NHAMCS data, calculations by IOM staff.

Non-Urgent Use of the ED

Many pediatric visits to the ED are preventable or avoidable. In comparison to adults, children have more visits to EDs that can be classified as ambulatory sensitive, meaning that they do not require care within 12 hours, immediate care is needed but could be provided in a typical primary care setting, or immediate care is needed but could have been avoided with timely and effective primary care. Three-quarters of pediatric ED visits that occur overnight and do not result in admission are preventable or avoidable with primary care, suggesting a need for after-hours ambulatory care (Weinick et al., 2003). Perhaps not surprising, parental ED utilization is significantly associated with increased childhood utilization for both number of visits and number of nonurgent visits (Anderson et al., 2004).

The delivery of nonurgent care in the ED is of concern for three reasons: First, the primary care delivered in the ED may be of lower quality than in other settings. The emergency department is designed for rapid, high intensity responses to acute injuries and illnesses. It is fast-paced and requires intensive concentration of resources for short durations. Such an environment is ill suited to the provision of primary care and preventive care (Derlet and Richards, 2000). Physicians in the ED typically do not have a patient relationship, often lack patient medical records, face constant interruption and distraction, and have no means for patient follow-up. Further, because they have low triage priority, these patients have extremely long wait

times—sometimes 6 hours or more. Certainly it would be preferable for children to see nonurgent care from a medical home.

Second, the literature is unclear whether providing nonurgent care in the ED is cost-effective. To some extent, emergency departments and trauma centers welcome the revenue generated from nonurgent pediatric visits if the hospital would otherwise serve a very low volume of emergent or urgent patients in the ED. Indeed, these revenues would be used to help cover the very large fixed overhead costs associated with maintaining the ED's readiness to provide a full array of services on a 24/7 basis.

But on the other hand, some studies support the notion that non-emergent care costs in the emergency setting may be substantially higher than in a primary care setting (Fleming and Jones, 1983; White-Means and Thornton, 1995). High costs may be due to the frequent lack of patient records and inability to construct a patient history, which result in a high frequency of full workups (Murphy et al., 1996). ED charges for services for minor problems have been estimated to be 2 to 5 times higher than a typical office visit (Kusserow, 1992; Baker and Baker, 1994), resulting in \$5–\$7 billion in excess charges in 1993 (Baker and Baker, 1994). While studies of charges probably overestimate the excess cost, they are nevertheless substantial. In contrast, Williams studied a sample of 6 hospitals in Michigan, and found that average and marginal costs of ED visits were quite low, especially for those classified as nonurgent, perhaps below the cost of a typical physician visit (Williams, 1996). However, if as a result of the increased use of nonurgent care hospitals build additional high cost emergency department capacity, then the true cost of treating nonurgent care in the ED will be much higher than just the marginal or average cost of treating such patients.

And third, nonurgent utilization may detract from the ED's primary mission of providing emergency and life-saving care. Regardless of their efficiency on average, ED resources are not unlimited. When the ED becomes saturated with patients that could be cared for in a different environment, there are fewer resources in terms of physicians, nurses, ancillary personnel, equipment, time, and space available to respond to the population of emergent patients.

Payor Mix

The most common source of payment was private insurance, though Medicaid coverage is quite prevalent among pediatric ED users (Figure 2-4). Indeed, Medicaid represents an important source of health insurance coverage for children as 27 percent of all children were covered by the program in 2004 (U.S. Census Bureau, 2005). But looking at insurance status for all pediatric visits masks some important differences by age group. In fact, private coverage becomes more prevalent in higher age groups while Medicaid coverage declines (Figure 2-5). Research has shown that Medicaid recipients have disproportionately high rates of ED use, and often use the ED for nonurgent care or as their primary source of care (Newacheck, 1992; Gadamski et al., 1995; Liu et al., 1999; Sarver et al., 2002; Irvin et al., 2003). Medicaid patients (of all age groups) use the ED at a rate of 81 visits per 100 persons compared to 41.1 visits per 100 persons with no insurance and 21.5 visits per 100 persons for the privately insured (McCaig and Burt, 2005).

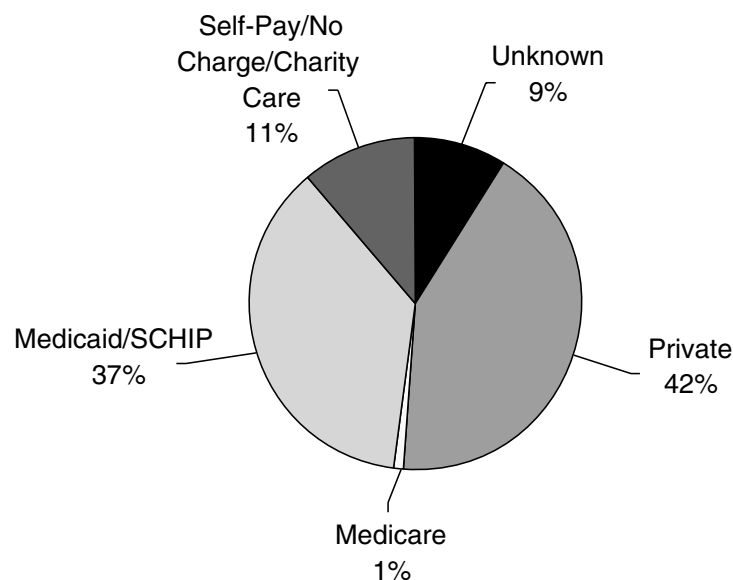


FIGURE 2-4 Pediatric ED visits by payor source.
SOURCE: 2002 NHAMCS data, calculations by IOM staff.

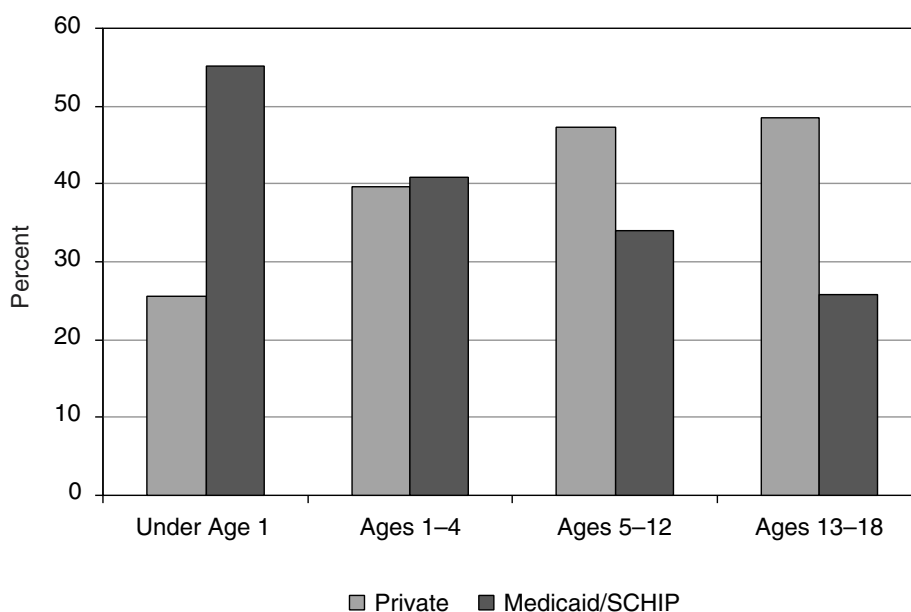


FIGURE 2-5 Percent of pediatric ED visits with private insurance or Medicaid/SCHIP coverage.
SOURCE: 2002 NHAMCS data, calculations by IOM staff.

There are several reasons why Medicaid enrollees have higher rates of ED use. A common assertion is that Medicaid enrollees have poorer access to primary care than other groups, which leads to greater ED use (Sharma et al., 2000). This explanation is plausible; because Medicaid reimburses providers at such low rates it limits access, leaving the ED as the only source of care

for some individuals. Additionally, Medicaid enrollees may have difficulty seeing primary care providers during regular office hours. According to one study, Medicaid providers that offer evening hours have patients that are less likely to use the ED (Lowe et al., 2005).

But a study by Luo and colleagues suggests that when controlling for confounding factors, type of insurance coverage is not associated with ED use for nonurgent visits (Luo et al., 2003). Access to primary care (Johnson and Rimsza, 2004) and continuity of care (having a strong relationship with a primary care provider) may be more important deterrents to ED utilization. In a study following 181 children, increased continuity of care with a primary care provider was associated with decreased ED utilization in the first two years of life (Brousseau et al., 2004). A larger study that reviewed claims data from over 46,000 children found that low continuity of care was associated with an increased risk of ED visits and hospitalization (Christakis et al., 2001).

Utilization in Rural Areas

Children in rural areas tend to use the ED more than their urban counterparts. According to data from the National Health Interview Survey (NHIS), 23 percent of rural children versus 20 percent of urban children had an emergency room visit within the last year. The higher utilization of the ED in rural areas holds true for adults as well (Center on Aging Society, 2004). Many hypothesize the shortage of primary care providers is a barrier to physician access for rural populations where the physician-to-patient ratio is 1 to 3,500, clearly higher than the recommended 1 primary care physician to every 2,000 individuals.

Utilization of Services as a Result of Child Abuse

At least one study has found a link between the number of prior ED visits for injury and subsequent substantiated reports of child maltreatment (Spivey et al., 2005). However, a focused look at child abuse cases in the ED is needed because national data do not adequately indicate the extent of its prevalence. Just over one percent of all pediatric ED patients are diagnosed with child abuse; however, it has been estimated that over 75 percent of all child abuse cases in the ED are missed (Kunen et al., 2003). In one study, researchers retrospectively identified 62 cases of child abuse in the ED. Half of the children had at least one prior ED visit, and suspicion of abuse was documented in only 5 cases. Those cases were reported to child protective services, but the children were not placed in protective custody. Of the 62 children identified as child abuse cases, most had subsequent ED visits, but a history of abuse was not documented in any of the subsequent visits for trauma (Saade et al., 2002). This study highlights the frequent missed opportunities in the ED to identify cases of abuse and intervene. In fact, abuse is often not recognized until severe injury or death occurs. A review of child abuse fatalities indicates that more than a quarter of children had old fractures consistent with prior abuse and/or recent contact with the health care providers (King et al., 2004).

Identification of child abuse varies by hospital type. A recent analysis of infants (children under age 1) admitted to hospitals for treatment for traumatic brain injury or femur fracture (excluding penetrating trauma or motor vehicle injury) shows that children's hospitals diagnosed child abuse more than twice as frequently as general hospitals (29 percent of cases in children's hospitals as compared to 13 percent in general hospitals) (Trokkel et al., 2006). This is a troubling finding considering that the majority of injured children receive care in general hospitals rather than children's hospitals.

The research on this subject indicates two failings. First, identification of child abuse is poor. Although emergency medicine physicians do receive didactic training in child abuse, a survey of residents found that many believed that the training is not sufficient (Wagh and Heon, 1999). One study also indicates that prehospital providers lack knowledge necessary for recognizing, managing, and reporting cases of child abuse (Markenson et al., 2002). Second, high coding errors of pediatric ED visits contribute to underestimates of child abuse (Kunen et al., 2003).

QUALITY OF CARE

Performance measures specific to emergency care are in the initial stages of development; so formal assessments of quality of the emergency care system are currently lacking. However, there is reason for concern about the quality of care delivered. The emergency care system is facing a number of challenges that threaten its ability to deliver quality care. Overwhelming demands on the system without the corresponding resources contribute to a growing national crisis in emergency care. But under the current system, accountability for assuring access or monitoring the quality of the system is dispersed among many providers. The result is that the system falls short of providing the type of care that it should be able to provide. And the situation is only worsening.

Growing Pressures on the Emergency Care System

One of the biggest challenges that the emergency care system now faces is overwhelming patient loads. The public's dependence on the ED as a source of care is growing; the total number of ED visits rose 26 percent between 1993 and 2003 (McCaig and Burt, 2005). In some EDs, nonurgent patients must wait 6 to 8 hours before being seen; nationwide, two percent of all patients, including pediatric patients, that come to the ED leave before ever being seen (McCaig and Burt, 2005) (2002 NHAMCS data, calculations by IOM staff).

Rising number patient visits is only part of the problem—EDs are also having great difficulty moving seriously ill and injured patients from the ED into inpatient beds. In response to cost cutting measures and lower reimbursement by managed care, Medicaid, and other payors, hospital inpatient bed capacity declined precipitously over the last decade. To remain viable, some hospitals consolidated and reduced their number of inpatient beds (Brewster and Felland, 2004). Others closed important but unprofitable services, such as trauma, burn, and psychiatric care (IOM, 2003). When no vacant bed is available for an admitted ED patient, most hospitals require the ED staff to provide ongoing care to the patient until one becomes vacant. Many patients are forced to wait for hours for an inpatient bed, but some wait for days (GAO, 2003). Because most EDs have a limited number of exam rooms and treatment bays, it is not uncommon for admitted patients to be kept on stretchers in ED hallways. This phenomenon, often called “boarding,” creates a logjam in the ED because the inpatient “boarders” require ongoing attention and care, reducing the resources available evaluate and treat incoming ED patients. EDs can quickly become overwhelmed by boarders and the crush of patients waiting for care. When patient volume becomes too high for the ED to handle, the hospital may order the ED to go “on diversion,” meaning that inbound ambulance traffic will be directed to other hospitals. Diversion has become a common occurrence in many areas. In 2003, 45 percent of EDs were on diversion at some point, resulting in the diversion of an estimated 501,000 ambulance runs (Burt et al., 2006).

The act of diversion has a ripple effect through the community, impacting patients, other hospitals, and the community's EMS system. Ambulance diversion delays lifesaving care to seriously ill and injured children and adults. In redirecting ambulances to a hospital farther away, valuable time for treating patients is lost (Neely et al., 1994). For patients who have suffered serious trauma, a heart attack, or stroke, time is essential to prevent death. In these instances, extra minutes spent in transit can have dire, even fatal consequences. For patients with non-life threatening injuries and illnesses, the extra commute time to an ED bed can cause unnecessary pain and stress. Also, when one hospital goes on EMS diversion, others often follow, either because the inflow of patients becomes too great to handle, or to limit exposure to an influx of ED uninsured patients. The result is the healthcare equivalent of a "rolling blackout" as hospital after hospital closes its doors to ambulance traffic.

When hospitals are on diversion, ambulance transport teams have more time in transit, resulting not only in less accessibility to the community, but also higher levels of stress if providers are regularly pressured to find an open hospital or care for patients in the ambulance for an extended period of time.

Boarding and ambulance diversion have been prevalent over the past several years. Several studies have documented the problem, but perhaps the most telling is a point-in-time study based on a survey sent to a random sample of hospitals. On Monday, March 12, 2001 (a typical Monday), at 7 PM (local time for hospitals), 11 percent of the responding hospitals reported being on diversion and 22 percent had patients boarding, awaiting transfer to an inpatient bed (Schneider et al., 2003). However, because most communities and states do not systematically monitor rates of ambulance diversion and the "boarding" of inpatients in hospital emergency departments, the extent of these problems and the magnitude of their impact on access to care is largely unknown.

Most studies of boarding and diversion do not specifically address pediatric boarding and diversion, so the extent to which these problems affect pediatric patients is also unknown. However, a GAO study indicates that ED staff have less difficulty transferring patients to pediatric beds than adult critical care or other adult inpatient beds (GAO, 2003). Some children's hospitals report that they do not go on diversion because there is no alternative source of care for critically injured or ill pediatric patients. However, ED crowding is at least anecdotally an important problem for many children's hospitals. And in hospitals where adults and children are treated in the same emergency department, the hospital's diversion status would affect children the same as adult patients.

Another challenge to the system is that hospitals are finding it increasingly difficult to identify key specialists, such as neurosurgeons and orthopedists, who are able and willing to take call to treat emergency cases. Surgical specialists typically do not work in the ED full time, but serve in an "on-call" capacity in case they are needed. Surveys confirm that the availability of on-call specialists, including pediatric specialists, in many areas is rapidly eroding, or is already inadequate to meet patients' needs (AAP, 2003; American College of Emergency Physicians, 2004; Vanlandingham et al., 2005) and that the problem is worsening (Green et al., 2005; O'Malley et al., 2005).

Its role as a safety net provider also takes a toll on the emergency care system. Emergency providers are the providers of last resort for millions of patients who are uninsured or lack adequate access to care from community providers. Hospitals on the front lines of safety net care encounter patients with intractable social problems, complications resulting from substance abuse or mental illness, and exacerbations of chronic diseases because of inadequate primary

care and lack of compliance with medical instructions. Much of the service provided to these difficult patients is compensated poorly or not at all. This care places tremendous financial pressure on safety net hospitals, many of which have or are in danger of closing as a result.

It is within this difficult environment that the emergency care system struggles to meet the unique needs of pediatric patients.

Pediatric Emergency Care on the Six Quality Aims

One way to assess how the current emergency care system is meeting the needs of children is to consider each of the six quality aims for care identified by the Institute of Medicine in its landmark report, *Crossing the Quality Chasm*: safe, effective, patient-centered, timely, efficient, and equitable. Although evidence on many of the aims is limited or dated, there is reason to believe that pediatric emergency care is compromised in each of the six aims.

- **Safe**—Patient safety is often compromised in emergency departments because of overcrowding, the rushed and chaotic environment, frequent provider interruptions, provider fatigue from long shifts, and limited information on patients' medical histories (Chisholm et al., 2000; Goldberg et al., 2002; Chamberlain et al., 2004). However, it is difficult to determine the safety of emergency care services for children because data on medical errors in emergency care are generally not available. The one exception is evidence suggesting that medication errors in the emergency department are common for pediatric patients (Selbst et al., 2004; Marcin et al., 2005). Indeed, one study found prescribing errors in the charts of 10 percent of all patients at one pediatric ED (Kozler et al., 2002). Medication errors are especially common for children because doses must be calculated based on the patient's weight—incorrect decimal placement frequently results in 10-fold prescribing errors (Selbst et al., 2004).

Another important threat to the safety of children during emergency care is the lack of knowledge among some providers of how treatment of children differs from that for adults. Without that knowledge and appreciation, a provider could injure a child while providing care. For example, if a provider does not use special pediatric equipment or exercise proper care when intubating a child, life-threatening errors could be made. Nevertheless, physicians with limited pediatric training or experience are responsible for the majority of patient care in some EDs (Goldmann and Kaushal, 2002). In fact, in many parts of the country, the doctors who staff emergency departments are not residency trained in emergency medicine or pediatric emergency medicine (Moorhead et al., 2002). Unfortunately, these providers may treat children as they would an adult because of their lack of training and experience (Gausche et al., 1998; Scribano et al., 2000).

- **Effective**—Are commonly practiced emergency care interventions effective? Surprisingly, it is a difficult question to answer for many types of interventions. Particularly in the EMS environment, there is very little evidence base for what treatments are performed and little data is collected that could be useful in understanding the effectiveness of interventions (Callahan, 1997). There is little or no evidence to support basic system design features, such as tiered levels of response, intensity of medical direction, and type of EMS system (fire-based, volunteer, etc.). The value of deploying paramedics, for example, has been questioned by a recent study (Stiell et al., 2005). A number of clinical practices that are used in current practice, particularly in the prehospital environment, such as, endotracheal intubation, do not have proven benefits (Gausche et al., 2000; Murray et al., 2000; Wang and Yealy, 2005).

Physician practice patterns for pediatric patients also vary widely, and examples are numerous. Substantial differences exist in the management of fever (Isaacman et al., 2001), croup (Hampers and Faries, 2002), splenic injury (Davis et al., 2005; Stylianos et al., 2006), diabetic ketoacidosis (Glaser et al., 1997), bronchiolitis (Mansbach et al., 2005), febrile seizures (Hampers et al., 2000), resuscitation efforts (Scribano et al., 1997), and sedation use (Krauss and Zurakowski, 1998) among physicians of different specialties, perhaps due to differences in specialty training. In some of these cases, there are guidelines for treatment (Isaacman et al., 2001); in others, it is unclear which treatment strategy is most beneficial (Glaser et al., 2001; Mansbach et al., 2005) and outcomes are likely to vary based on the treatment provided. Variability in the management of the same conditions suggests that not all children are receiving the most effective care.

- **Patient-centered**—Patient centeredness encompasses the qualities of compassion, empathy, and responsiveness to the needs, values, and preferences of patients. In the case of pediatrics, where parents are recognized as the child’s primary source of strength and support and play an integral role in the health and well being of the child, “family-centered care” is often used in place of patient centeredness (Eichner et al., 2003). In the prehospital environment, this means that providers should take the time to explain the function of equipment, procedures being performed and their rationale so that family members can be better prepared to make decisions about care. In the ED, family-centered care includes creating a comfortable environment for children and their families, having child-life specialists on staff, and enhancing communication between providers and families. In both environments, it involves giving families the option of being present during procedures and resuscitation, so long as it does not compromise provider or patient safety.

However, few EDs have written policies or guidelines that allow for family presence during invasive procedures (MacLean et al., 2003) and few EMS providers are trained in managing family members or integrating their needs into the needs of the patient (Loyacono, 2001). Further, many EDs, particularly non-pediatric EDs, can hardly be described as family-friendly, with long waits to be seen and uncomfortable environments. In some EDs, adults and children wait together and are treated in the same patient care areas, which can frighten children.

- **Timely**—It is expected that patients with life-threatening problems will have prompt access to emergency care in the prehospital setting as well as in EDs. But timeliness of care is compromised in overcrowded EDs. Surveys have shown that most hospitals hold ED boarders (GAO, 2003) and many have gone on ambulance diversion for varying lengths of time (The Lewin Group, 2002); both practices can result in delayed care. Long ED wait times can result in protracted pain and suffering and delays in diagnosis and treatment (Derlet et al., 2001; Derlet, 2002; James et al., 2005). Unfortunately, existing studies on timeliness of care do not contain analysis specific to pediatric patients.

Of particular concern are children who leave the emergency department without being seen. Several studies have investigated which patients leave without being seen (LWBS) and why. Most conclude that patients leave without being seen because the wait was too long (Stock et al., 1994; Quinn et al., 2003), though one Canadian study found that children most often leave because they began to feel better (Rowe et al., 2003). The majority of patients that leave without being seen have low acuity levels (Fernandes et al., 1994), but in some cases, patients that LWBS are in need of immediate medical attention (Baker et al., 1991; Fernandes et al., 1997). In one study, two thirds of patients that LWBS could identify no alternative site of care that would be available to them other than the ED (Baker et al., 1991). Patients that leave without being seen

are more likely than those who received care to report pain or that the seriousness of their problem had worsened (Bindman et al., 1991). Many end up returning to the ED at another time and a small percent subsequently require hospitalization (Sainsbury, 1990; Bindman et al., 1991).

Specific data on prehospital response times for pediatric patients based on acuity are not currently available. However, seriously ill or injured children present a real challenge to the system's ability to provide timely care, particularly when pediatric specialists are needed. Ambulances may have to drive to a distant hospital in order to access providers with pediatric expertise. But more troubling, under some EMS agencies, ambulances are only authorized to transport patients to the nearest hospital, even if that hospital is not appropriate for the patient. Geographic boundaries of an EMS catchment area may also limit where ambulances may transport patients.

Timeliness also refers to the treatment of pain, and there is some evidence indicating that children do not receive pain management in a timely manner. In one study of hospitals in Illinois, only half of children (aged 15 and younger) in severe or moderate pain were offered an analgesic. Older children were more likely to be offered opioids than younger children, particularly those under age 1 (Probst et al., 2005).

- **Efficient**—Efficiency refers to the system's ability to avoid waste, including the waste of equipment, supplies, and energy (IOM, 2001). The considerable patient loads that EDs are required to treat demands efficient care delivery. Clearly there are many children who use prehospital and ED services that might be treated elsewhere if such care were available. One study in this area found that when Medicaid children are provided enhanced, coordinated access to primary care, utilization of the ED is lower for healthy children while the total cost of care remains the same (Wang et al., 2005).

But whether it is efficient for those patients to receive care in the ED rather than wait for treatment at a later date remains open for debate. Although EDs are presumed to have many inefficiencies, the economies of scale resulting from utilization of fixed capital may make it cost effective to accommodate a certain amount of "after hours" non-urgent care in the hospital ED if this gets patients treated more quickly and allows parents to work the following day. Also, when the opportunity costs to patients and employers for reduced time loss are factored in, the emergency system may look like a reasonably good alternative. Regardless, many of the patients that use the ED for non-urgent care lack access to other sources of care; restricting their use will put their health at greater jeopardy.

Under the current system, providers do not have access to patients' medical histories, which can result in the ordering of diagnostic tests that the patient has already received (Cordell et al., 1998). Many emergency physicians fear the legal consequences of failing to detect rare but dangerous conditions, and compensate by ordering costly diagnostic tests and treatments (Katz et al., 2005). Although some surveys indicate that defensive medicine is not a widespread problem or major contributor to rising health costs (Office of Technology Assessment, 1994; Pearson et al., 1995), research suggest that it does occur and that physicians with a perceived high risk of a lawsuit are more likely to order tests and procedures that may not be needed (Lawthers et al., 1992). Defensive medicine may be more common in emergency settings, where the prevalence of serious illness and injury is high, the public's expectation of diagnostic accuracy is high, and the physicians' risk of making an error is increased by the limited time available to make a diagnosis and the lack of an ongoing relationship with the patient and his or her family.

Overall, it would be a considerable stretch to describe the emergency care system as efficient. The practice of boarding patients, long waits at EDs, ambulance diversion, and long EMS patient off-load times all indicate that the system does not operate smoothly.

But all of the issues concerning efficiency described above apply to both adult and pediatric patients. There is little information on efficiency that is specific to pediatric emergency care. An exception is that one study looked at the efficiency of residents in a pediatric emergency department in terms of number of patients evaluated and treated. The study showed that efficiency varied by residents' subspecialty and years of training (Dowd et al., 2005). Still, there is little information on the cost-effectiveness of pediatric emergency care. Recognizing the absence of data in this area, the EMS-C Program listed the development of additional economic analyses of pediatric emergency care as an objective in its most recent five-year plan (MCHB, 2004a).

- **Equitable**—Disparities in access and outcomes have long been a problem in the U.S. health care system (IOM, 2002; AHRQ, 2003). One might assume that because the emergency care system services all individuals regardless of insurance status, age, race, or income, greater equity may exist for emergency care. However, of the small number of studies that have looked at equity in emergency care – and the very few that have examined equity in pediatric emergency care – many indicate that inequities in treatment and access exist.

We know from the discussion on effectiveness that not all patients receive the same type of treatment even if they suffer from the same conditions, which indicates a lack of equity in receipt of care. There is some evidence of variability in treatment based on patients' race and ethnicity for patients of all ages. For example, African Americans and Hispanics are less likely to receive pain medication for certain conditions (Todd et al., 2000) and African American patients are more likely than whites to be denied authorization for ED visits by their primary care provider (Lowe et al., 2001). However, disparities also extend to children of different races and ethnicities. Studies indicate that (Todd et al., 1994) wait times for pediatric patients vary based on race and ethnicity (James et al., 2005), that racial and ethnic disparities exist in ED care provided to children with mild traumatic brain injury (Bazarian et al., 2003), and that African American children with orthopedic fractures covered by Medicaid are less likely to receive parenteral analgesic and sedative than other patients with similar injuries (Hostetler et al., 2002).

Although only a limited number of studies have looked at racial and ethnic disparities in emergency care, there is belief among some that it is a greater problem than is currently recognized. Racial and ethnic disparities may occur in the prehospital setting through ambulance destination, triage assessments, diagnostic testing, and disposition decisions. In the ED, disparate treatment may include the timing and intensity of therapy, patterns of referral or prescription choices, and/or priority for hospital admission or bed decisions (Richardson et al., 2003).

However, not all studies indicate disparities in treatment. Oster and Bindman (2003) found that emergency department triage and admission decisions were made independent of racial, ethnic or financial considerations (Kellermann and Haley, 2003; Oster and Bindman, 2003).

Disparities in care also occur based on age. Prehospital providers are less likely to administer treatment to young children in comparison to adults (Gausche et al., 1998; Scribano et al., 2000). For example, one study found that paramedics are less likely to perform basic resuscitation procedures for pediatric patients in comparison to equally critical adults (Su et al., 1997). This is discussed further in Chapter 4. Children are less likely to receive pain medication than adults, and the youngest children, those under age 2, are less likely to receive pain management than

older children (Selbst and Clark, 1990; Petrack and Christopher, 1997; Alexander and Manno, 2003).

Naturally, geography also plays a very important role in access to emergency care and pediatric specialists. Issues in rural pediatric emergency care are explored in the next section.

Rural Pediatric Emergency Care

In 2000, there were more than 15 million children less than 18 years of age residing in rural areas, constituting a full 26 percent of the rural population of the United States (U.S. Census Bureau, 2000). While there is no standard definition of a rural area, the basic demographic feature is that is a place of low population density and small aggregate size (IOM, 2005). Despite the large numbers of patients requiring emergency care, rural children still encounter significant barriers to appropriate emergency care (AAP, 2000). Friedlander, et al, points out that these rural children are classically underserved, with the conditions of poverty transcending geographic considerations (Friedlaender, 2004). Compared to non-rural, rural children tend to be poorer, lacking in access to primary care and appropriate referral sources, are more likely to be covered by a public insurance program, and are more likely to utilize an ED.

In 2003, more than 14 percent of people living outside of a metropolitan area existed below the poverty level, compared to 12 percent of their metropolitan counterparts (U.S. Census Bureau, 2004). According to the Kaiser Commission on Medicaid and the Uninsured, 47 percent of rural families have incomes less than 200% of the poverty level (compared to 27 percent non-rural), qualifying a disproportionately large number of rural children for Medicaid benefits and emphasizing their reliance on public insurance. Less than half of rural children living in counties not adjacent to a county with a large city have private insurance coverage. Thirty percent of these children are covered by Medicaid or S-CHIP (as compared to 19 percent of urban/adjacent rural children), and 1 in 5 are uninsured (Kaiser Family Foundation, 2003).

Rural residence has been demonstrated to be predictive of ED use in low-income children (Polivka et al., 2000). Sharma and colleagues determined that in infants, the highest rate of ED use, 1.8 per person year, was obtained by rural white infants on Medicaid. The lowest rate, 0.4 visits per person year, was seen in urban white infants with commercial insurance (Sharma et al., 2000).

Rural emergency care for pediatric patients is subject to many of the same issues as emergency care in other areas. However, many studies have shown differences in the epidemiology of pediatric emergency care use between rural and urban areas. In an examination of pediatric coroners' cases in both rural and urban California counties, rural children were less likely to use EMS provider services than their urban counterparts (66% vs. 84%) and a significantly greater number of rural children died on the street or highway (Gausche et al., 1989). In rural counties of California, Seidel reported that trauma was a more frequent complaint in rural areas, instigating 64% of all rural prehospital calls (Seidel et al., 1991). A study by Svenson found trauma in rural settings of Kentucky to be responsible for nearly 50% of EMS calls (Svenson et al., 1996). Rural trauma centers have also been demonstrated to receive proportionately more victims of motor vehicle crashes (28.5%) and 'other' injury classification (28.2%), to which bicycle injuries are assigned (Nakayama et al., 1992). More recently, similar injury patterns were noted by Serleth between 1990–1993 where over half of all pediatric trauma admissions were the result of injuries related to falls, recreational activities, and motor vehicle crashes (Serleth et al., 1999).

Despite the variations over time and setting by the above studies, trauma was a leading cause of EMS activation by rural children in each study. But there are deficiencies in the provision of ALS in rural areas. The use of BLS/ALS was dependent on the patient's age and the level of provider care, with ALS provision to younger children less frequent. Failure to provide ALS occurred even though time on scene would not have been prolonged (Svenson et al., 1996). Gausche documented only 66 % of rural child victims of trauma to have received ALS interventions, 31% less than urban children in the same study (Gausche et al., 1989). So, rural children are more likely to require EMS for traumatic injuries, but are less likely to obtain EMS services and appropriate life support modalities. Additionally, a recent study of admissions in rural EDs indicates higher nonessential admission rates at rural hospitals and by non-pediatric EM physicians, which may reflect a lack of resources, comfort, or expertise of emergency providers to care for pediatric patients (Derrington et al., 2005).

Rural emergency care providers and provider organizations face a number of operational challenges that those in urban or suburban areas do not. In rural areas, the relatively low volume of emergency calls in relation to the high overhead of keeping a prepared staff results in very high costs per transport. In order to lower those costs, many rural EMS squads rely on volunteers, rather than paid EMS providers, which by nature results in a less stable system. But in many rural communities, younger residents are leaving while the remaining population becomes more elderly. As a result, the pool of potential volunteers is dwindling as their average age and the demands on their time increases. The closure or restructuring of many rural hospital facilities has further increased the demand on rural EMS agencies by creating an environment that requires long-distance, time-consuming, and high-risk inter-facility transfers. Another challenge facing some rural areas is that the population can swell – double or triple – during tourist season. As such, the EMS staffing required throughout the year varies.

Under the Balanced Budget Act of 1997, Congress established the Medicare Rural Hospital Flexibility Program. In addition to providing cost-based reimbursement to certain rural hospitals, the “Flex Program” provides states with grants to support the rural health infrastructure and foster the growth of collaborative rural healthcare delivery systems. In fiscal year 2003, states received approximately \$22 million, with an average state award of approximately \$500,000. EMS systems development has been a growing focus of state planning efforts under the grants (Flex Monitoring Team, 2004). The committee finds this trend promising and encourages states to focus attention on pediatric needs within rural EMS systems.

REIMBURSEMENT FOR PEDIATRIC EMERGENCY CARE

The costs of providing emergency care services reflects not just the operational costs of responding to each emergency call, but also the cost of readiness of having personnel available on a 24-hour, 7-day a week, 365-day a year basis. The importance of appropriate reimbursement for pediatric emergency care services is obvious. It allows emergency organizations to increase their readiness by hiring and retaining providers with the right mix of skills and training, offer continuing pediatric education, and equip providers with appropriate pediatric supplies. It also allows providers to make investments that can improve the quality of care delivered, from the development of new quality initiatives to the installation of information systems. This section is focused on reimbursement issues for pediatric emergency care.

Funding for pediatric emergency care differs from funding for adult emergency care in that the payor mix is different, which has important implications for reimbursement levels. Emergency care provider organizations are highly dependent on the Medicaid and SCHIP

programs for reimbursement for pediatric emergency care services. To the extent that those programs do not adequately cover the cost of services provided to Medicaid and SCHIP enrollees, providers are harmed financially by providing services to those patients. At the time of this writing, policymakers are facing a dilemma with the Medicaid program's growing expenditures. Among the options being considered are significant cuts in benefits coupled with increases in patient cost sharing. While the committee believes that fair provider payment for emergency care services under Medicaid is critical, they recognize the political and economic realities of proposing increases in payment at this time. As a result, this section is designed to highlight some of the difficulties associated with reimbursement for pediatric emergency care services rather than to suggest immediate changes to payment and policies.

Payor Mix

Although some emergency providers may receive financial support through public subsidies or private donations, the primary source of income for emergency providers is reimbursement for services. Because reimbursement levels vary based on the insurance status of the patient, payor mix is critical to the financial health of providers.

Data from the March 2004 CPS data indicate that in 2003, 61 percent of children were covered by private insurance, 27 percent by Medicaid or other public insurance programs (for example, SCHIP or Medicare), and 12 percent were uninsured (Kaiser Family Foundation, 2004b). If all children used emergency services at the same rate, the payor source for emergency care visits would mirror the data on insurance coverage for children. However, that is not the case. There are important differences in the use of emergency services by insurance status. Table 2-7 displays information on the expected source of payment for ED visits made by children and adults in 2002.

TABLE 2-7 Payor Mix for ED Visits, Children and Adults, 2002

	Children (<19)	Non-Elderly Adults (19–64)
Private Insurance	42%	44%
Medicaid/SCHIP	37	16
Medicare	1	6
Self-Pay	10	20
No Charge	1	2
Workers Comp	0	3
Unknown	9	10

Source: 2002 NHAMCS data, calculations by IOM staff.

Privately insured children use the emergency department less than publicly insured or uninsured children. Although 61 percent of children are covered by private insurance, they represent approximately 42 percent of pediatric visits to emergency departments. Children covered by Medicaid or other public programs tend to use the emergency department at disproportionately high rates. Only 27 percent of children are covered by Medicaid or other public insurance but they account for at least 37 percent of all pediatric visits to EDs. Uninsured children tend to use the emergency department at rates proportionate to their numbers.

The difference in payor mix between non-elderly adult and pediatric emergency department visits is also notable. Children are more likely to be covered by Medicaid or SCHIP than their adult counterparts, but considerably less likely to be uninsured. Data on payor mix for

prehospital care at the national level are unavailable, but, as noted earlier, data from regional ambulance services confirm the heavy reliance of pediatric patients on Medicaid or SCHIP for health insurance coverage. However, these regional data also indicate that a large percent of pediatric ambulance calls are for uninsured children, and therefore, not likely to be reimbursed. Indeed, an examination of EMS transports by the Albuquerque, NM ambulance service (which provides 99% of EMS transports in that city) during 1992 through 1995 showed that 57% of transports for patients under 21 were uninsured. That study also found that payment source varied by patient age with public insurance overrepresented among patients younger than 11 years old, private insurance and uninsurance were overrepresented among patients aged 11 to 16 years old and no insurance was overrepresented in the 17 to 20 year old age group (Sapien et al., 1999).

Medicaid and SCHIP

Medicaid is a federal-state health insurance entitlement program that provides coverage for low-income people. The program is administered by the states and the federal government sets guidelines and matches state spending between 50 and 77 percent, depending on state per capita income (Kaiser Family Foundation, 2004a). Children typically qualify for Medicaid coverage by meeting financial criteria, which varies across states. Federal law mandates coverage of some groups below specified minimum income levels, but also allows states to expand Medicaid eligibility beyond those levels. Medicaid coverage is relatively broad, covering inpatient and outpatient services including emergency services, physician and nurse practitioner services, nursing home and home health care, lab and X-ray services, and early and periodic screening, diagnostic, and treatment (EPSDT). In addition, states commonly cover a wide range of optional Medicaid services including prescription drugs, durable medical equipment, and clinic services (Kaiser Family Foundation, 2004a). In June 2003, there were over 42 million individuals enrolled in Medicaid (CMS, 2003). While the program also covers other groups, children represent approximately 50 percent of Medicaid enrollees (Kaiser Family Foundation, 2004a).

The State Children's Health Insurance Program (SCHIP) is a relatively new public insurance program, introduced in 1997. SCHIP is designed to cover "near poor" children whose family income levels are too high to qualify for Medicaid yet too low to purchase private coverage. SCHIP operates like the Medicaid program in that it is administered by the states and funding is matched by the federal government up to a limit. However, under the SCHIP program, states have greater flexibility to define eligibility requirements and benefits. Some states design their SCHIP programs as essentially expansions of their Medicaid programs; in other states, SCHIP is an entirely separate health insurance program with different benefits and cost sharing requirements. Also, unlike Medicaid, SCHIP is not an entitlement program. In fact, some states have a waiting list for enrollment. In the third quarter of 2004, approximately 3.5 million children were enrolled in SCHIP (CMS, 2004).

Children covered under Medicaid and SCHIP are needy in terms of their low family incomes and the prevalence of health problems. In comparison to privately insured children, those covered by Medicaid or SCHIP are more likely to report only fair or poor health, have asthma, have learning disorders, and have medical conditions that require regular treatment with prescription drugs (Ku and Nimalendran, 2004).

States have considerable freedom to develop their own methods and standards for Medicaid reimbursement. The Omnibus Budget Reconciliation Act of 1989 requires that Medicaid payments to providers "are sufficient to enlist enough providers so that care and services are

available under the plan at least to the extent that such care and services are available to the general population in the geographic area.” This provision, known as the “equal access” provision, has traditionally not been enforced by CMS. In fact, many states establish physician payment rates without guidance and may not review their rates for several years at a time (AAP, 2002).

The result is that Medicaid reimburses care at a lower rate than other payors. Medicaid reimbursement rates are approximately 60 percent of Medicare rates and only 35 to 40 percent of private insurance rates. In a survey conducted by the American Academy of Pediatrics (AAP), over half of responding pediatricians said that Medicaid payments failed to cover overhead (AAP, 2002).

The low reimbursement rates under Medicaid are evident from results of a 2001 AAP survey of state Medicaid offices. For three different types of ED visits, the average Medicaid rate was well below the Medicare rate in the vast majority of states. Selected survey results are displayed in Table 2-8. These results also show the tremendous variation in reimbursement across states.

TABLE 2-8 Medicaid Rates for ED Visits, 2001

ED Visit	Medicare Rate	Average Medicaid Rate	Lowest Medicaid Rate	Highest Medicaid Rate	Number of states where the Medicaid rate is higher than the Medicare rate
Low complexity decision	\$30.61	\$25.85	\$9.00	\$50.40	11
Intermediate complexity decision	\$64.66	\$41.68	\$9.00	\$97.00	2
High complexity decision	\$100.62	\$61.28	\$9.00	\$148.91	1

SOURCE: AAP Medicaid Reimbursement Survey, 2001.

Medicaid rates for emergency services are so low that hospitals tend to collect a greater portion of their charges from uninsured patients than from Medicaid patients. Tsai and colleagues examined payments for emergency department care using 1998 data from the Medical Expenditure Panel Survey. They found that in 1998, the percent of charges paid by the uninsured was 58%; the percent of charges paid by Medicaid was only 44%. Their analysis includes both children and adults (Tsai et al., 2003).

There are other important problems with Medicaid reimbursement in addition to the low rates. States also have various rules and practices under Medicaid that limit the ability of providers to collect timely payments for services provided. First, some Medicaid program will provide reimbursement for only one service per patient per day. But many children, particularly those with special needs, receive multiple services on the same day. As a result, some services go completely unreimbursed. Second, some states have rules against providing payment to providers if the beneficiary seeks service in another state. This is particularly troubling to

providers near a state boarder, such as Washington, DC., Chicago, and Kansas City. Many patients opt for care outside of their state of residence, particularly if a children's hospital is on the other side of the boarder. In addition, the Medicaid payment cycle can be twice as long as most private insurance payors so providers do not receive timely reimbursement. Third, some Medicaid programs do not reimburse for a variety of services that are provided to pediatric patients in the ED. An example is sedation and analgesia, which are not reimbursable services under the Illinois Medicaid program. Any prevention services provided in the ED, even though they have the potential to reduce future ED visits, are also not typically reimbursed. And finally, the retrospective nature of Medicaid payment does not account for the diagnostic resources that may be necessary during an ED visit. For example, in some states Medicaid may pay for treatment of a fractured ankle, but not a sprained ankle; however, the only way to determine whether the ankle is fractured is through an X-ray. If the X-ray is negative, Medicaid will not pay for the X-ray or the service provided to the patient.

Clearly, there are a number of problems associated with Medicaid payment for pediatric emergency care services. While coverage expansions through SCHIP may aid in offsetting the cost of uncompensated care, the low reimbursement rates and poor payment policies of both programs may not meet the financial needs of operating a pediatric ED.

The impact of Medicaid's poor payment policies are felt most acutely by safety net and Children's Hospitals, because of their sizable dependence on Medicaid as a revenue source. Data from the Children's Memorial Hospital in Chicago, IL indicate that a large and growing number of ED patients are covered by Medicaid (Table 2-9). Because of Medicaid's poor payment rates and policies, in 2004, the hospital lost \$1.2 million for treating 28,000 patients covered by Medicaid. If Medicaid paid the same rates paid by Medicare, the hospital would just about break even on those ED patients. While it's true that children's hospitals receive additional sources of funding, for example, disproportionate share hospital payments and graduate medical education funding, those sources still may not cover the hospital's operating expenses. Many children's hospitals pursue philanthropy as a way to cover operating expenses.

TABLE 2-9 Growing Dependence on Medicaid at One Children's Hospital

	1999	2000	2001	2002	2003	2004
Total ED Visits	40,556	39,991	43,882	46,841	47,200	49,511
Medicaid ED Visits	20,278	20,395	23,696	26,230	26,902	28,201
Percent Medicaid	50%	51%	54%	56%	57%	57%

SOURCE: Data from Children's Memorial Hospital Emergency Department.

Given the low payment rates under Medicaid, it should not be surprising that children—even those with private insurance coverage—have difficulty accessing pediatric specialists in the ED. If specialists expect that one-half of all patients at Children's Hospital EDs will be covered by Medicaid, they may not be willing to provide care in the ED.

Medicaid payment for prehospital services is no better. Medicaid pays a fixed rate—\$25 in some states—for an EMS transport, regardless of the complexity of the case or the resources utilized. Additionally, reimbursement is provided only when a patient is transported. This

naturally leads to perverse incentives to transport patients to the ED, even if they do not require an ED visit.

Other Payment Considerations

While Medicaid concerns are primary, there are a number of other reimbursement issues specific to pediatric care that make it difficult for emergency care providers to collect appropriate revenues for services rendered.

Only a small percentage of children (less than one percent) have health insurance coverage under the Medicare program (U.S. Census Bureau, 2005). Medicare is a federal program that provides health care coverage to senior citizens and individuals with disabilities. However, the way that Medicare reimburses providers—using the Resource Based Relative Value Scale (RBRVS)—serves as a model for other payors. The RBRVS is a way of valuing physician services based on physician work, associated practice expense, geographic location, and professional liability expense. However, the RBRVS does not recognize the considerable work effort involved in providing emergency services to children—particularly infants and young children. And in fact, there are several reasons why pediatric emergency care requires greater physician time and attention than adult emergency care. First, emergency providers must respond to children's fear and anxiety before examinations or treatment, which tends to add time and stress. Providers must also address the needs of parents, which adds an element of complexity. Second, providers must constantly adapt the examination or procedure in response to the patients' level of cooperation or changing behavior. For example, a child may need to be sedated in order to allow ED staff to perform suturing whereas suturing an adult is a relatively simple task. Third, pediatric emergencies may require follow-up with a number of different individuals and organizations including day care facilities, schools, parents/guardians, which results in increased time (Committee on Coding and Nomenclature, 2004). Certainly similar concerns regarding extra work effort could be made for other patient groups, such as the elderly—the RBRVS does not currently recognize the greater work effort necessary for those patients either.

Like some Medicaid programs, the Medicare program does not provide payment for certain services provided in the ED. Certain neonatal and pediatric critical care services, preventive care, some vascular care, immunizations, and sedation/analgesia are not recognized, reimbursable pediatric services. Because the Medicare payment system serves as a model for private payors and some Medicaid programs, other payors also exclude reimbursement for those services.

In addition to serving as an important source of reimbursement for patient services for the elderly, Medicare is also the largest source of funding for graduate medical education (GME). In fact, U.S. teaching hospitals receive approximately \$7 billion each year in order to help cover the additional expenses that are associated with training medical residents (HRSA, 2002). However, because children's hospitals treat children, rather than many elderly Medicare recipients, children's hospitals have largely been excluded from Medicare GME payments (National Association of Children's Hospitals and Related Institutions, Accessed in 2006). Congress has recently addressed this imbalance through special funding for independent teaching children's hospitals. However, children's hospitals are arguably less able to financially support resident training than other hospitals. This has resulted in a reluctance on the part of some children's hospitals to have emergency medicine residents train at their facilities because emergency medicine residents compete with pediatric residents and pediatric specialists for limited training dollars.

Despite the reimbursement problems associated with pediatric emergency care services, a number of hospitals have recently added pediatric emergency departments. Although this movement appears counterintuitive, hospitals view pediatric EDs as a way of generating revenue for the organization. Parents and caregivers generally prefer to bring their children to a pediatric ED, rather than a general ED. In addition, pediatric emergency departments offer a marketing opportunity by bringing additional family members into contact with the associated hospital. One study found that an offsite pediatric urgent care clinic helped to increase a hospital's market share, capturing a large number of well-insured patients (Tennyson, 2003). Certainly these new pediatric emergency departments are not opening up in areas where many uninsured and Medicaid children reside. And in fact, they may be causing additional financial difficulties for children's hospitals if they are pulling the privately insured patients away from those hospitals.

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3

Building a 21st-Century Emergency and Trauma Care System

The committee's vision for the emergency care system is rather simple. The committee envisions a system in which patients of all ages and in all communities receive well planned and coordinated emergency care services. Inclusion of pediatric concerns during planning stages will ensure that the system meets the needs of children. Dispatch, EMS, ED providers, trauma, public safety, and public health will be fully interconnected and united in an effort to ensure that each patient receives the most appropriate care, at the optimal location, with the minimum delay. From the standpoint of the patients and their parents or guardians, delivery of emergency care services will be seamless. All service delivery will be evidence-based, and innovations will be rapidly adopted and adapted to each community's needs. The performance of the system will be completely transparent, so that EMTs and parents know which hospitals are best able to deliver care to critically ill or injured children (See Box 3-1).

BOX 3-1 Pediatric Emergency Care in 2010

In a rural area, a car slides off the road and crashes 30 minutes from the nearest town. An automated crash notification system signals an emergency response center with detailed information about the location and characteristics of the crash. Passenger weights indicate that an adult and child, both properly restrained, are in the car. A dashboard displays information about the crash to air and ground response teams, emergency departments, and trauma facilities throughout the region. Because of the large impact of the crash, the automated triage system launches two ALS response teams. An air medical response team is placed on standby.

Once on the scene, patients' complete medical history and alerts, obtained through a regional information system, are instantly available to the EMS teams. Using an evidence-based triage protocol, one of the EMS teams determines that the child, an 8-year-old boy, is suffering from serious injuries. In accordance with regional transport protocols, the first responders call for air transport to bring the boy to the nearest trauma center. The paramedics stabilize the boy using age and size scaled equipment and drugs, and begin transmission of telemetry and on-board diagnostic scans to the trauma center. The other EMS team assesses the child's father and determines that, although he requires a lower level of care, he should be transported to the trauma center to accompany his son.

An air transport team arrives at the scene and transports the child and father to a level one trauma center with the resources and medical experts needed to handle high level pediatric and adult trauma. Care continues to be delivered en route following evidence-based treatment guidelines. The pediatric trauma specialist—alerted to the emergency when the air medical team was dispatched—performs emergency surgery when the child arrives at the hospital and a pediatric intensivist is available for consult. The child receives the highest level of care based on the available clinical evidence. His medications, all approved for use in children, are delivered according to dosage guidelines for his age and size. The child's pediatrician and father's primary care provider are notified of the event.

The child's mother, who was not in the vehicle, is contacted immediately and apprised of the status of her husband and son. While understandably upset at the news, the mother takes some comfort knowing that her husband and son are at a trauma center that has earned high marks for quality care delivery. When the mother arrives at the hospital, she is met by a social worker and nurse and given a clear explanation of the surgery being performed on her son. Hospital staff remain

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available to answer all of her questions. After surgery, the child is admitted to the hospital where he spends a couple of days in recovery. When the child is eventually released from the hospital, the parents are given clear instructions for his continued care.

A record of the event is automatically collected by the region's emergency care information system, capturing information from the ground and flight paramedics as well as the hospital. A copy of that information is sent to the state trauma registry as well as the National Trauma Data Bank. Additionally, the automatic crash notification system identifies that the crash occurred in an area where crashes are common and sends a notification to the public health department.

The committee recognizes that improving care for children cannot occur without addressing some of the failings in the larger emergency care system. The committee's vision centers on three goals: coordination, regionalization, and accountability. While the vision may sound innovative, many elements of the vision have been advocated for decades. However, early progress to achieve these elements was derailed due to deeply entrenched political interests and cultural attitudes, as well as funding cutbacks and practical impediments to change. These obstacles remain today, and represent the chief challenges to achieving the committee's vision. Concerted, cooperative efforts at multiple levels of government and the private sector are necessary to finally break through and achieve these goals.

This chapter is dedicated to describing the key goals of the committee's vision for the emergency care system of the future, with a special focus on pediatric emergency care. In some areas of the country, states and regions are already developing coordinated, regionalized systems that have elements of accountability. A few of these efforts are described.

GOAL 1: COORDINATION

The current emergency care system is facing a number of problems, but among the most longstanding is that emergency services are fragmented, resulting in poor communication and delayed services. EMS, hospitals, trauma centers, and public health have traditionally worked in silos, a situation that largely persists today (NHTSA, 1996). For example, public safety and EMS agencies often lack common communications frequencies and protocols for communicating with each other during disasters. Similarly, emergency care providers do not have access to patient medical histories that could be useful in decision-making. But even within those silos, coordination may be limited. For example, only about half of hospitals with EDs have pediatric interfacility transfer agreements (MCHB, 2004), which are necessary in case a hospital has a critically ill or injured child but lacks the resources to properly manage his or her care. Jurisdictional borders also contribute to fragmentation under the current system. For example, one county in Michigan has 18 different EMS systems with different service models and protocols. Medicaid and other payor policies contribute to geographical fragmentation when reimbursement does not seamlessly follow patients across state lines.

The problem is exacerbated in some regions by turf wars between firefighters and EMS personnel that were documented in a series of articles for USA Today (Davis, 2003). Even within emergency departments (EDs), there may be friction between emergency staff trying to admit patients and personnel on inpatient units who are understaffed and have no incentive for speeding the admissions process. Lack of coordination between EMS and hospitals can result in delays compromising care, and emergency departments may clash with on-call specialists over delays in response.

Also contributing to fragmentation is that pediatric concerns are often not included in initial planning stages. Either pediatric concerns are overlooked entirely or planning for adult and pediatric care occurs independently. This is particularly true of disaster and trauma planning. A 2003 NASEMSD survey found that only 14 states involved pediatric experts in the development of the state, regional, and local disaster planning. It is not surprising, then, that the majority of state disaster plans do not address pediatric equipment and medications at hospitals (National Association of State EMS Directors, 2004). Only about half of states report having designated pediatric trauma centers and trauma registries, indicating another important gap in planning (MCHB, 2004).

Importance of Linkages with Public Health

The ED has a special relationship with the community and state and local public health departments because it serves as a community barometer of both illness and injury trends (Malone, 1995). In her analysis of heavy users of ED services, Malone argues that “emergency departments remain today a ‘window’ on wider social issues critical to health care reforms.” A commonly cited example is the use of seat belts. We now know that increased utilization of seat belts reduces the number of seriously injured car crash victims in the ED—the ED served as an incubator for documenting the results of pre- and post-seat belt enforcement initiatives. Although prevention activities have been limited in the emergency care setting, that setting represents an important teaching opportunity. To take advantage of that opportunity, emergency care providers would benefit from the resources and experiences of public health agencies and experts in establishing injury prevention activities.

Perhaps now more than ever, with the threat of bioterrorism and outbreaks of such diseases as avian influenza and severe acute respiratory syndrome (SARS), it is essential that EMS, EDs, trauma centers, and state and local public health agencies partner to conduct surveillance for disease prevalence and outbreaks and other health risks. Hospital EDs can recognize the diagnostic clues that may indicate an unusual infectious disease outbreak so that the public health authorities can respond quickly (GAO, 2003c). However, a solid partnership must first be in place—one that allows for easy communication of information between emergency providers and public health officials.

Importance of Linkages with Other Medical Care Providers

According to the American College of Emergency Physicians (ACEP), EDs “define their mission in terms of unlimited access regardless of citizenship, insurance status, ability to pay, day of week, or time of day...it is the only source of care available for certain populations” (O’Brien et al, 1999). Indeed, EDs fill many existing gaps within the health care network, serving as key safety net providers in many communities (Lewin and Altman, 2000). Studies have shown that a significant number of patients use the ED for nonurgent purposes because of financial barriers, lack of access to clinics after hours, transportation barriers, convenience, and lack of a usual source of care (Young et al., 1996; Grumbach, 1993; Koziol-McLain, 2000; Wilson and Nguyen, 2004; Peterson et al, 1998; Cunningham and May, 2003). There is also evidence that clinics and physicians are increasingly using EDs as an adjunct to their practice, referring patients to the ED for a variety of reasons, including their own convenience after regular hours, reluctance to take on a complicated case, the need for diagnostic tests they cannot perform in the office, liability concerns, and so on (Berenson et al., 2003; Studdert et al., 2005).

Unfortunately, in many communities there is little interaction between emergency care services and community safety net providers, although they share a common base of patients, and their actions may affect one another substantially. The absence of coordination represents missed opportunities for enhanced access; improved diagnosis, patient follow-up, and compliance; and enhanced quality of care and patient satisfaction.

Previous Calls for Improved Coordination

The value of integrating and coordinating emergency care has long been recognized. The 1996 National Academy of Sciences/National Research Council (NAS/NRC) report *Accidental Death and Disability* called for better coordination of emergency care through Community Councils on Emergency Medical Services, which would bring together physicians, medical facilities, EMS, public health, and others “to procure equipment, construct facilities and ensure optimal emergency care on a day to day basis as well as in disaster or national emergency” (NAS and NRC, 1966). In 1972, the NAS/NRC report, *Roles and Responsibilities of Federal Agencies in Support of Comprehensive Emergency Medical Services*, promoted an integrated, systems approach to planning at the state, regional, and local levels and called for the Department of Health, Education, and Welfare (DHEW) to take an administrative and leadership role in federal EMS activities. The Emergency Medical Services Systems Act of 1973 (P.L. 93-154) created a new grant program in the Division of EMS in DHEW to foster the development of regional EMS systems. The Robert Wood Johnson Foundation added support by funding the development of 44 regional EMS systems. Although the drive toward system development waned after the demise of the DHEW program and the block-granting of EMS funds in 1981, the goal of system planning and coordination has remained paramount within the emergency care community. In 1996, the National Highway Traffic Safety Administration’s (NHTSA) *EMS Agenda for the Future* also emphasized the goal of system coordination:

EMS of the future will be community-based health management that is fully integrated with the overall health care system. It will have the ability to identify and modify illness and injury risks, provide acute illness and injury care and follow-up, and contribute to treatment of chronic conditions and community health monitoring...patients are assured that their care is considered part of a complete health care program, connected to sources for continuous and/or follow-up care, and linked to potentially beneficial health resources...EMS maintains liaisons, including systems for communication with other community resources, such as other public safety agencies, departments of public health, social service agencies, departments of public health, social service agencies and organizations, health care provider networks, community health educators, and others.....EMS is a community resource, able to initiate important follow-up care for patients, whether or not they are transported to a health care facility (NHTSA, 1996).

Successes Achieved

While progress toward a highly integrated emergency care system has been slow, there have been some important successes in the coordination of emergency care services, which point the way toward solutions to the fragmentation that dominates the system today. For example, the trauma system in Maryland, described in more detail later in this chapter, provides a

comprehensive and coordinated approach to the care of injured children. Children's hospitals have also been successful at regional coordination to ensure the transport and appropriate care of children needing specialized services. The pediatric intensive care system is a leading example of regional coordination among hospitals, community physicians, and EMTs (Gausche-Hill and Wiebe, 2001). These are but a few examples that demonstrate the possibilities for enhancing coordination of the system as a whole.

One promising public health surveillance effort is Insight, a computer-based clinical information system at the Washington Hospital Center (WHC) in Washington, D.C., designed to record and track patient data, including geographic and demographic information. The software proved useful during the 2001 anthrax attacks, when it enabled WHC to transmit complete, real-time data to the Centers for Disease Control and Prevention (CDC) while other hospitals were sending limited information with a lag of one or more days. The success of Insight attracted considerable grant funding for the system's expansion; WHC earmarked \$7 million for Insight to link it to federal and regional agencies and to integrate it with other hospital systems (Kanter and Heskett, 2002).

Many communities have established primary care networks that integrate hospital EDs into their planning and coordination efforts. A rapidly growing number of communities, such as San Francisco and Boston, have developed regional health information organizations that coordinate the development of information systems to facilitate patient referrals and tracking and the sharing of medical information between providers to optimize the patient's care across settings. The San Francisco Community Clinic Consortium brings together primary and specialty care providers and EDs in a planning and communications network that closely coordinates the care of safety net patients throughout the city.

The Importance of Communications

Communications are a critical factor in establishing systemwide coordination. An effective communications system is the glue that can hold together effective, integrated emergency care services. It provides the key link between 9-1-1/dispatch and EMS responders, and is necessary to ensure that on-line medical direction is available when needed. It enables ambulance dispatchers to tell callers what to do until help arrives and to track the patient's progress following the arrival of EMS responders. An effective communications system also enables ambulance dispatchers to assist EMS personnel in directing patients to the most appropriate facility based on the nature of the patient's illness or injury and the capacity of receiving facilities. It links the emergency medical system with other public safety providers—such as police, fire and emergency management, and public health—and facilitates coordination between the medical response system and incident command in both routine and disaster situations. It helps hospitals communicate with each other to organize interfacility transfers and arrange for mutual aid. And it facilitates medical and operational oversight and quality control within the system.

GOAL 2: REGIONALIZATION

Because not all hospitals within a community have the personnel and resources to support high-level pediatric emergency care delivery, critically ill and injured children should not be directed simply to the closest facility, but to the nearest facility with the pediatric expertise and resources needed to deliver high level care. The goal of regionalization is to improve patient

outcomes by directing patients to facilities with the optimal capabilities and best outcomes for any given type of illness or injury. A regionalized system ensures access to care at a level appropriate to patient needs while maintaining efficient use of available resources (Wright and Klein, 2001).

Regionalization of emergency care is not a new concept. The 1993 IOM report *Emergency Medical Services for Children* noted that, “categorization and regionalization are essential for full and effective operation of [pediatric emergency care] systems.” Steps to regionalize certain pediatric services have been supported by The American College of Critical Care Medicine and the Society of Critical Care Medicine in their 2000 *Consensus Report for Regionalization of Services for Critically Ill or Injured Children* (Committee on Pediatric Emergency Medicine Pediatric Section and Task Force on Regionalization of Pediatric Critical Care, 2000). Through higher volume, regional providers gain added experience in treating severely injured children, resulting in higher quality care. Two recent studies have found that child trauma patients have better outcomes at specialized pediatric centers (Stylianou, 2005; Densmore et al., 2006). Mortality of pediatric patients with respiratory failure or head injury is lower in hospitals that provide tertiary-level pediatric intensive care than those that do not (Pollack et al., 1991).

There is substantial evidence that regionalization of services to designated hospitals with greater experience improves outcomes and reduces costs across a range of high-risk conditions and procedures for adult patients, including cardiac arrest and stroke (Grumbach et al., 1995; Imperato et al., 1996; Nallamotheu et al., 2001; Chang and Klitzner, 2002; Bardach et al., 2004). The literature also shows improved outcomes and lower costs associated with the regionalization of care for severely injured patients (Mullins and Mann, 1999; Jurkovich and Mock, 1999; Mann et al., 1999; Nathens et al., 2001; Chiara and Cimbanassi, 2003; Bravata et al., 2004), although the evidence is not uniformly positive (Glance et al., 2004). Regionalization benefits triage, medical care, outbreak investigations, security management, and emergency management. Regionalization may also be a cost-effective strategy for developing and training teams of response personnel (Bravata et al., 2004).

An example of a pediatric regionalization effort is the regionalization of neonatal care. The use of neonatal intensive care services in the 1960s and 1970s proved to decrease neonatal mortality (Williams and Chen, 1982), but not all hospitals could purchase and support the sophisticated equipment and specialized staff to care for the small number of infants requiring intensive care (Holloway, 2001). In the interest of using resources efficiently and ensuring access to neonatal care, in 1976, a Committee on Perinatal Health organized by the March of Dimes recommended the development of a regionalized system of neonatal intensive care (Cifuentes et al., 2002). Under the system, premature or very ill newborns were to be transferred to the nearest designated center to receive the level of care each infant required (Jones, 2004). While it is difficult to draw a definitive conclusion, studies suggest that regionalization has contributed to lower neonatal mortality rates (Bode et al., 2001; Holloway, 2001; Cifuentes et al., 2002).

Another example is organized trauma systems, which have been shown to improve outcomes of trauma care and to reduce mortality from traumatic injury through regionalization (Mullins et al., 1994; Jurkovich and Mock, 1999; MacKenzie, 1999; Mullins and Mann, 1999; Nathens et al., 2000; MacKenzie et al., 2006). While the literature has long reported benefits for adult patients, there is less evidence-based information on how children fare within trauma systems (Wright and Klein, 2001). However, the limited research available indicates benefits from regionalized pediatric trauma care. The initiation of a regionalized trauma system in Oregon resulted in a reduction in the risk of death from serious pediatric injuries (Hulka et al., 1997;

Hulka, 1999). In New York, the triage of moderately to severely injured children to centers within regionalized systems reduced the risk of death in comparison to nonregionalized systems operating in other parts of the state (Cooper et al., 1993; Hulka, 1999).

Many states and/or communities have taken steps toward regionalizing pediatric emergency care by designating hospitals that meet certain requirements as “stand-by emergency departments approved for pediatrics” (SEDPs), “emergency departments approved for, or accepting pediatrics” (EDAPs), and/or “emergency pediatric centers” (EPCs) (Gausche-Hill and Wiebe, 2001). In some areas, only EDAP or EPC hospitals are allowed to accept pediatric patients that have been transported by advanced life support (ALS) EMS providers. However, a state-by-state analysis shows that many states have still not formally regionalized pediatric intensive care or trauma (Adomako and Melese-d’Hospital, 2004). Most pediatric trauma patients are not brought to pediatric trauma centers and they receive less than optimal care as a result (Densmore et al., 2006).

But simply designating hospitals as EPCs, EDAPs, or SEDPs and formalizing pediatric EMS transport protocols to reflect those designations is not sufficient. As noted in Chapter 2, the vast majority of children do not access EMS before arriving at an ED (McCaig and Burt, 2005) and in part for this reason, most children are seen in general emergency departments (Gausche-Hill et al., 2004). In all likelihood, many of these departments are not designated as EPCs, EDAPs, or SEDPs, certainly so if the state lacks a designation process. It is natural that many parents simply bring their children to the closest ED. Therefore, all hospitals, especially those not recognized as having the ability to care for critical pediatric patients, must be linked to a broader regional system. There must be clear protocols for transferring critical pediatric patients from an ED without specialized pediatric capabilities to one that is better prepared to handle those patients. Regionalization of emergency care helps ensure that pediatric patients receive definitive care as soon as possible, even in rural or remote areas.

Concerns about Regionalization

One concern about the regionalization of pediatric emergency and trauma care is that moving too many children to regional centers will further dilute the pediatric experience of community hospitals. But all hospitals must have some baseline of pediatric readiness. As noted above, they must have the capabilities to stabilize pediatric patients and must have formal transfer agreements in place with regional pediatric centers.

Another concern is that regionalizing services may adversely impact the overall availability of other services in a community. For example, loss of emergency services for certain product lines could result in the closure of a unit or an entire hospital, particularly for small, rural hospitals. Survival of small, rural facilities may require identification and treatment of those illnesses and injuries that do not require the capacities and capabilities of larger facilities, as well as repatriation to the local facility after stabilization at the tertiary center for long term care and follow-up. A systems approach to regionalization considers the full effects of regionalizing services on a community. Determining the appropriate metrics for this type of analysis and defining the process for applying them within each region represent significant research and practical issues. Nonetheless, in the absence of rigorous evidence to guide this process, planning authorities should take these factors into account in developing regionalized systems of emergency care.

Configuration of Services

The design of the emergency care system envisioned by the committee bears similarities to the inclusive trauma system concept that was espoused by the American College of Surgeons (ACS) and has been widely adopted throughout the United States. Under the ACS approach, every hospital in the community can play a role in the trauma system by undergoing verification and designation as a Level I to Level IV/V trauma center, based on its capabilities. Trauma care is optimized in the region through protocols and transfer agreements that are designed to direct trauma patients to most appropriate level of care available given the type of injury and the relative travel times to each center. As discussed earlier, the advantages of such a system are evident from the studies that demonstrate improved outcomes of patients when they receive care from designated facilities with specialized resources. These benefits hold for pediatric patients as well as adults (Stylianou, 2005; Densmore et al., 2006).

The committee's vision expands this concept beyond trauma to include all illnesses and injuries, and beyond hospitals to include the entire continuum of emergency care—including 9-1-1 and dispatch and prehospital EMS, as well as clinics and urgent care providers that may play a role in emergency care. In this model, every provider organization can play a role in providing emergency care in the community according to its capabilities. All hospitals would be categorized in a manner similar to the way some states and communities have designated EPCs, EDAPs, or SEDPs. Initially, this categorization may simply be based on the existence of a dedicated pediatric emergency department, recommended pediatric equipment, and specialized pediatric services, for example, pediatric neurosurgery. Over time, the categorization process may evolve to include detailed information, such as the times specific emergency procedures are available; the arrangements for on-call pediatric specialty care; service-specific outcomes; or general emergency service indicators, such as time to treatment, frequency of diversion, and ED boarding. Prehospital EMS services could be similarly categorized according to pediatric capabilities. The result would be a complete inventory of emergency care assets and capabilities within a community.

A standard national approach to the categorization of emergency care providers that reflects both adult and pediatric capabilities is needed. Categories should reflect meaningful differences in the types of emergency care available, yet be simple enough to be understood easily by the provider community and the public. The use of national definitions will ensure that the categories are understood by providers and by the public across states or regions of the country, and will also promote benchmarking of performance.

The committee concludes that a standard national approach to the categorization of emergency care is essential for the optimal allocation of resources and provision of critical information to an informed public. Therefore, **the committee recommends that the Department of Health and Human Services and National Highway Traffic Safety Administration in partnership with professional organizations convene a panel of individuals with multidisciplinary expertise to develop evidence-based categorization systems for EMS, EDs and trauma centers based on adult and pediatric service capabilities.** The categorization system should be developed within 18 months of the release of this report. The federal agencies should fund the process and convene the emergency care experts and medical professionals who will review the literature and develop the categorization system. The multidisciplinary nature of the process will help ensure that the categories consider the viewpoints of the various stakeholders, and facilitate knowledge of the categories and their

adoption. The results of this process will be a complete inventory of emergency care assets for each community, which should be updated regularly to reflect the rapid changes in delivery systems nationwide.

Treatment, Triage, and Transport

This information, in turn, can be used to develop protocols that would guide EMTs in the transport of patients. But more research and discussion is needed to develop transport protocols. For example, it is unclear whether pediatric dispatch cards, which vary across jurisdictions, are appropriate. More research and discussion is needed to determine under what circumstances patients should be brought to the closest hospitals for stabilization and transfer as opposed to transporting patients directly to the highest level of care, even if that facility is farther away. A debate remains over whether EMS providers should perform advanced life support procedures in the field or whether rapid transport to definitive care is best (Wright and Klein, 2001). The answer to this question likely depends, at least in part, on the type of emergency condition. It is evident, for example, that whether a patient will survive out of hospital cardiac arrest depends almost entirely on actions taken at the scene, including rapid defibrillation, provision of cardiopulmonary resuscitation (CPR), and perhaps other advanced life support interventions. Delaying these actions until the unit reaches a hospital results in dismal rates of survival and poor neurological outcomes. Conversely, there is little that prehospital personnel can do to stop internal bleeding from major trauma. In this instance, rapid transport to definitive care in an operating room offers the victim the best odds of survival. For example, a recent study showed that bypassing a level II trauma center in favor of a more distant level I trauma center may be optimal for head trauma patients (McConnell et al., 2005).

EMS responders who provide stabilization before the patient arrives at a critical care unit are sometimes subject to criticism because of a strongly held bias among some physicians that out-of-hospital stabilization only delays definitive treatment without adding value; however there is little evidence that the prevailing “scoop and run” paradigm of EMS is always optimal (Orr et al., 2006). Decisions regarding the appropriate steps to take should be resolved using the best available evidence. The committee concludes that there should be a national approach to the development of prehospital protocols. Therefore, **the committee recommends that the National Highway Traffic Safety Administration in partnership with professional organizations, convene a panel of individuals with multidisciplinary expertise to develop evidence-based model prehospital care protocols for the treatment, triage, and transport of patients, including children.** The protocols should be developed within 18 months of the release of this report. NHTSA should fund the process and convene the emergency care experts and medical professionals who will review the literature and develop the protocols. In addition, the process of updating these protocols will also be important because it will dictate how rapidly patients receive the current standard of care. This effort need not start from scratch. The Model Pediatric Protocols developed by the National Association of EMS Physicians and supported by the ESM-C Program, which cover the treatment of pediatric patients in the prehospital environment, can serve as a starting point for the initiative as it relates to pediatric patients.

Treatments may require modification to reflect local resources, capabilities, and transport times; however the basic pathophysiology of human illness is the same in all areas of the country. Once in place, the national protocols could be tailored to local assets and needs. Regional protocols should reflect the state of readiness of given facilities within a region at a

given point in time. Real-time, concurrent hospital resource and specialty availability should be made available to EMS providers to inform transport decisions.

In addition to the use of the EMS system to direct patients to the optimum location for emergency care, hospital emergency care designations should be posted prominently. Particularly for pediatric patients, who are largely transported to the ED by their parents or caregivers rather than by EMS, public information about an ED's pediatric capabilities is essential.

Again, the concept of categorization of hospitals based on capabilities is not new. Not only was it recommended in the 1993 IOM Report *Emergency Medical Services for Children*, but also in the 1966 NAS/NRC report, *Accidental Death and Disability* (NAS and NRC, 1966). The 1966 report states:

Hospital emergency departments should be surveyed ...to determine the numbers and types of emergency facilities necessary to provide optimal emergency treatment for the occupants of each region...Once the required numbers and types of treatment facilities have been determined, it may be necessary to lessen the requirements at some institutions, increase them in others, and even redistribute resources to support space, equipment, and personnel in the major emergency facilities. Until patient, ambulance driver, and hospital staff are in accord as to what the patient might reasonably expect and what the staff of an emergency facility can logically be expected to administer, and until effective transportation and adequate communication are provided to deliver casualties to proper facilities, our present levels of knowledge cannot be applied to optimal care and little reduction in mortality and/or lasting disability can be expected.

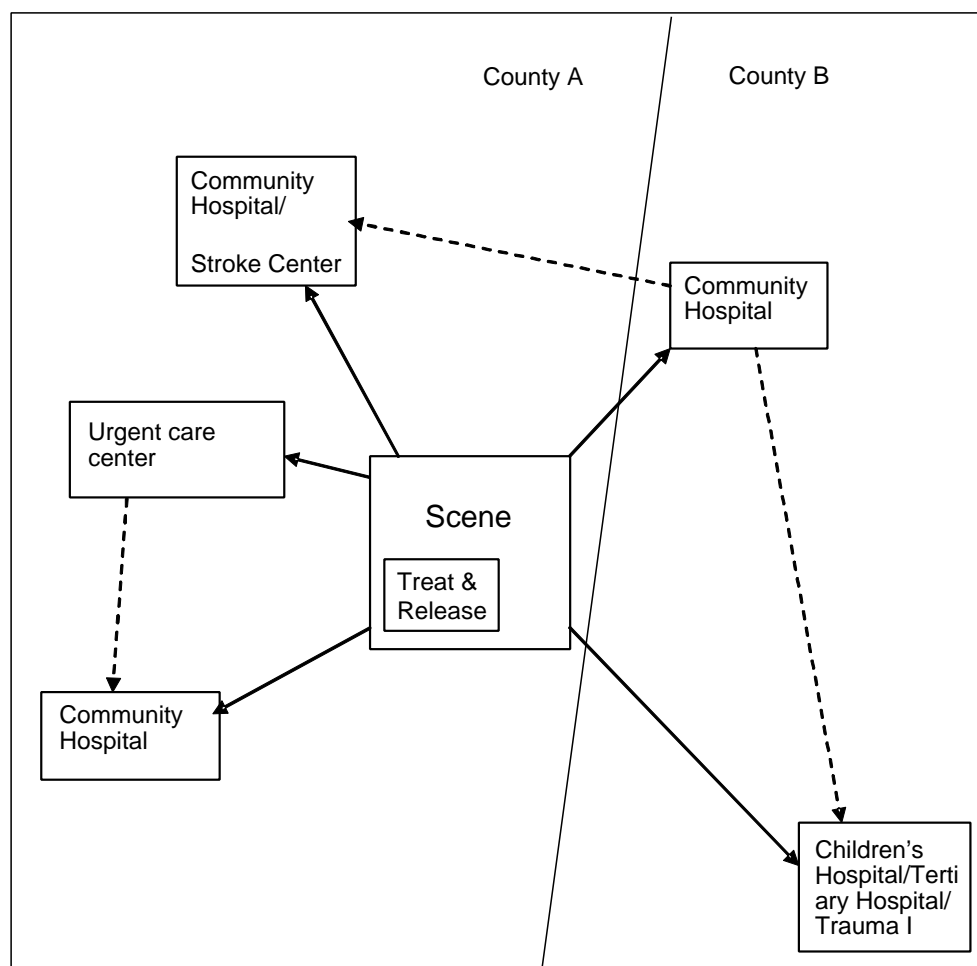


FIGURE 3-1 Service configurations in regional systems. Some potential transport options within a regionalized system are illustrated below. The basic structure of current EMS systems is not altered. Protocols are refined to ensure that patients go to the optimal facility given their type of illness or injury, the travel time, and facility status (e.g., ED and ICU bed availability). For example, instead of taking a pediatric trauma victim to the closest general community hospital within the county, EMTs could cross county lines and transport the patient to a nearby pediatric center. Over time, based on evidence on the effectiveness of alternative delivery models, some pediatric patients may be transported to a nearby urgent care center for stabilization or treated on the street and released. Whichever pathway the patient follows, communications are enhanced, data collected, and performance of the system evaluated and reported so that future improvements can be made.

GOAL 3: ACCOUNTABILITY

Accountability is perhaps the most important of the three goals envisioned by the committee because it is necessary to achieving the other two. Lack of accountability has contributed to the failure of the emergency care system to adopt these changes in the past. Without accountability, participants in the system need not accept responsibility for failures, and can avoid making changes necessary to improve the delivery of care.

Accountability is difficult to establish in emergency care because it is dispersed across many different components of the system; thus it is difficult even for policy makers to determine where system breakdowns occur and how they can subsequently be addressed. When hospitals lack transfer agreements, when providers receive no continuing pediatric education, and when pediatric specialists and on-call specialists are not available, no one party is to blame – it is a system failure. Ambulance diversion is another good example. When a city recognizes it has an unacceptably high frequency of diversion, whom should it hold accountable? EMS can blame the hospitals for crowding and excessively long off-loading times; hospitals can blame the on-call specialists or the discharge sites that are unwilling to take additional referrals; and both can blame the state public health department for inadequate funding of community-based alternatives or community physicians for excessive referrals of their patients to the ED.

The unpredictable and infrequent nature of emergency care contributes to the lack of accountability. Most people have limited exposure to the emergency care system—an ambulance call or a visit to the ED is a rare event. Therefore, the performance of the system is generally not in the forefront of the minds of the public. Further, public awareness is hindered by the lack of nationally defined indicators of system performance. Few localities can answer basic questions about their emergency care services, such as ‘how well do 9-1-1, dispatch, prehospital EMS, hospital emergency and trauma care, and other components of the system perform?’ and ‘how does the performance compare with other regions and to the rest of the nation?’ Consequently, few understand the present crisis facing the system. By and large, the public assumes that the system functions better than it actually does (Harris Interactive, 2004).

Building Accountability

The committee believes that three steps are required to bring accountability into the emergency care system: development of national performance indicators, measurement of performance within communities, and public dissemination of information on system performance.

Development of National Performance Indicators

There is no shortage of standards-setting efforts. ED performance measures have been developed by Qualis Health and Lindsay (Lindsay et al., 2002). The Data Elements for Emergency Department Systems (DEEDS) project and Health Level Seven (HL7) are working to develop uniform specifications for emergency department performance data (Pollock et al., 1998; National Center for Injury Prevention and Control, 2004; Personal communication, R.W. Sattin, November 30, 2005; Health Level 7, 2005). The American College of Surgeon’s and several partners developed surgical process and outcome measures under the National Surgical Care Improvement Project.

The EMS Performance Measures Project is working to develop consensus measures of EMS system performance that will assist in demonstrating the system’s value and defining an adequate level of EMS service and preparedness for a given community (EMS Performance Measures Project, 2005). The consensus process of the project has sought to unify disparate efforts previously undertaken nationwide to measure performance have lacked consistency in definitions, indicators, and data sources.

Work undertaken by the committee in 2004 under the EMS Performance Measures Project resulted in the development of 138 indicators of EMS performance. This list was pared down to 25 indicators in 2005. The list included system measures such as “What are the time intervals in

a call?” and “What percentage of transports is conducted with red lights and sirens?” and clinical measures such as “How well was my pain relieved?” The questions were defined using data elements from the National EMS Information System (NEMSIS) dataset so that results could be compared across EMS systems. The EMS Performance Measures Project is coordinated by the National Association of State EMS Officials in partnership with the National Association of EMS Physicians, and is supported by NHTSA and HRSA. CDC, the Association of American Medical Colleges, and Emory University are currently developing a simple cardiac arrest registry that will allow communities across the US to determine their rate of successful resuscitations and identify opportunities for improvement.

In addition, statewide trauma systems and EMS systems are evaluated by the American College of Surgeons, HRSA’s Division of Trauma and EMS, and NHTSA’s Office of EMS. There are also various components of the system with independent accrediting bodies. Hospitals, for example, are accredited by the Joint Commission on Accreditation of Healthcare Organizations. Ambulance services are accredited by the Commission on Accreditation of Ambulance Services, and air medical services are voluntarily accredited by the Commission on Accreditation of Medical Transport Systems. Each of these organizations collects performance information.

But there are two major shortcomings to many of the performance measurement efforts. First, many of these efforts do not specifically address pediatric performance measures. As we discuss in Chapter 5, it is critical that information systems incorporate specific attributes of pediatric illness and injury. Second, these measures cannot assess the performance of the full emergency care system within each community and benchmark that performance to statewide and national performance. A credible entity to develop such measures would not be strongly tied to any one component of the emergency care continuum. One approach would be to form a collaborative entity that would include representation from all of the system components—hospitals, trauma centers, EMS agencies, physicians, nurses, etc. Certainly individuals with pediatric expertise must be involved as well.

Another approach would be to work with an existing organization, such as the National Quality Forum (NQF), to develop a set of emergency-care specific measures. NQF grew out of the President’s Advisory Commission on Consumer Protection and Quality in the Health Care Industry in 1998. NQF operates as a not-for-profit membership organization made up of national, state, regional, and local groups representing consumers, public and private purchasers, employers, health care professionals, provider organizations, health plans, accrediting bodies, labor unions, supporting industries, and organizations involved in health care research or quality improvement. NQF has reviewed and endorsed measure sets applicable to several health care settings and clinical areas and services, including hospital care, home health care, nursing-sensitive care, nursing home care, cardiac surgery, and diabetes care (NQF, 2002, 2003, 2004a,b; 2005).

The committee concludes that a standard national approach to the development of performance indicators is essential and **recommends that the Department of Health and Human Services convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency and trauma care system performance, including performance of pediatric emergency care.** The federal government must play a lead role in this effort because of the need for an independent, national process that involves broad participation of every component of emergency care. DHHS should fund the process and convene a panel of individuals with emergency care expertise to review the research and develop

the performance indicators. The committee intends for this to be a discrete project to be conducted in a short time frame. The set of performance indicators should be selected within 18 months of the release of this report.

The measures developed should include structure and process measures, but evolve toward outcome measures over time. They should be nationally standardized so that statewide and national comparisons can be made. Measures should evaluate the performance of individual provider organizations within the system, as well as that of the system as a whole. Measures should also be sensitive to the interdependence among the components of the system; for example, EMS response times may be related to emergency departments going on diversion. Naturally, measures should also be appropriate for assessing the performance of pediatric emergency care. This may involve including additional pediatric-specific measures in data collection efforts.

Furthermore, because an episode of emergency care can span multiple settings, each of which can have a significant impact on the final outcome, it is important that patient-level data from each setting can be captured and combined. Currently it is difficult to piece together an episode of emergency care. To address this need, states should develop guidelines for the sharing of patient-level data from dispatch through post hospital release. The federal government should support such efforts by sponsoring the development of model procedures that can be adopted by states to minimize their administrative costs and liability exposure as a result of sharing these data.

Measurement of Performance

Using measures that are developed through a national consensus process, performance data should be collected on a regular basis from all of the emergency care providers in a community. It should be tabulated in ways that can be used to measure, report on, and benchmark system performance. For example, emergency care systems across the country might be tasked with providing data on time critical pediatric conditions, such as respiratory arrest. Data from the different system components would allow researchers to measure how well the system assures each link in the “chain of survival” for the care of children (9-1-1, first response, EMS, ED, trauma). This information will be useful for ongoing feedback and process improvement. Using their regulatory authority over health care services, states should play a lead role in collecting and analyzing performance data. Careful attention will be required by the states to ensure that the reporting of performance measures by provider organizations results in real improvements in the care process and outcomes as opposed to cosmetic paper exercises that show compliance.

While a full-blown data collection reporting system for performance measurement is the desired ultimate outcome, the committee believes a handful of key indicators of regional system performance should be collected and promulgated as soon as possible. These could include, for example, indicators of diversion, boarding, and EMS time to arrival. But, pediatric indicators must be included in the initial data collection and performance assessment efforts. Examples could include time to antibiotics for meningitis or time to first nebulization for asthma. But indicators should also aim to be outcomes-based. For example, systems could collect data on pediatric respiratory arrest or respiratory failure, which are time sensitive sentinel conditions and amenable to an outcomes assessment.

Public Dissemination of Information on System Performance

Public dissemination of performance data is crucial to drive the needed changes in the delivery of emergency care services. Dissemination can take various forms—public report cards, annual reports, state public health reports. Public dissemination of health care information is still in a state of development, despite the proliferation of initiatives over the past two decades. Problems include the costs associated with data collection, the sensitivity of individual provider information, concerns about interpretation of data by the public, and lack of public interest. There are many examples from which to learn—the Health Plan Employer Data and Information Set (HEDIS), which reports on managed care plans to purchasers and consumers; The Center for Medicare and Medicaid’s reports on home health and nursing home care, the *Home Health Compare* and *Nursing Home Compare* websites (CMS, 2005e); and *Hospital Compare* from the Hospital Quality Alliance, which reports comparative quality data on hospitals (CMS, 2005d). A number of states and regional business coalitions have also developed report cards on managed care plans and hospitals (State of California Office of the Patient Advocate, 2005). Because of the unique status of the emergency care system as an essential public service and the public’s limited awareness of the significant problems facing the system, the public is likely to take an active interest in this information. The committee believes dissemination of these data will have an important impact on public awareness and the development of integrated regional systems.

Public reporting can be at a detailed or aggregate level. Because of the potential sensitivity of performance data, they should initially be reported in the aggregate, at the national, state, and regional levels, rather than at the level of the individual provider. Prematurely reporting provider performance data may inhibit participation and divert providers’ resources to public relations rather than corrective efforts; yet movement toward public reporting should begin as swiftly as possible. But individual providers should have full access to their own data so they can understand and improve their individual performance, as well as their contribution to the overall system. Over time, information on individual provider organizations should become an important part of the public information on the system. Eventually, the data may be used to drive performance-based payment for emergency care.

CURRENT APPROACHES

There are a number of current efforts to establish systems that achieve some or all of the committee’s goals of regionalization, coordination and accountability. Some are purely voluntary approaches, others have the force of state regulation. Some are local and regional efforts, others are statewide or national. This section highlights several different approaches that provide insights for the development of future such initiatives.

The Maryland EMS and Trauma System

Maryland has a unique statewide system that coordinates all EMS and trauma activity throughout the state. The Maryland Institute for EMS Systems (MIEMSS) is an independent state agency governed by an 11 member board that is appointed by the governor. The system provides training and certification, established statewide EMS protocols, coordinates care through a central communications center, and operates the air medical system in coordination with the Maryland State Police. The system is partially funded through a surcharge on state drivers license fees.

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Regionalization

While EMS and 9-1-1 are operated locally, they utilize statewide protocols that promote regionalization of pediatric services to two designated centers. Regionalization is also used to take adult patients to trauma, stroke, burn, eye, perinatal, and hand referral centers. The control of air medical services by the state facilitates the regionalization of care through the active operation of dispatch.

Coordination

MIEMSS has an emergency medical services for children program, which oversees grants from the federal EMS-C Program and provides a focal point for statewide resources and networking on emergency care for children and their families. The Maryland emergency medical services for children program develops state guidelines and resources for care, reviews pediatric emergency care and facility regulations, and coordinates pediatric education programs. Additionally, the program works with organizations, including the Safe Kids Coalition, the National Study Center for Trauma and Emergency Medical Systems, the Maryland Highway Safety Office, and the American Trauma Society to foster and support education and injury prevention programs.

A statewide communications center coordinates all communications between EMS and other components of the system. The system links ambulances, helicopters, and hospitals and enables direct communications between components at any time. For example, paramedic in western Maryland can talk directly with a local ED physician or obtain on-line consultation with a specialty hospital in Baltimore. While the local 9-1-1 centers initiate dispatch, they are usually too busy to follow patients through the continuum of care. The central communication center provides support by maintaining communications links, providing medical direction, and maintaining continuity of care. The communications center has direct links to incident command to facilitate management of EMS resources as an event unfolds.

The state also is developing a new wireless digital project which connects emergency medical services with other public safety entities (police, fire, emergency management, public health) throughout the state.

In addition, the state has developed a County Hospital Alert Tracking System (CHATS) that enables it to monitor the status of hospitals and EMS assets so that ambulances can be directed to less crowded facilities. This can also apply to individual services—for example, patients with acute coronary syndrome can be directed to facilities based on the current availability of reperfusion suites. The Facility Resource Emergency Database (FRED) system was designed to electronically gather detailed information from hospitals on bed availability, staffing, medications, and other critical capacity issues during disasters, but is also used to monitor and report on system capacity issues on a regular basis.

The state ensures coordination and protocol compliance through its statewide training, provider designation, and licensure functions. In addition to providing EMS training and certification, the system provides statewide disaster preparedness training for members of the National Disaster Medical System.

Accountability

The state monitors performance at the provider and system levels through a provider review panel that regularly evaluates the operation of the system. As a state agency, the system reports

on its performance goals and improvements. Also, the CHATS system enables participating hospitals and the public to view the status of hospitals at all times through the web site, including data on availability of cardiac monitor beds, ED beds and trauma beds. The system is replacing paper ambulance run sheets with an electronic system so that system data can be collected and analyzed quickly to facilitate real-time performance improvement.

While Maryland is relatively advanced in achieving the goals of regionalization, coordination and accountability, it is not clear how easily the Maryland system could be replicated in other states. It has benefited from strong and stable leadership in the state office, adequate funding, a high concentration of resources, and limited geography--features that many states do not currently enjoy.

Austin/Travis County, Texas

Austin/Travis County and four surrounding counties agreed to form a single EMS and trauma system to provide seamless care to emergency and trauma patients throughout the region. The initiative, ten years in the making, started with a fragmented delivery system consisting of the Austin EMS system, 13 separate fire departments, and a 9-1-1 service run through the sheriff's office that lacked unified protocols. These different entities agreed to come together to form a unified system that coordinates all emergency care within the region. It operates through a Combined Clinical Council that includes representatives of the different agencies and providers within the geographic area, including fire, 9-1-1, EMS, air medical services, and corporate employers. This is a "third service" system—it is separate from fire and other public safety entities.

Regionalization

The system supports the regional trauma system through clinical operating guidelines that determine the care and transport of all patients within the system. But the system is more focused on coordination and medical direction of EMS than on regionalizing care.

Coordination

The coordination of care is achieved through several means. A unified set of clinical guidelines were developed and are maintained by the system based on current clinical evidence. These guidelines provide a common framework for the care and transport of patients throughout the system. Any changes to the guidelines must be evaluated and approved by the Combined Clinical Council.

All providers in the region have a common set of credentials and are given badges that identify them as certified providers within the system, substantially reducing the multi-jurisdictional fragmentation that is common across metropolitan areas. In addition, there is no distinction within the system between volunteer and career providers. The integrated structure facilitates both incident command and disaster planning.

Accountability

There is a Healthcare Quality Committee charged with reviewing the performance of the system and recommending specific actions to improve quality.

San Diego County, California

San Diego County has a regionalized trauma system that is characterized by a strong public-private partnership between San Diego County and its 5 adult and 1 children's trauma centers. Public health, assessment, policy development, and quality assurance are core components of the system. The system operates under the auspices of the state EMS Authority.

Regionalization

The County is divided into 5 service areas, each of which has at least a Level II trauma center. Adult trauma patients are triaged and transported to the appropriate trauma center, while the children's hospital provides trauma care to all seriously injured children below the age of age 14. Serious burns are taken to the UCSD Burn Center. The county is considering regionalization of other diseases, such as stroke and heart attack based on the trauma model. The system includes the designation of regional trauma centers, designation of base hospitals to provide medical direction to EMS personnel, establish regional medical policies and procedures, and licensure of EMS services.

Coordination

A county-wide electronic system (QA Net) provides real time status of every trauma center and emergency department in the County, including the reason for diversion status, ICU bed availability, trauma resuscitation capacity. The system has been in place for over 10 years and is a critical part of the coordination of emergency medical and trauma care in the County.

A regional communication system serves as the backbone of the EMS and trauma system both for day to day operations and disasters. It includes an enhanced 911 system and a county-wide communication network that allows all ambulance providers and hospitals to communicate. The network is used to coordinate EMS destination decisions and bypass information, and allows each hospital and EMS provider to know the status of each other hospital and provider on a real time basis. Because the system's authority comes from the state to the local level, all prehospital and emergency hospital services are coordinated through one lead agency. This provides continuity of services, standardized triage, treatment and transport protocols, and an opportunity to improve the system as issues are identified.

Accountability

Accountability is driven by quality improvement program in which a medical audit committee meets monthly to review system-wide patient deaths and complications. The committee includes trauma directors, trauma nurse managers, the county medical examiner, the chief of EMS, and representatives of key specialty organizations, including orthopedic surgeons, neurosurgeons, as well as a representative for non-designated facilities. A separate prehospital audit committee also meets monthly and discusses any relevant prehospital issues. It includes ED physicians and prehospital providers.

Palm Beach County, Florida

An initiative currently underway in Palm Beach County, FL, is more limited in scope than the systems highlighted above and is just in the initial stages of development. The goal of the Palm Beach County initiative is to find regional solutions to the limited availability of physician specialists who provide on-call emergency care services. In Spring 2004, physician leaders,

hospital executives, and public health officials formed the Emergency Department Management Group (EDMG) to address this problem. One approach is to attack the rising cost of malpractice insurance for emergency care providers, which discourages specialists from serving on on-call panels. The organization is developing a group captive insurance company to supply physician liability coverage to physicians providing care in county emergency departments.

Regionalization

The group is exploring the regionalization of certain high-demand specialties, such as hand surgery and neurosurgery, so that the high costs of maintaining call coverage can be concentrated in a few high volume hospitals, where the volume of cases makes it feasible to maintain full on-call coverage. Hospitals throughout the county would pay a “subscription fee” to support the cost of on-call coverage at designated hospitals. The fee would be set at a level below what it would cost to have hospitals manage their on-call coverage problems individually.

Coordination

The group is developing a web-based, electronic ED call schedule so the EMS system can track which specialists are available at all hospitals throughout the county. This will enable the system to direct transport to the most appropriate facility based on the type of injury or illness of the patient.

Accountability

The initiative includes the development of a countywide quality assurance program under which all hospitals would submit certain data elements for assessment. It is unclear at this time how far this system will go toward public disclosure of system performance.

NEED FOR A DEMONSTRATION PROGRAM

States and regions face a variety of different situations, and there is no “one size fits all” approach to building emergency care systems that will achieve the desired goals. There is, for example, substantial variation across states and regions in the level of development of trauma systems, the effectiveness of state EMS offices and regional EMS councils, and the degree of coordination and integration between fire, EMS, hospitals, trauma centers, and emergency management. The baseline conditions and needs also vary. For example, rural areas face very different problems than urban areas, and the approach that works for one may be counterproductive in the other.

In addition to the varying needs and conditions, the problems are too complex for an a priori solution to be prescribed by the committee. A number of different avenues should be explored and evaluated to determine what works and what does not. Over time, and over a number of controlled initiatives, such a process should lead to important insights about what works and under what conditions. These insights will provide “best practice” models that can be widely adopted to advance the nation toward the committee’s vision.

The process described is one that can be supported effectively through federal demonstration projects. Demonstration projects can provide funding critical to the success of the project, guidance in the design and implementation, waivers from federal laws that might otherwise impede the process, and standardized, independent evaluations of projects and overall national assessment of the program. At the same time, the demonstration approach allows for significant

variation in approach according to state and regional needs and conditions, within a set of clearly defined parameters. The IOM report, *Fostering Rapid Advances in Health Care: Learning from System Demonstrations*, articulated the benefits of the demonstration approach, “There is no accepted blueprint for redesigning the health care sector, although there is widespread recognition that fundamental changes are needed....For many important issues, we have little experience with alternatives to the status quo...the committee sees the launching of a carefully crafted set of demonstrations as a way to initiate a “building block” approach” (IOM, 2002).

The committee, therefore, recommends that Congress establish a demonstration program, administered by HRSA, to promote regionalized, coordinated and accountable emergency care systems throughout the country, and appropriate \$88 million over 5 years to this program. The demonstration projects should aim to optimize emergency services for both adults and children. The essential features of this program are described below.

Recipients

Grants would be targeted at states, which could develop the projects at the state, regional, or local levels; cross-state collaborative proposals would be encouraged. Grantees would be selected through a competitive process that is based on the quality of proposals and an assessment of the likelihood of success in achieving the stated goal(s). Grantees could propose approaches that address one, two or all three of the goals of regionalization, coordination, or accountability. It would not be necessary for proposals to address more than one goal, but proposals should consider the implications for both pediatric and adult patients within the proposed project.

Purpose of the Grants

Each proposal would be required to describe the proposed approach in detail, explain how the approach will achieve the stated goal(s), identify who will carry out the responsibilities associated with the initiative, identify the costs associated with its implementation, and describe how success will be measured. The proposals should describe the state’s current stage of development and sophistication with regard to the selected goal, and explain how the grant will be used to significantly increase its system performance in that regard.

Grants could be used in a number of different ways. Grant dollars could be used to enhance communications for the purpose of improving coordination of services, particularly for the development of centralized communications centers at the regional or state levels. Grants could be used to establish convening and planning functions, such as the creation of a regional or state advisory group composed of stakeholders for the purposes of building collaboration, and designing and executing plans to improve coordination. They could be used to hire consultants and staff to manage the planning and coordination functions. They could also be used to pay for data collection, analysis, and public reporting. In very limited circumstances, they could also be used to implement information systems for the purpose of improving coordination of services. But they should not be used for routine functions that would be performed in the absence of the demonstration project, such as the hiring or training of pediatric specialists, or the purchase of pediatric equipment. Funds could also be used to enhance linkages between rural and urban emergency services within broadly defined regions in order to improve rural emergency care through communications, telemedicine, training, and coordination activities.

Funding Levels

The committee proposes a two-phase program. In Phase I, the program would fund up to 10 projects at up to \$6 million over three years. The committee recommends support for ten projects for two reasons. First, the committee hopes that the publication of its recommendations within this report stimulates a desire among states and communities to undertake efforts at reaching the committee's vision. Resources should be available to encourage and support these efforts. Second, there is likely to be considerable variation in the types of projects proposed. A good number of projects is needed to generate appropriate lessons learned.

Based on successful results that appear to be replicable and sustainable in other states, the program would launch Phase II, in which a smaller, 2-year demonstration grant—up to \$2.0 million each, would be made available to up to 10 additional states. This would be combined with a technical assistant program designed to disseminating results and practical guidance to all states. Program administration would include evaluation of the program throughout its five years, including reports and public comments at 2.5 years and 5 years after project initiation. The committee estimates funding for the program as follows:

- Phase I grants: \$60 million (over 3 years)
- Phase II grants: \$20 million (over 2 years)
- Phase II technical assistance: \$4 million (over 2 years)
- Overall program administration: \$4 million (over 5 years)
- Total program funding: \$88 million (over 5 years)

Granting Agency

There is currently no single agency that has responsibility for the multiple components of the emergency care system. This responsibility is currently shared among multiple agencies—principally NHTSA, HRSA, CDC, and DHS. If, as recommended elsewhere in this report, a lead agency is established that consolidates funding and leadership for these multiple activities, that would be the appropriate agency to lead this effort. Until that consolidation occurs, however, the committee believes that this demonstration program should be placed within HRSA. HRSA currently directs the EMS-C Program and sponsors the Trauma-EMS Systems Program, both of which share many of the broad goals of the proposed demonstration project. HRSA has already demonstrated a willingness and ability to collaborate effectively with other relevant federal agencies and should be encouraged to consider them as partners in this enterprise. The agency or agencies that oversee the program should be sure that the grantees consider pediatric concerns within their demonstration projects.

REDUCING BARRIERS TO IMPLEMENTATION

In order for the process to be successful, it must be supported. As stated in *Fostering Rapid Advances*, "...we must both plant the seeds of innovation and create an environment that will allow success to proliferate. Steps must be take to remove barriers to innovation and to put in place incentives that will encourage redesign and sustain improvements." This must include payment policies that reward successful strategies. It must recognize the interdependencies within emergency care and address systems problems with systems. It must balance the interests of many different stakeholders. And it must involve leadership at many levels taking

responsibility for creating change. Institutional barriers to the adoption of integrated, regionalized care that is held accountable currently exist. These include the payment systems, the legal framework that defines much of the structure of emergency care delivery, and the level of coordination of emergency care at the federal level.

Aligning Payments with Incentives

No major change in health care can take place without strong financial incentives. The way that emergency care services are reimbursed reinforces certain modes of delivery that are inefficient and stand in the way of achieving the committee's vision of emergency care. For example, under Medicare and Medicaid, prehospital providers do not get paid unless they transport a patient to the hospital. This payment system makes it difficult for regional systems to innovate in "treat and release" or other non-transport approaches that may result in better care for patients and more efficient system design. CMS and all other payors should eliminate this requirement and develop a payment system for prehospital care that reflects the costs of providing those services.

Similarly, many hospitals do not have a strong economic motivation to address the problems of ED crowding, boarding, and ambulance diversions, and these practices may even benefit them. There are several payment approaches that could eliminate this perverse incentive. One is to eliminate or compensate for the differential in payment between scheduled and ED admissions that relate to differences in both payor mix and severity of illness. Another method is to assess direct financial rewards or penalties on hospitals based on their management of patient throughput. CMS, through its purchaser and regulatory power, has the ability to drive hospitals to address and manage patient flow and assure timely access to quality care for its clients. All payors, including Medicare, Medicaid, and private insurers, could also develop contracts that penalize hospitals for chronic delays in treatment, crowding, and diversions. CMS should lead the way in the development of innovative payment approaches that accomplish these objectives. All payors should be encouraged to do the same.

Adapting the Legal and Regulatory Framework

The way that hospitals and EMS agencies deliver emergency care is largely shaped by federal laws, including EMTALA and HIPAA. The application of these laws to the actual provision of care is guided by regulatory rules and advisories, enforcement decisions, and court decisions, as well as by providers' understanding of them.

The Emergency Medical Treatment and Active Labor Act (EMTALA) of 1986 was passed in order to prevent hospitals from refusing to serve uninsured patients and "dumping" them on other hospitals. EMTALA requires that hospitals provide every patient with a medical screening exam and, if needed, treatment or transfer to an appropriate facility (GAO, 2001). EMTALA establishes a mandate for hospitals and physicians who provide emergency care to provide a medical screening exam to all patients and appropriately stabilize or transfer patients if an emergency medical condition exists. This is required regardless of patients' ability to pay.

EMTALA also has implications for the regional coordination of care. EMTALA was written to provide individual patient protections—it focuses on the obligations of an individual hospital to an individual patient (Rosenbaum and Kamoie, 2003). The statute is not clearly adaptable to a highly integrated regional emergency care system in which the optimal care of patients may diverge from conventional patterns of emergency treatment and transport.

Until recently, EMTALA guidelines appeared to hinder the regional coordination of services in several ways—requiring a hospital-owned ambulance to transport a patient to the parent hospital, even if it is not the optimal destination for that patient; requiring a hospital to interrupt the transfer to administer a medical screening exam for a patient being transferred from ground transport to helicopter if the hospital’s helipad was used; limiting the ability of hospitals to direct non-emergent patients who enter the emergency department to an appropriate and readily available ambulatory care setting. Interim guidance published by CMS in 2003 appeared to mitigate these problems (DHHS, 2003). It established, for example: that a patient visiting an off-campus hospital site that does not normally provide emergency care does not create an EMTALA obligation; that a hospital-owned ambulance need not return the patient to the parent hospital if it is operating under the authority of a community-wide EMS protocol; and that hospitals are not obligated to provide treatment for clearly non-emergency situation as determined by qualified medical personnel. Further, hospitals involved in disasters need not strictly adhere to EMTALA if operating under a community disaster plan. Despite these changes, uncertainty surrounding interpretation and enforcement of EMTALA remains a damper to the development of coordinated, integrated emergency care systems.

A technical advisory group was convened by CMS in 2005 to study EMTALA and address additional needed changes (CMS 2005a; 2005b; 2005c). To date, the advisory group has focused incremental modifications to EMTALA. While the recent CMS guidance and deliberations of the EMTALA Advisory Group are positive steps, the committee envisions a more fundamental rethinking of EMTALA that would support and facilitate the development of regionalized emergency systems, rather than simply addressing each obstacle on a piecemeal basis. This new EMTALA would continue to protect patients from discrimination in treatment, while enabling and encouraging communities to test innovations in emergency care system design, for example, direct transport of patients to non-acute care facilities, such as dialysis centers and ambulatory care clinics, when appropriate.

The Health Insurance Portability and Accountability Act (HIPAA) was enacted to facilitate electronic data transmission between providers and payers while protecting the privacy of patient health information. In protecting patient confidentiality, HIPAA can present certain challenges for providers, for example, making it more complicated for a physician to send information about a patient to another physician for a consultation. Regional coordination is based on the seamless delivery of care across the multiple provider settings. Patient level information must flow freely between these settings—from dispatch to emergency response to hospital care—in order to ensure that appropriate information is available for clinical decision-making and coordination of services. Current interpretations of HIPAA would make it difficult to achieve the degree of information fluidity that is required. Additionally, HIPAA can be a barrier to family-centered care by limiting access of information to parents or legally identified caregivers of children.

Both EMTALA and HIPAA protect patients from potential abuses and serve invaluable purposes. But, as written and interpreted, they can be difficult and costly for providers to comply with. More importantly, they are likely to impede the development of regional systems. The committee believes that appropriate modifications can be made to both EMTALA and HIPAA that preserve their original purpose while reducing their adverse impact on the development of regional systems. **The committee recommends that the Department of Health and Human Services adopt rule changes to EMTALA and HIPAA so that the original goals of the laws are preserved but integrated systems may further develop.**

Coordinating Federal Leadership in Emergency Care

The committee's vision of a coordinated, regionalized and accountable emergency and trauma care system for adults and children is impeded by the structure of federal programs that currently support emergency and trauma care. To function effectively, the components of the emergency and trauma care system must be highly integrated. Operationally this means that all of the key players in a given region—hospital emergency and trauma departments, EMS dispatchers, state public health officials, trauma surgeons, EMS agencies, ED nurses, hospital administrators, firefighters, police, and community safety net providers, and others—must work together to make decisions, deploy resources, and monitor and adjust system operations based on performance feedback.

As documented throughout this report, however, fragmentation, silos, and entrenched interests prevail throughout emergency and trauma care. The organization of federal government programs that support and regulate emergency and trauma care services to a large degree reflect the fragmentation of emergency and trauma care services at the local level. Responsibility for emergency and trauma care is widely dispersed among multiple federal agencies within DHHS, DOT and DHS. This reflects the history and inherent nature of emergency and trauma care—emergency and trauma care are essential public services that operate at the intersection of medical care, public health, and public safety (police, fire and emergency management). Furthermore, the mounting toll of highway deaths in the 1960s led the National Highway Traffic Safety Administration (NHTSA) to become the first government home for EMS, where it has remained. Thus, while EMS is primarily a medical discipline, federal responsibility for it rests with the Department of Transportation. This was recently reinforced by the elevation of NHTSA's EMS program to the status of an Office of EMS within the agency. Today, NHTSA sponsors a number of workforce and research initiatives, the development of the National EMS Information System, and recently received funding for a major nationwide initiative to promote the development of next generation 9-1-1 service.

DHHS has played an important supporting role in the development of EMS, and has taken the leading role with respect to hospital-based emergency and trauma care. For many years, it housed the Division of Emergency Medical Services and the Division of Trauma and EMS, and most recently the Trauma/EMS Systems Program. All of these programs have been eliminated; the latter was recently zeroed out of the federal budget for FY 2006. DHHS continues to support the CDC Center for Injury Prevention and Control, the Emergency Medical Services for Children (EMS-C) program and the National Bioterrorism Hospital Preparedness Program. These programs have made important contributions to emergency and trauma care, despite inconsistent funding and/or the frequent threat of elimination. AHRQ, another DHHS agency, has historically been the principal federal agency funding research in emergency care delivery, including much of the early research on management of out-of-hospital cardiac arrest. Recently, AHRQ has funded important studies of ED crowding, operations management, and patient safety issues. It is also active in funding research on preparedness, bioterrorism planning and response.

DHS also plays an important role in emergency and trauma care. The Federal Emergency Management Administration (FEMA), once an independent cabinet-level agency that is now housed in DHS, provides limited amounts of grant funding to local EMS agencies through the U.S. Fire Administration. DHS also houses the Metropolitan Medical Response System (MMRS), a grant program designed to enhance emergency and trauma preparedness in major population centers. This program was migrated from DHHS to DHS in 2003. DHS also houses

the Disaster Medical Assistance Team (DMAT) program, through which health professionals volunteer and train as locally organized units in order to be able to rapidly deploy, under federal direction, in response to disasters nationwide.

Efforts have been made to improve inter-agency collaboration at the federal level, especially in recent years. Over the last decade, federal agencies have worked collaboratively to provide leadership to the emergency and trauma care field, to minimize gaps and overlaps across programs, and to pool resources in order to jointly fund promising research and demonstration programs. For example, NHTSA and HRSA jointly supported the development of the *EMS Agenda for the Future*, which was published in 1996. This degree of collaboration has not been universal, however, and has been evident in some agencies more than others. Furthermore, collaborative efforts are limited by the constraints of agency authorization and funding. To some point, agencies must pursue their own programmatic goals at the expense of joint initiatives. Furthermore, to the degree that successful collaboration has occurred, it has generally depended on the good will of key individuals in positions of leadership, limiting the sustainability of these efforts when personnel changes occur.

In an effort to enhance the sustainability of collaborative initiatives, a number of agencies have participated in informal planning groups. For example, the “Interagency Committee on Emergency Medical Services for Children Research” (ICER), which is sponsored by HRSA, brings together representatives from a number of federal programs involved in research issues for the purposes of information sharing and improving research in emergency and trauma care for children.

A broader initiative is the Federal Interagency Committee on EMS (FICEMS), a planning group designed to coordinate the efforts of the various federal agencies involved in emergency and trauma care. FICEMS was established in the late 1970s. After a subsequent period of dormancy, it was reconstituted in the mid-1980s. The organization had no statutory authority until 2005, when it was given formal status by the Emergency Medical Services Support Act (Public Law 109-59). While the focus of FICEMS is EMS, it has in practice reached beyond the strict boundaries of prehospital care to facilitate coordination and collaboration with agencies involved in other aspects of hospital-based emergency and trauma care. NHTSA is charged with providing the administrative support for FICEMS, which must submit a report to Congress annually. The central aims of this group are to:

1. Ensure coordination among the federal agencies involved with state, local or regional emergency medical services and 9-1-1 systems
2. Identify state, local or regional emergency medical services and 9-1-1 needs
3. Recommend new or expanded programs, including grant programs, for improving state local or regional emergency medical services and implementing improved emergency medical services communications technologies, including wireless 9-1-1
4. Identify ways to streamline the process through which federal agencies support state, local or regional emergency medical services
5. Assist state, local or regional emergency medical services in setting priorities based on identified needs
6. Advise, consult, and make recommendations on matters relating to the implementation of the coordinated state emergency medical services programs.

BOX 3-3 FICEMS Membership

The 2005 Emergency Medical Services Support Act designated the following agencies as members of FICEMS. Each year, members elect a representative from one of these member organizations as the FICEMS chairperson.

- National Highway Traffic Safety Administration (DOT)
- Preparedness Division, Directorate of Emergency Preparedness and Response (DHS)
- Health Resources and Services Administration (DHHS)
- Centers for Disease Control and Prevention (DHHS)
- U. S. Fire Administration, Directorate of Emergency Preparedness and Response (DHS)
- Centers for Medicare and Medicaid Services (DHS)
- Under Secretary of Defense for Personnel and Readiness (DoD)
- Indian Health Service (DHHS)
- Wireless Telecommunications Bureau, Federal Communications Commission
- A representative of any other federal agency appointed by the Secretary of Transportation or the Secretary of Homeland Security through the Under Secretary for Emergency Preparedness and Response, in consultation with the Secretary of Health and Human Services, as having a significant role in relation to the purposes of the Interagency Committee
 - A State emergency medical services director appointed by the Secretary

In addition, FICEMS is developing an advisory council composed of non-federal representatives, which will solicit public input on key emergency and trauma care issues.

Problems with the Current Structure

Despite recent efforts at improved federal collaboration, there is widespread agreement that the various components of emergency and trauma care (EMS, trauma, EMS-C, hospital-based care) individually have not received the sufficient attention, stature and funding within the federal government. The scattered nature of federal responsibility for emergency care limits the visibility necessary to secure and maintain funding within the federal government. The result has been marked by fluctuations in budgetary support, and the constant risk that key programs will be dramatically downsized or eliminated. The lack of a clear point of contact for the public and for stakeholders makes it difficult to build a unified constituent base that can advocate effectively for funding and provide feedback to the government on system performance. The lack of a unified budget has created overlaps, gaps and idiosyncratic funding of various programs (e.g., separate hospital surge capacity initiatives are currently taking place in AHRQ, CDC, HRSA, and DHS). Finally, lack of unified accountability disperses responsibility for system failures, and perpetuates divisions between public safety and medical-based emergency and trauma care professionals.

The degree to which the scattered responsibility for emergency and trauma care at the federal level has contributed to this disappointing performance is unclear. But the committee believes that a new approach is warranted.

Alternative Approaches

Strong federal leadership for emergency and trauma care is at the heart of the committee's vision for the future, and continued fragmentation of responsibility at the federal level is unacceptable. To that end, the committee considered two alternatives: (1) maintain the status

quo, giving the FICEMS approach time to strengthen and mature, or (2) designate or create a new lead agency in the federal government for emergency and trauma care. Some of the key differences between these competing approaches are summarized in Table 3-1.

TABLE 3-1 Comparison of the Current Approach and the Lead Agency Proposal

	Maintain Status Quo, Allowing FICEMS to Strengthen	Lead Agency
Description	<ul style="list-style-type: none"> Current agencies retain autonomy, but the FICEMS process fosters collaboration in planning. 	<ul style="list-style-type: none"> Combines emergency care functions from several agencies into a new lead agency.
Authority	<ul style="list-style-type: none"> Has the authority to convene meetings; but no authority to enforce planning, evaluation and coordination of programs and funding. 	<ul style="list-style-type: none"> Would have planning and budgetary authority over the majority of emergency care activities at the federal level.
Funding	<ul style="list-style-type: none"> No guarantee of coordinated program funding. Distributed responsibility for federal functions means that if programs are cut, others remain, reducing the risk of losing all federal support for emergency and trauma care. 	<ul style="list-style-type: none"> Consolidates visibility and political representation of emergency care, enhancing federal funding opportunities. Emergency care funding is fully coordinated. Risk of losing significant funding for emergency care in a hostile budget environment.
Collaboration	<ul style="list-style-type: none"> Brings together the key emergency and trauma care agencies. Cannot enforce coordination or collaboration. 	<ul style="list-style-type: none"> Unified agency will drive collaboration among all components of emergency and trauma care to achieve system-wide performance goals.
Public Identity	<ul style="list-style-type: none"> Still lacks unified point of authority from the public’s perspective. FICEMS, especially through its advisory council, facilitates response to the public. 	<ul style="list-style-type: none"> Provides for a unified federal EC presence for interaction with the public and stakeholder groups.
Professional Identity	<ul style="list-style-type: none"> Fragmented federal representation makes it hard to break down silos in the field 	<ul style="list-style-type: none"> Provides a home for emergency and trauma care, which can project and enhance the professional identity of emergency care providers over time. Lead agency can consolidate constituencies and engender stronger political representation

	Maintain Status Quo, Allowing FICEMS to Strengthen	Lead Agency
Efficiency	<ul style="list-style-type: none"> • May reduce redundancy through enhanced collaboration. • Very low administrative overhead costs. 	<ul style="list-style-type: none"> • Eliminates redundant administrative structure, reducing administrative overhead costs. • Consolidated funding would allow for better allocation of federal dollars across the various emergency care needs (e.g. Eliminates overlapping programs)
Transition	<ul style="list-style-type: none"> • FICEMS is established in law and implementation is underway. • Due to FICEMS' limited powers, risks to individual programs and constituencies are minimal. 	<ul style="list-style-type: none"> • Substantial start-up costs associated with the transition to a single agency. • Potential for changes in program and funding emphasis during transition which could create winners and losers. • Potential dissension among emergency care agencies and constituencies could impact the organization's effectiveness.

Maintaining the Status Quo, Wait for FICEMS to Strengthen. The committee considered the ramifications of maintaining the status quo. The problems associated with fragmented federal leadership of emergency care are documented above. These include variable funding, periodic program cuts, programmatic duplications, and critical program gaps. But with the recent enactment of a statutory framework for FICEMS, the committee considered the possibility that the need for a lead federal agency has diminished. The rationale for delaying the movement toward a lead federal agency and allowing FICEMS time to gain strength was carefully considered by the committee. The central argument in support of this strategy is that there have been a number of positive recent improvements in the level of collaboration at the federal level, and these should be given an opportunity to work before pushing ahead with an unproven and politically risky approach. A number of recent developments support this: the recent enactment of a statutory framework for FICEMS; the current development of a public advisory committee within FICEMS; the increasing level of collaboration among some federal agencies; the substantial new NHTSA funding for a next generation 9-1-1 initiative; and the elevation of the NHTSA EMS program to the Office of EMS, which has the potential to improve visibility and funding for EMS, and perhaps other aspects of emergency and trauma care, within the federal government.

While the committee applauds these positive developments, it notes that setbacks have occurred as well. Recently, DHHS' Division of Emergency Medical Services, Division of Trauma and EMS, and most recently the Department's Trauma/EMS Systems Program were zeroed out of the federal budget. Federal funding to AHRQ, non-bioterrorism programs at the CDC and other federal programs related to emergency and trauma care at the federal level have been cut. These observations suggest that a fragmented organizational structure at the federal level will significantly hinder the development of a coordinated, regionalized, accountable emergency and trauma care system. FICEMS can be a valuable body, but it is a poor substitute for formal agency consolidation. FICEMS is expressly focused on EMS, and ultimately has

limited power over even this sphere. It is not a federal agency and, therefore, cannot regulate, spend or withhold dollars. It cannot even hold its own member agencies accountable for their actions, or a lack of action.

New federal lead agency. The possibility of a lead agency has been discussed for years, and was highlighted in the 1996 report, *EMS Agenda for the Future*. While the concept of a lead agency promoted in the *EMS Agenda* was focused on prehospital emergency medical services, the committee believes that a lead agency should include all components involved in the provision of emergency and trauma care. This lead federal agency would unify federal policy development related to emergency and trauma care, provide a central point of contact for the constituencies within emergency and trauma care, serve as a federal advocate for emergency and trauma care within the government, and coordinate grants so that federal dollars are allocated efficiently and effectively.

A lead federal agency could better move the emergency and trauma care system toward improved integration, unify decision-making and funding decisions, and represent all emergency and trauma care patients, providers, and settings, including prehospital EMS, (both ground and air), hospital-based emergency and trauma care, pediatric emergency and trauma care, rural emergency and trauma care, and medical disaster preparedness. Specifically, a federal lead agency could:

- Provide federal leadership on important policy issues that cross agency boundaries;
- Create unified accountability for the performance of the emergency and trauma care system;
- Rationalize funding across the aspects of emergency and trauma care in order to optimize the allocation of resources in achieving system outcomes;
- Coordinate programs to eliminate overlaps and gaps in current and future funding;
- Create a large combined federal presence, increasing the visibility emergency and trauma care within the government and to the public;
- Provide a single point of contact for stakeholders and the public, resulting in consolidated and efficient data collection and dissemination, program information, coordinated messages, and a recognizable identity;
- Enhance the professional identity and stature of emergency and trauma care practitioners;
- Bring together multiple professional groups and cultures under one roof will create cross-cultural, and interdisciplinary interaction and collaboration that will model and reinforce the integration of services that are envisioned by the committee in the field.

Although creating a lead agency could produce many benefits, such a move also involves significant challenges. Numerous questions must be addressed regarding the location of such an agency in the federal government, the structure and functions of the new agency, and the possible risk of weakening or losing current programs. HRSA's rural EMS and EMS/Trauma System programs have already been de-funded, and the EMS-C program is under the constant threat of elimination. There is a real concern that proposing an expensive and uncertain agency consolidation might jeopardize programs that are already at risk, such as EMS-C, as well as cripple new programs that are just getting started, such as NHTSA's enhanced 9-1-1 program. This is particularly likely if there is resistance to the consolidation from within the current agency homes for these programs.

A related concern is that the priority currently given to certain programs may shift, resulting in less support for existing programs. EMS advocates have expressed concern that in a unified agency, hospital-based emergency and trauma care issues would dominate the agenda of a the new agency. The pediatric community worries about getting lost in a new agency—they fought hard to establish and maintain strong categorical programs supported by historically steady streams of funding. There is a concern that under this new structure, the current focus of the EMS-C program might get lost or diminished, or simply lose visibility in the multitude of programs addressed by the new agency.

There is also the potential for administrative and funding disruptions. Combining similar agencies may be straightforward, particularly those that reside within the same department. But combining agencies with different missions across departments with different cultures, may prove very difficult. The problems that were experienced during the consolidation of programs in DHS increase anxiety about this proposal.

Another concern is that pulling medical-related functions out of DHS and DOT will worsen fragmentation rather than reduce it. Operationally, nearly half of EMS services are fire-based. Thus, there is concern that separating EMS and fire at the federal level may splinter relationships, rather than strengthen them.

The Committee's Recommendation

Despite these fears, the Committee believes the potential benefits of consolidation outweigh the potential risks. A lead federal agency is required to fully realize its vision of a coordinated, regionalized, and accountable emergency and trauma care system. It recognized that there are a number of challenges associated with the establishment of a new lead agency, though it believes that these concerns can be mitigated through appropriate planning for the new agency. It therefore recommends that **Congress establish a lead agency for emergency and trauma care within 2 years of this report. The lead agency should be housed in the Department of Health and Human Services, and should have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. Congress should establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency care.**

The Objectives of the Lead Agency

The agency's mission would be to enhance the performance of the emergency and trauma care system as a whole, as well improve the performance of the various components of the system, for example, prehospital EMS, hospitals, trauma systems, pediatrics, prevention, rural emergency and trauma care, and disaster preparedness efforts. The lead agency would set the overall direction for emergency and trauma care planning and funding, would be the key collector and repository of data about the field, and be the key source of information about emergency and trauma care for the public, the federal government and the practitioners themselves. The lead agency would be responsible for allocating federal resources across all of emergency and trauma care to achieve system-wide goals, and should be held accountable for performance of the system and its components.

The Location of the Lead Agency

The lead agency would be housed within the Department of Health and Human Services. The committee considered many factors in its selection of the DHHS over the Department of Transportation and the Department of Homeland Security. The factor that drove this decision above all others was the need to unify emergency and trauma care within a public health/medical care framework. Emergency and trauma care is by its very nature involved in multiple arenas—medical care, public safety, public health, emergency management. The multiple identities that result from this reinforce the fragmentation that is endemic to the emergency and trauma care system. For too long, the gulf between EMS and hospital care has hindered efforts at communication, continuity of care, patient safety and quality of care, data collection and data sharing, collaborative research, performance measurement and accountability. It will be difficult for emergency and trauma care to achieve seamless and high quality care across the system until all of the system is organized within a medical/public health framework, while retaining its operational linkages with public safety and emergency management.

Only DHHS, as the Department responsible for medical care and public health in the U.S., can effectively encompass these functions. Although DOT has played an important role in both EMS and acute trauma care, and has collaborated effectively with other agencies, its EMS and highway safety focus is too narrow to represent all of emergency and trauma care. The Department of Homeland Security houses the Fire Service, which is closely allied with EMS, particularly at a field operations level. But the focus of DHS on disaster preparedness and bioterrorism is also too narrow to encompass the broad scope of emergency and trauma care concerns.

Because emergency and trauma care functions would be consolidated in a public health/medical-oriented department, there is a risk that public safety and emergency management components may receive less attention, stature, or funding. Therefore, it is absolutely imperative that the mission of this new agency be understood and clearly established by statute so that the public safety and emergency management aspects of emergency and trauma care are not neglected.

The Programs Included in the Lead Agency

In the committee's vision, the lead agency would have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. The focus of the new lead agency would be on program development and strategic funding to improve the delivery of emergency and trauma care nationwide.

It would not be primarily a research funding agency, with the exception of a few of the existing grant programs mentioned above. Funding for basic, clinical, and health services research in emergency and trauma care will remain the primary responsibility of existing research agencies, including NIH, AHRQ, and the CDC. Because of the very limited research focus of the lead agency, it is imperative that existing research agencies, NIH in particular, work closely with the new lead agency and strengthen their commitment to emergency and trauma care research. On the other hand, it may be appropriate to keep certain clinical and health services research initiatives with the programs in which they are housed, and therefore bring them into the new agency. For example, responsibility for funding the infrastructure for the

Pediatric Emergency Care Applied Research Network (PECARN) would be moved into the new agency along the rest of the EMS-C program.

In addition to existing functions, the lead agency would become the home to future programs related to emergency and trauma care, including new programs that would be dedicated to the development of inclusive systems of emergency and trauma care.

Working Group

While the committee envisions a consolidation of most of the emergency care-related functions currently residing in other agencies and departments, the committee recognizes that there are many complex issues involved in determining which programs should be combined and which left in their current agency homes. A deliberate process must be established to determine the exact composition of the new agency and to coordinate an effective transition to it. For these reasons, the committee has recommended the establishment of an independent working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and to coordinate and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency care. The committee considered whether or not FICEMS was an appropriate entity to assume this advisory and oversight role, and concluded that, as currently constituted, FICEMS lacked the scope and the independence to effectively serve in this role.

The Role of FICEMS

FICEMS is a highly promising entity that is complementary to the lead agency. FICEMS would play a vital role during the interim two-year period by continuing to enhance coordination and collaboration between agencies and provide a forum for public input. In addition, it can play an important advisory to the independent working group. Once the lead agency is established, FICEMS would continue to coordinate work between the lead agency and other agencies, such as NIH, CMS, and DOD, that remain closely involved in various emergency and trauma care issues.

The Structure of the Lead Agency

While the principal of integration across components of emergency and trauma care should drive the structure, operation, and funding of the agency, the committee envisions distinct program offices to provide focused attention and programmatic funding for key areas, for example:

- Prehospital EMS, including 9-1-1, dispatch, and both ground and air medical services;
- Hospital-based emergency and trauma care;
- Trauma systems;
- Pediatric emergency and trauma care;
- Rural emergency and trauma care;
- Disaster preparedness.

In order to ensure that current programs do not lose visibility and stature within the new agency, it is critical that each program office has equal status and reporting relationships within the agency's organizational structure. The committee lacks the expertise to specify the organizational structure in further detail. It envisions a national dialogue over the coming year,

coordinated by the independent working group, aided with input from FICEMS, and with the involvement of the Office of Management and Budget, Congressional Committees with jurisdiction, to implement this recommendation.

Funding for the Lead Agency

Existing programs transferring to the new agency should take their full current and projected funding with them to the new agency. Congress must also establish additional funding to cover the costs associated with the transition and with the new administrative overhead associated with the new agency. In addition, Congress should add new funding for the offices of hospital-based emergency and trauma care, rural emergency and trauma care, and trauma systems. In light of the pressing challenges confronting emergency care providers and the American public, this would be money well spent. While the committee is not qualified to estimate the costs associated with establishing a unified agency, it recognizes that it would be substantial. But the committee believes that there would be substantial cost savings resulting from reduced duplication and lower overhead. New funding that flows into the agency would result in new programming, rather than an increase in existing overhead.

Mitigating Concerns Regarding the Establishment of a Lead Federal Agency

The Committee recognizes that transitioning to a single lead agency is a difficult challenge under any circumstances, but will be especially difficult for an emergency and trauma care system that is already under duress from funding cutbacks, elimination of programs, growing public demand on the system, and pressure to enhance disaster preparedness. During this critical period, it is imperative that support for emergency and trauma care programs already in place in the various federal agencies be sustained. In particular, the Office of EMS within NHTSA has ongoing programs which are critical to the emergency medical services system. Similarly, existing emergency care-related federal programs such as those in HRSA's EMS-C Program and Office of Rural Health Policy and at CDC should be supported during the transition. In order to be successful, the constituencies associated with established programs must not perceive that they are being politically weakened during the transition period.

The committee believes that the proposed consolidation of agencies will enhance support for emergency and trauma care across the board, benefiting all current programs. But it also considers it critically important to avoid disruptions that could adversely affect established programs. Therefore, the committee insists that legislation creating the new agency must protect current levels of funding and visibility for existing programs. The agency should balance its funding priorities by adding to existing funding levels, not by diverting funds away from existing programs.

The committee recognizes that there are concerns that pulling medical-related emergency and trauma functions out of DHS and DOT will create additional fragmentation. The committee believes that the public safety aspects of emergency and trauma care must continue to be addressed as a core element of the emergency and trauma care identity. But the primary focus of emergency and trauma care must be medical and public health oriented in order to ultimately achieve the recognition, stature, and outcomes that are critical to its success.

THE EMERGENCY MEDICAL SERVICES FOR CHILDREN PROGRAM

It is the committee's hope and expectation that in the future the deficiencies in pediatric emergency care will be eliminated and providers will be equally prepared for the care of both children and adults. However, the work of the EMS-C program today remains relevant and vital.

In the chapters that follow, the committee outlines a number of recommendations for improving pediatric emergency care. Addressing these recommendations will require the leadership of a well-recognized, well-respected entity not just within pediatrics, but within the broader emergency care system. The EMS-C Program, with its long history working with federal partners, state policymakers, researchers, providers, and professional organizations across the spectrum of emergency care, is in the best position to assume this leadership role. **The committee recommends that Congress appropriate \$37.5 million each year for the next five years to the Emergency Medical Services for Children Program.**

Note that the committee is not suggesting that the EMS-C Program should assume full responsibility for funding the implementation of the recommendations presented in this report; rather, the program should serve as a facilitator to begin the implementation process. For example, the EMS-C Program could convene national conferences of individuals with multidisciplinary expertise to address how various recommendations should be implemented. But additional funding support is needed to ensure that the program has the capacity to initiate these efforts. An additional \$500,000 should be added to the Program's budget to sponsor four to five national conferences per year.

The program's budget should also be expanded to accommodate an increase in the award size for the State Partnership Grants. In FY 2005, EMS agencies (or a designated alternative) in 54 U.S. states and territories received grant support from the Program to institutionalize pediatric EMS improvements. However, in many states, the award from the EMS-C program (\$100,000 to \$115,000) represents the largest or only investment in pediatric emergency care in the state. After covering salary and overhead for a staff person, the current size of the grant leaves little to be spent on programmatic initiatives. An additional \$8 million per year is needed to increase the annual award amount to \$250,000 per state/territory. This additional funding will allow a representative of the state to better initiate improvements, which could include organizing pediatric disaster drills, increasing the level of pediatric emergency care training available, participating in and convening statewide pediatric emergency care planning, and meeting with provider organizations to encourage and facilitate improvements in pediatric preparedness.

The EMS-C Program also provides financial support for infrastructure of the Pediatric Emergency Care Applied Research Network (PECARN) through its network demonstration cooperative agreements. The importance of the PECARN network cannot be overstated. While it remains small in size, it is perhaps the best resource for conducting multi-center randomized trials on pediatric emergency care. However, as the network is currently organized, its linkages to prehospital providers are limited, thereby limiting the ability of researchers to conduct analysis along the continuum of care. Additional funding is needed to build a sustainable link between the four regional nodes of PECARN and the prehospital providers in those nodes. EMS-C Program funding should be boosted to allow each regional node \$1 million per year to establish data linkages with local prehospital providers, for a total cost of \$4 million per year. Looking towards the future of the research network, the administrators of PECARN should also explore the possibility of integrating more general hospitals into the network and expanding research nodes in the south and southeast to improve the network's geographic reach.

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Finally, the program is in need of additional funding that can be directed toward special initiatives or one-time projects that address issues of need. An example is that the program is currently funding two projects to development of clinical practice guidelines (\$250,000 per year for three years for each project). Justification for expanding this initiative is provided in Chapter 4 where the committee calls for development, evaluation, and updating of pediatric clinical practice guidelines. An additional \$5 million per year would allow the EMS-C Program to support approximately 18 large projects of a similar type. Examples of other types of special projects that this funding could support is the development of pediatric medication dosing guidelines for certain medications and the development of labeling techniques to reduce medication errors.

The five year timeframe is suggested so that the program has the capacity to quickly address the deficiencies in the pediatric emergency care system for children. The program should focus on creating sustainable activities and strive toward integrating pediatrics into emergency care planning at the federal, state, and local level.

Five years is not intended as a limit on federal funding dedicated to improving pediatric emergency care; indeed, there will always be a need for pediatric emergency care to be monitored and studied. However, the committee's expectation is that the various components of emergency care leadership at the federal level will be better integrated and consolidated in the future (as discussed above). Supporting pediatric emergency care will always remain a vital component of that federal leadership, but it may not be in the form of a separate stand-alone program. After five years, it will be necessary to reevaluate how best to identify and fund pediatric emergency care objectives at the federal level; future funding levels for the EMS-C Program must also be reevaluated.

RECOMMENDATIONS

3.1 The Department of Health and Human Services and National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop an evidence-based categorization system for EMS, EDs, and trauma centers based on adult and pediatric service capabilities.

3.2 The National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop evidence-based model prehospital care protocols for the treatment, triage, and transport of patients, including children.

3.3 The Department of Health and Human Services should convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency care system performance, including performance of pediatric emergency care.

3.4 Congress should establish a demonstration program, administered by the Health Resources and Services Administration, to promote regionalized, coordinated, and accountable emergency care systems throughout the country, and appropriate \$88 million over 5 years to this program.

3.5 The Department of Health and Human Services should adopt rule changes to the Emergency Medical Treatment and Active Labor Act and the Health Insurance Portability and Accountability Act so that the original goals of the laws are preserved but integrated systems may further develop.

3.6 Congress should establish a lead agency for emergency and trauma care within 2 years of the publication of this report. The lead agency should be housed in the Department of Health and Human Services, and should have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. Congress should establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency and trauma care.

3.7 Congress should appropriate \$37.5 million each year for the next five years to the EMS-C Program.

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4

Arming the Emergency Care Workforce with Pediatric Knowledge and Skills

This chapter begins with an overview of the emergency care workforce. The review focuses on the level of pediatric education and training that providers receive and evidence of their ability to appropriately treat children. What becomes clear from the discussion is that pediatric care comprises a relatively limited component of education requirements for many emergency providers, and many emergency care providers infrequently treat critically ill or injured pediatric patients and therefore may be unable to maintain the requisite level of skill. The result is that some emergency care providers are ill prepared to address the wide spectrum of ailments that children encounter, from common to critical injuries and illnesses. This is a long-standing problem that has improved some over time, but naturally has led to continued concerns about the ability of the emergency care workforce to properly care for pediatric patients. In order to reduce the consequences of illness and injury, the workforce must have the knowledge and skills necessary to deliver appropriate pediatric emergency care. The committee offers several recommendations to enhance and support providers' ability to deliver quality care to children.

PREHOSPITAL EMERGENCY CARE

The term "first responder" is often used to identify the first person on the scene. However, in the mid-1990s, the National Highway Traffic Safety Administration (NHTSA) developed a formal classification of EMS responder called "first responder." First responders represent the most basic level of EMS response and are trained to provide basic emergency medical care. They have more training than first aid, but less than an emergency medical technician (EMT). A certification exists for first responders, and many firefighters, police officers, and other emergency workers have first responder training, which is useful since they may arrive on the scene before an EMT. They use a limited amount of equipment to perform initial assessment and intervention and are trained to assist EMTs once they arrive on the scene (NHTSA and MCHB, 1995; Bureau of Labor Statistics and U.S. Department of Labor, 2004).

EMTs are the backbone of pre-hospital emergency care in the U.S. as they are usually the first providers of direct medical care to patients needing emergency treatment. There are generally three levels of EMTs: EMT-Basic, EMT-Intermediate, and EMT-Paramedic.

Basic EMTs are those trained to provide basic, non-invasive pre-hospital care, although scope of practice varies by state and may include some invasive procedures in some states. They provide care to patients at the scene of a medical emergency (e.g., car crash) and during transport to the hospital. Basic EMTs:

- examine victims to determine the nature and scope of injury or illness
- administer basic life support (BLS), including the provision of oxygen or performing cardiopulmonary resuscitation
- use automatic or semiautomatic defibrillators to perform lifesaving shocks to a stopped heart, and

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- upon arrival at the hospital or medical center, help the staff provide pre-admittance treatment and obtain patient medical histories (Bureau of Labor Statistics, 2002; State of California Employment Development Department Labor Market Information Division, 1995).

EMT-Ps, or paramedics, are the most highly skilled EMTs and they provide the most extensive care. Paramedics are trained in all phases of emergency, pre-hospital care, including advanced life support (ALS) treatment. In addition to the tasks performed by Basic EMTs, paramedics may also:

- administer drugs (usually intravenous);
- administer intravenous fluids;
- use manual defibrillators to perform lifesaving shocks to a stopped heart;
- use advanced airway techniques and equipment to assist those patients experiencing a respiratory emergency;
- perform endotracheal intubations and perhaps other invasive airway maneuvers, and;
- interpret the results of heart-monitoring equipment (Bureau of Labor Statistics, 2002; State of California Employment Development Department Labor Market Information Division, 1995).

Most states recognize levels of practice between those of Basic EMTs and Paramedics. These EMTs, sometimes known as Intermediate EMTs (EMT-I), perform all the tasks of a Basic EMT, but also may perform some of the tasks of a Paramedic. Scope of practice for these Intermediate EMTs varies by state, but is always broader than the scope of practice for a Basic EMT in the same state and narrower than the scope of practice for a Paramedic.

The EMT profession is different from most medical occupations in that a substantial number of workers serve in a volunteer capacity. According to data gathered from a sample of National Registry of Emergency Medicine Technicians (NREMT) members in 2003, 36.5% of registered EMTs were volunteers (Brown et al., 2002). The vast majority of volunteer EMTs were Basic EMTs (89.5%), while paid EMTs were much more likely to be registered as Paramedics (46.3%). Volunteer personnel have, traditionally, been the lifeblood of rural EMS agencies. Since the development of EMS systems began in the 1960's millions of hours of time and effort have been donated by rural EMTs to the care of their neighbors, friends and complete strangers.

Staffing Challenges. Working conditions for EMTs tend to be very challenging, leading to high rates of turnover. EMTs may experience burnout, or even post-traumatic stress disorder, as a result of the emotional and psychological stressors of their job. Many EMTs work irregular hours, and some are not well-compensated in salary or retirement benefits. The work of EMTs is also occasionally dangerous, as they must respond to unpredictable and uncontrolled situations and are exposed to threat of violence or infectious disease (Franks et al., 2004). There is no well-defined career ladder for EMTs, and EMTs in fire-based services sometimes must leave EMS work for other duties in order to advance within their organization. Many individuals work as EMTs as a step to becoming a physician assistant, registered nurse (RN), or physician.

Recruitment and retention are a constant problem for EMS agencies and administrators ranked recruitment and retention as a top priority at a recent EMS conference (EMS Insider, 2005). Anecdotal reports indicate that many regions are facing shortages of prehospital personnel; some reports indicate a critical shortage of EMTs in rural areas. But even some urban

areas struggle. For example, the District of Columbia Fire and EMS Service Department reported a shortage of emergency medical services personnel that had driven staffing levels below half of what is needed to staff the city's fleet of ambulances. In 2005, 57 of the 166 paramedic positions in the District of Columbia were vacant. As a result, the city is staffing advance life support ambulances with a paramedic and a lesser-trained EMT rather than two paramedics (Wilber, 2005). Reports indicate that staffing shortfalls appear to be most pronounced at the EMT-P level. This is likely due to the increased educational levels required and attrition of personnel to fire service (Personal communication, M. Williams, March 27, 2006).

Demand for EMTs will also continue to be strong in rural and smaller metropolitan areas (Bureau of Labor Statistics, 2002). Volunteer staffing has become increasingly more difficult in rural areas for a variety of reasons. Decades ago it was common for volunteers to be on-call virtually twenty-four hours a day. Today, increased demands for time predicated by the need for two income family support and vying interests create an environment where volunteers may donate one specific weeknight or a few hours on a weekend. Rural EMS agencies are currently faced with volunteer staffing shortages, particularly during the weekday work hours.

Pediatric Training. Although there is a national standard curriculum for all levels of EMT training, that curriculum is not mandatory, so training requirements for certification varies across states. A written exam is required in most states and some require an additional practical exam to obtain certification. Generally, for Basic Life Support (BLS), the national standards for training are a minimum of 110 hours of instructional training with additional field training requirements that vary by state. For Advanced Life Support providers (ALS), training at the paramedic level, requires didactic training of 1000-1200 hours beyond the EMT basic level (U.S. Department of Transportation, 1998) with additional practicum time. Certification in all states needs to be renewed (every 2 years for most states). Renewal usually entails completion of continuing education, verification of skills by a medical director and current affiliation with an EMS agency.

Pediatric care has traditionally been a small component of EMT training. In a mid-1980s survey of EMT training programs across the country, Seidel found that 41 percent of training programs offered 10 hours or less of didactic training in pediatrics; 5 percent of programs offered none. All EMTs on average received 8 hours of didactic training in pediatrics; paramedics received 15 hours. Seidel also identified wide variation in the content of pediatric topics covered in the curriculum. Most training programs covered epiglottitis (98% of agencies covered the topic), croup (98%), respiratory distress (98%), asthma (97%) and seizures (95%). However, half of programs did not offer pediatric field simulation, half did not cover pediatric dysrhythmias, 36% did not cover hypotension, 26% didn't cover drowning, 22% did not cover pediatric advanced life support, and 16% did not cover neonatal resuscitation (Seidel, 1986).

Since the early 1990s, a number of efforts have been made to improve pediatric training opportunities for EMTs. Among the earliest courses specifically for EMTs was the development of the Prehospital Trauma Life Support course in 1990. This continuing education course was developed by the National Association of EMTs in cooperation with the American College of Surgeons (ACS) Committee on Trauma, and incorporated material on prehospital pediatric assessment and stabilization. It is an intensive 16-20 hour course attended by all levels of EMTs.

In 1992, the first national consensus curriculum on prehospital pediatrics was published by The California Pediatric Emergency and Critical Care Coalition, the California EMS-C Project, and the American College of Emergency Physicians (ACEP). The initiative grew and in 1995 a task force produced the Pediatric Education for Paramedics (PEP) course, which built on work of

several state projects funded by the EMS-C program (AAP, 2005). That course was eventually expanded by a steering committee assembled by the AAP to serve both BLS and ALS EMTs. The result was the Pediatric Education for Prehospital Providers (PEPP) course. The BLS course consists of a minimum of seven hours while the ALS course is a minimum of 13 hours. In developing course recommendations, the most current data on efficacy, safety, and feasibility was reviewed by the steering committee. Where scientific data was not available, the steering committee used expert opinion and clinical experience in hospitals, EDs, and pediatric ambulatory settings to shape the content of the course. The course is subject to ongoing review from the steering committee (AAP, 2005). The first edition of the PEPP manual sold over 100,000 copies and the program extends into 9 countries and includes more than 5,000 instructors worldwide (PEPP Program, 2006).

In the 1990s, the Maternal and Child Health Bureau (MCHB) worked with and supported the National Highway Traffic Safety Administration (NHTSA) to revise the DOT National Standard Curricula to ensure that the needs of children were being met during initial EMT education and refresher courses. The curricula for first responders, EMS-Basic, EMT-Intermediate, and Paramedics were all revised. Table 4-1 shows the content of the National Standard Curriculum specific to pediatrics for first responders, EMT-Bs and EMT-Is. It should be noted that there are more cognitive, affective, and psychomotor objectives related to pediatrics included in other parts of the curriculum. For example, a module on assessment based management may include instruction related to pediatrics. Still, the number of hours dedicated to pediatrics appears low.

TABLE 4-1 Recommended Pediatric Education in the Current U.S. Department of Transportation National Standard Curriculum

First Responder National Standard Curriculum (1995)	
Content	Recommended Minimum Hours
Infants and Children	2
Practical Lab: Children and Childbirth	1
Evaluation: Children and Childbirth	1
Emergency Medical Technician-Basic (EMT-B) (1994)	
Content	Recommended Minimum Hours
Infants and Children	3
Practical Skills Lab: Infants and Children	3
Evaluation: Infants and Children	1
Emergency Medical Technician-Intermediate (EMT-I) (1999)	
Content	Recommended Minimum Hours
Neonatal Resuscitation	2
Practical Lab: Neonatal Resuscitation	2
Pediatrics	8
Practical Lab: Pediatrics	4

SOURCE: Personal communication, D. Bryson, National Highway Traffic Safety Administration, 2006.

The National Standard Curriculum for Paramedics was developed in 1998, but the hours specific to each module are not specified. Instead, the curriculum emphasizes meeting education objectives. The EMT-P curriculum includes the following modules that address pediatric issues:

pharmacology, venous access and medication administration, life span development, neonatology, pediatrics, abuse and assault, patients with special challenges, acute interventions for the chronic care patient, and assessment based management (Personal communication, D. Bryson, January 26, 2006). The National Standard Curriculum, which many, but not all states follow, is likely to be replaced in the future by the National EMS Education Standard, which will be updated on a two or three year cycle, as a new national approach to EMT education is developed (NHTSA, Accessed 2006).

With the development of the DOT National Standard Curricula, there was concern that many EMS instructors did not have the knowledge or clinical experience to adequately teach the new pediatric components of the curriculum (MCHB, 1996). As a result, the EMS-C program awarded a grant to New York University to develop the Teaching Resource for Instructors in Prehospital Pediatrics (TRIPP). TRIPP, originally published in 1997, is an encyclopedic resource manual for instructors who teach the pediatric sections of the EMT-Basic National Standards Curriculum. In 2002, the developers of TRIPP released another version for instructors of advanced life support.

The NAEMT also established their own Pediatric Prehospital Care (PPC) course in 2000 after recognizing a need by EMTs for additional training to better understand the anatomical, physiological, and communication challenges surrounding the treatment of children. The course is primarily overseen by EMTs with strong guidance from a pediatric emergency physician. Some EMS systems adopt the course as their only pediatric training program (NAEMT, Accessed 2005). However, the pediatric continuing education courses required by EMS agencies still vary considerably. Others commonly used include Pediatric Airway Management for the Prehospital Professional, Pediatric Advanced Life Support, and Advanced Pediatric Life Support. However, a review of the literature found no studies that have evaluated whether EMS training in these courses has led to a change in patient outcomes.

Perhaps the newest course for the prehospital professional is one that focuses on children with special health care needs. The EMS-C program funded the development of Special Children's Outreach and Prehospital Education (SCOPE), designed to teach EMTs how to care for children with special health care needs. This curriculum is particularly important since special needs children are frequent users of the prehospital system. The curriculum, created in 2003, provides basic information on various chronic medical conditions, as well as the technologies and equipment that may be necessary for their survival (MCHB, 2003).

Despite advances in educational opportunities and materials in pediatric care for EMTs, pediatric issues continued to be a challenge for EMTs. In 1996, almost one-third of individuals taking the NREMT EMT-P examination failed on their first attempt. Of those that failed the exam, two-thirds failed the pediatric/OB section; the failures related primarily to the pediatric questions within that section (NREMT, Accessed 2004).

Limited studies of pediatric training for EMTs continued to show deficiencies, though many of these studies are dated. A survey of EMS agencies in North Carolina revealed that only 11 percent of agencies provided more than 10 hours of basic training in pediatric emergency care (Zaritsky et al., 1994). A similar survey of EMS agencies in Oklahoma found more than half did not address pediatric topics in continuing education training (Graham et al., 1993). According to the 2003 EMS-C National Grantee Survey Assessment, pediatric education requirements were a condition for recertification for EMT-Bs in 24 states and for EMT-Ps in 31 states (MCHB, 2004a).

Glaeser's et al.'s survey of nationally registered EMTs revealed that mandatory continuing education was not required for 35 percent of EMT-Bs, 40 percent of EMT-Is, and 25% of EMT-Ps. In the two years prior to the survey, 24 percent of EMT-Bs, 20 percent of EMT-Is, and 6% of EMT-Ps received 0-3 hours of pediatric continuing education. Still, continuing education was the main source of pediatric knowledge and skills for 42 percent of EMT-Bs, 56% of EMT-Is, and 60 percent of EMT-Ps. More than three-fourths of all EMTs surveyed said that they support a state or national mandate for required continuing education in pediatrics beyond what they currently receive (Glaeser et al., 2000). Of those EMTs in Glaeser's survey that support mandated pediatric continuing education, approximately half said that there were no barriers to obtaining this training. However, 23 percent of EMT-Bs, 21 percent of EMT-Is, and 13 percent of EMT-Ps said that continuing education was not available. Other common barriers cited included costs of continuing education courses, which are frequently borne by the EMTs themselves, rather than their EMS agency, and the distance to the courses. Only a small percent of EMTs said that their medical director is not interested in increasing pediatric continuing education or pediatric facilities are not cooperative (Glaeser et al., 2000).

Maintenance of Pediatric Skills. Performing skills in real life is important to reinforce training (Wood et al., 2004). However, one of the challenges of keeping pediatric skills sharp is that EMTs rarely have the opportunity to practice lifesaving procedures in real situations (Gausche-Hill, 2000). Children represent only five to ten percent of all prehospital calls (Seidel et al., 1984; Federiuk et al., 1993); of those pediatric calls, only 12 percent involve the need for pediatric ALS (Seidel et al., 1984). Only a small percent of EMTs identify field experience as the main source for their pediatric knowledge and skills. This is not surprising considering that fewer than 3 percent of all EMTs care for more than 15 pediatric patients during a typical month – perhaps only one of whom will need ALS care. In one survey, 87 percent of EMT-Bs, 84 percent of EMT-Is, and 60 percent of EMT-Ps said that they treat less than four pediatric patients per month (Glaeser et al., 2000).

Several research efforts have pointed out how infrequently EMTs have the opportunity to practice certain interventions in the field. In an analysis of ALS prehospital provider calls in Boston, MA, Babl and colleagues (2001) found that ALS providers deliver, on average, one bag mask ventilation every 1.7 years, one intubation every 3.3 years, and one intraosseous access (the placement of a needle into a bone in order to give fluid for resuscitation) every 6.7 years (Babl et al., 2001). Similarly, Gausche concluded that it would take at least 20 years for every paramedic in 11 counties in California to perform bag-valve-mask ventilation at least once on a pediatric patient (Seidel et al., 1991; Gausche, 1997).

Quality of Care. Lack of initial and continuing pediatric education coupled with the low frequency in which EMTs encounter critical pediatric patients results in a lower level of care than should be expected of our prehospital emergency care system. Several studies have documented deficiencies in treatment for pediatric patients. In the 1980s, Seidel found that the death rates from trauma are significantly higher for children than adults (highest for infants) and deaths occur more commonly in areas where there are not pediatric centers. The study suggests that the needs of children in the prehospital setting were not being met (Seidel et al., 1984). Ramenofsky and colleagues (1984) in a study of 100 pediatric trauma deaths, found that 53 could have survived if the EMS/Trauma system functioned properly. Errors were found in almost 80 percent of those cases (Ramenofsky et al., 1984). Several studies have shown that EMTs have

greater success rates intubating adults than children (Mishark et al., 1992; Boswell et al., 1995; Doran et al., 1995).

Underutilization of acquired skills can lead to fear or reluctance on the part of the EMT to perform an intervention in a time of crisis (Orr et al., 2006). And in fact, children tend to be under-treated in comparison to adults (Gausche et al., 1998; Orr et al., 2006). There are several examples. A study of children in respiratory distress found that 44% received inappropriate interventions. Oxygen and medications were underused while vascular access, a procedure that paramedics do frequently, was over-utilized (Scribano et al., 2000). Another study found that paramedics are less likely to perform basic resuscitation procedures for pediatric patients in comparison to equally critical adults (Su et al., 1997). In one Canadian study, half of children under six who required intravascular access did not receive an IV line (Lillis and Jaffe, 1992).

Comfort Caring for Pediatric Patients. Studies indicate that many EMTs are less comfortable caring for pediatric patients, particularly infants, than adult patients. An example is that paramedics reported being very comfortable terminating CPR on adults, but very uncomfortable terminating CPR on children (Hall et al., 2004). A study that looked at job satisfaction of paramedics found that pediatric calls are among the most stressful due to the low volume of pediatric cases that they typically encounter (Federiuk et al., 1993).

Although in Glaeser's survey the majority of EMTs said that they were comfortable to some degree with their own ability and their EMS system's ability to care for a critical pediatric patient, they indicated that critical care infants are the patients of greatest concern. Indeed, 94 percent of respondents were more uncomfortable with infants and toddlers than any other age group (Glaeser et al., 2000). This is an important finding considering that infants tend to use prehospital and ED services at higher rates than older children. In a 1999 study of EMS transports in Kansas City, MO, Murdock et al found that infants younger than 1 year had the highest transport rates (47 transports per 1,000 persons), followed by those aged 1 to 4 years (26 per 1,000 persons), 10 to 14 years (18 per 1,000 persons), and 5 to 9 years (17 per 1,000 persons) (Murdock et al., 1999).

Another problem associated with the lack of practice in the field is that certain skills deteriorate rather quickly if not used. Pediatric resuscitation skills training can boost knowledge and skills initially, but one study found that this knowledge decays significantly after 6 months (Su et al., 2000). Deterioration of skills is even a concern for paramedics with years of experience. Two years after taking a Pediatric Advanced Life Support (PALS) course, a majority of experienced paramedics could not pass a test on PALS concepts (Wolfram et al., 2003).

But more troubling, EMTs' confidence is not necessarily a good indication of ability. Henderson (1998) showed that 95 percent of paramedics who failed both bag-valve-mask and endotracheal intubation attempts reported a feeling of confidence and a lack of anxiety in their ability to perform those tasks (Henderson, 1998; Orr et al., 2006). Training increases EMTs' perception of ability and their confidence declines slowly over time. Unfortunately, the actual skill performance declines more quickly (Gausche-Hill, 2000).

EMERGENCY DEPARTMENT CLINICIANS

A number of different types of clinicians deliver care to children in EDs. Although many are familiar with the roles of physicians and nurses, pharmacists, nurse practitioners, physician assistants and others play an important role in many EDs. Like the section above, we provide an overview of the responsibilities of the various clinicians in the ED to care for children, describe the pediatric training that they receive, and where applicable, discuss issues of shortages. At the end of the section we discuss the evidence on their effectiveness at caring for children.

ED Physicians

There were approximately 32,000 physicians working in EDs in 1999, an average of almost 8 physicians per ED (Moorhead et al., 2002). Emergency physicians evaluate the presenting problems of patients, make diagnoses, and initiate treatment. They must be prepared for a wide variety of medical emergencies, and must be well-versed in such diverse subjects as anesthesia, cardiology, critical care, environmental illness, neurosciences, obstetrics/gynecology, ophthalmology, pediatrics, psychiatry, neonatology, resuscitation, toxicology, trauma, and wound management. In addition, they often represent the only source of primary care to patients whose only access to care is through EDs. Emergency department physicians also perform duties beyond their scheduled clinical time; they spend several hours per week performing unscheduled clinical duties, administrative work, teaching, and/or research (Moorhead et al., 2002). In small hospitals that lack in-house physician support at night, many emergency physicians are required to provide backup support to the hospital from the ED.

A medical specialty of emergency medicine (EM) was created to enhance the training and skills of physicians wishing to practice in the ED. EM residency training involves a minimum of three years of specialized training after medical school. Board certification is granted by the American Board of Emergency Medicine (ABEM) or its osteopathic equivalent, the American Osteopathic Board of Emergency Medicine (AOBEM). Largely as a result of the steady growth in EM residency training programs, the number of self-identified EM physicians in the U.S. has increased substantially since 1979, when EM was first recognized as a specialty. Growth in EM has been much stronger than growth in medicine overall. The number of self-identified EM physicians in the U.S. increased from 14,000 in 1990 to more than 25,500 in 2002 (an increase of 79%). During the same period the number of all physicians increased by 39% (AMA, 2003).

Despite the growth in EM physicians, only 38 percent of practicing emergency department physicians in the U.S. are residency trained and board certified in the specialty of emergency medicine. The majority of those ED physicians who are not residency trained or board certified in emergency medicine have completed a residency in another specialty, most often family practice or internal medicine. Only three percent of practicing emergency physicians are residency trained or board certified in pediatrics (Moorhead et al., 2002). Many rural hospitals higher “moonlighting” residents to provide physician coverage in their EDs. Traditionally, moonlighting is the unsupervised practice of residents before the completion of their residency (Armon and Coren, 2005). The practice has stirred considerable controversy among medical organizations (Kaji and Stevens, 2002), but moonlighting physicians are not likely to have extensive training or experience in either emergency medicine or pediatrics.

Residency trained EM physicians and pediatricians have the option of pursuing sub-specialty fellowship training and board certification in pediatric emergency medicine. Alternatively, graduating medical students can enroll in a joint EM-Pediatrics residency program, an option established in 1992 by The American Board of Pediatrics (ABP) and the American Board of

Emergency Medicine (ABEM). Pediatric Emergency Medicine is now a recognized subspecialty of the American Board of Medical Specialties. The creation of the pediatric emergency care subspecialty grew from the recognition that the pediatric population is a distinct group of patients needing trained staff to be able to respond to their unique needs (Tamariz et al., 2000). A subspecialist in pediatric emergency medicine is a physician that has completed training in either pediatrics or emergency medicine, and then secured additional training in pediatric emergency medicine in an accredited fellowship program (ABMS, 2002). At present, the total number of PEM physicians is quite small. In fact, the number of EM physicians and pediatricians choosing to subspecialize in pediatric emergency medicine has declined significantly, from a high of 355 in 1996-97 to a low of 121 in the entire country in 2002-03. However, the large number of physicians in the mid-1990s that received their certification reflects those individuals that did so before the grandfather provision into the specialty ran out. The number since that time indicates a rather stable number of trainees in pediatric emergency medicine. Most of the slots in these fellowship programs are being awarded to graduates of pediatric residency programs. As a result, the vast majority of pediatric EM subspecialists (89% of the total between 1994 and 2003) hold primary board certification in pediatrics rather than emergency medicine (Figure 4-1) (ABMS, 2003).

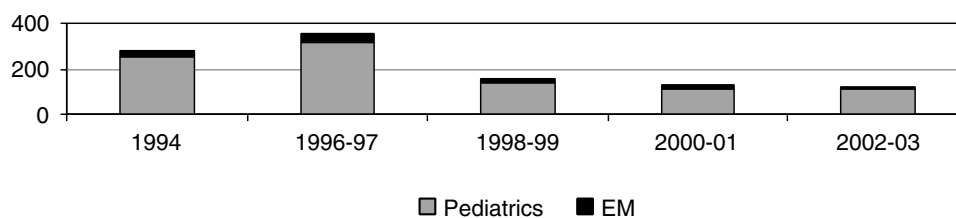


FIGURE 4-1 Subspecialty certificates in pediatric emergency medicine, U.S., 1994–2003.
SOURCE: ABMS, 2003.

The average hospital is likely to have a board certified emergency medicine physician attending, but unlikely to have a pediatric emergency medicine attending. Approximately 23 percent of EDs have a pediatric emergency medicine physician attending. Children’s hospitals and hospitals with large pediatric volumes (more than 7,500 pediatric ED visits per year) are more likely to have a pediatric emergency medicine physician attending than the average hospital (Middleton and Burt, 2006). Among those hospitals without a PEM attending, just over half had a board certified pediatrician attending, and 20 percent had a written protocol for calling a pediatrician. Results also showed that 17 percent of EDs have no EM, PEM, or pediatric attending physician.

Pediatric Training. The physicians that work in the ED have varying degrees of training in pediatrics. Those with the most formal training are those that have completed a fellowship in pediatric emergency medicine (PEM). The goal of the fellowship program in pediatric emergency medicine is to produce physicians who are clinically proficient in the practice of pediatric emergency medicine, especially in the management of the acutely ill or injured child, in the ED (ACGME, Accessed 2004). The training period for pediatric-EM subspecialty residents is two years for EM physicians, three for pediatricians. The Accreditation Council for Graduate

Medical Education (ACGME) specifies that the curriculum include at least 12 months of seeing children in an emergency department that treats children for the full spectrum of illnesses and injuries. The training also includes 4 months in the reciprocal specialty from which the resident enters the training program. For example, pediatric graduates must spend four months in adult care rotations. The core content of the curriculum must include training in EMS, administration, ethics, legal issues, research and procedures. Certification is limited according to the physician's primary board—seven years for the American Board of Pediatrics, ten years for the American Board of Emergency Medicine (ACGME, Accessed 2004).

Emergency medicine (EM) resident physicians are mandated to receive training in pediatric emergency care. In the early 1980s, there was considerable concern about the level and quality of pediatric emergency care provided in these programs. Pediatric emergency training care accounted for approximately 16 percent of training time for EM residents, even though pediatric patients represented about 25 percent of all ED visits (Ludwig et al., 1982). In a survey, 42 percent of residency program directors expressed dissatisfaction with the pediatric training component of the EM residency (Ludwig et al., 1982; Christopher, 2000). Since that time, there has been increased involvement of PEM physicians in EM residencies. Additionally, more EM residencies include specific training experience in pediatric emergency care and more EM residency programs are affiliated with pediatric centers (AAP, 2000; Tamariz et al., 2000; Christopher, 2000).

But a more recent assessment of pediatrics in emergency medicine residency programs indicates that progress has been mixed. Pediatric training in EM residency programs continues to represent a relatively small percent of training time. Today, approximately 13 percent of training time is spent on pediatric electives (Tamariz et al., 2000). EM residents may see children during non-pediatric rotations, and certainly during their 18-plus months of supervised training on emergency department rotations, but the amount of pediatric contact time on these rotations is difficult to determine. But the confidence of residency directors in their pediatric curriculum has improved. The majority of directors indicated that they were either very confident or somewhat confident in the areas of trauma, intensive care, airway, and urgent care. This confidence likely reflects the relatively large exposure of emergency residents to pediatric patients in emergency departments, pediatric emergency departments, pediatric intensive care units, and urgent care or fast track clinics. In the area of neonatal resuscitation, most residency directors were somewhat confident or not very confident, suggesting that the skill should be increased in the curriculum (Tamariz et al., 2000).

To be board certified in emergency medicine, a physician must pass a special exam in that specialty. Approximately eight percent of the emergency medicine board exam focuses on pediatric topics (ABEM, 2004). However, an individual need only answer 75 percent of the questions correctly to pass. Therefore, an individual can answer all of the pediatric questions incorrectly and still receive a passing score for the exam.

Unfortunately, the majority of physicians practicing in the ED have not had residency training in either Emergency Medicine or Pediatric Emergency Medicine (Moorhead et al., 2002). An assessment conducted in the late 1990s found that the supply of EM physicians is simply not sufficient to staff all emergency departments physician positions, and not all EDs have access to a PEM physician on staff (Holliman et al., 1997). That appears to be the case today as well (Moorhead et al., 2002). As such, physicians from some of the other disciplines (internal medicine, family practice, etc.) are needed to fill positions in emergency departments. It is difficult to determine the level of pediatric and emergency medicine training that they have

received. Certainly the ED physicians that are pediatricians are familiar with children, but their formal training in emergency medicine may be limited. ED physicians from other disciplines (i.e., family practice, internal medicine) may have little formal training in either EM or pediatrics. Although they lack dedicated intensive training in emergency medicine and/or pediatrics, these ED physicians presently represent an essential component of ED staffing in many hospitals. Many may possess a high level of competency in pediatric emergency care, but it was gained through “on the job” experience rather than through formal training in a supervised setting.

As stated above, three percent of emergency department physicians are board certified in pediatrics. Just as the committee has concerns about ED physicians lacking substantial training in pediatrics, the committee is concerned that some pediatricians working in the ED lack sufficient training in emergency medicine. According to the Residency Review Committee’s requirements for pediatric residency programs, pediatric residents must spend a minimum of four months training in emergency and acute illness, but only two of those months must be in emergency medicine (National Capital Consortium Pediatrics Residency, 2004). This means that some pediatricians practicing in the ED may have only spent 5.5 percent of their three-year residency on emergency medicine. But again, many of these physicians may possess a high level of competency in emergency medicine based on their experience in the ED. Another concern is that sick children access care through their pediatricians, who may find it difficult to detect certain emergency conditions, such as epiglottitis, among their patients. A pediatrician who received little training in emergency medicine and who spends the majority of time on well-child visits may have difficulty recognizing and addressing an emergency condition.

Beyond initial specialty training, there are a number of opportunities for physicians to obtain training in pediatric emergency care. Different hospitals have their own requirements in terms of continuing education for ED physicians. However, the most popular pediatric continuing education courses are Pediatric Advanced Life Support (PALS) and Advanced Pediatric Life Support (APLS). These courses are often required during initial training as well, for example, the PALS course is required in 78% of emergency medicine residency programs; and APLS was required in 17 percent of programs (Tamariz et al., 2000). Additionally, professional societies help member physicians comply with continuing education requirements from state medical boards. For example, the American College of Emergency Physicians (ACEP), which represents EM physicians, has a number of educational offerings designed to help members earn 150 hours of continuing education every three years. Of the 800 courses approved for credit, 23% are pediatric topics, the most popular being PALS and APLS. Several other pediatric courses are offered at the ACEP Annual Meeting. However, according to a 1997 ACEP survey, 17 states did not offer APLS, PALS, or other similar pediatric course in the previous two years (Santamaria et al., 1997). Having to travel a long distance to attend a pediatric training course naturally places an added burden on physicians to obtain the training.

Pediatric and Trauma Surgeons

The other medical specialties of particular relevance to pediatric emergency care are the surgical subspecialties of trauma surgery and pediatric surgery. Through a five-year residency training program in general surgery, surgeons receive training in a number of specialty areas including trauma and pediatric surgery, after which they are expected to be able to manage the commonly encountered and less complex cases associated with these content areas (The

American Board of Surgery, 2004). They may subsequently choose to undertake advanced training in trauma surgery or pediatric surgery (The American Board of Surgery, 2005).

Trauma surgeons perform emergent surgical procedures, usually but not exclusively involving life or limb-threatening injuries to the neck, chest, abdomen, pelvis, and vasculature. Trauma surgeons generally complete two years of fellowship training in Trauma Surgery and Surgical Critical Care following the completion of the five year surgical residency. The American College of Surgeons estimates that there are about 3,000 trauma surgeons practicing in the United States today (Personal communication, C. Williams, February 17, 2006). Trauma surgeons tend to focus their practice in trauma centers.

The American Board of Surgery awards Certification in Pediatric Surgery to surgeons who complete a two year fellowship in pediatric surgery and pass an examination in pediatric surgery following the five year surgical residency (The American Board of Surgery, 2004). Pediatric surgery residents are required to meet specific curricular goals and objectives in pediatric trauma care and must help to provide definitive pediatric trauma care to large numbers of pediatric trauma patients.

On-Call Specialists

Hospitals that offer specialist services, such as neurosurgery and orthopedic surgery, to inpatients must also have the same services available to patients that present at the ED (Glabman, 2005). ED physicians rely on and consult these specialists for advice or admission, to arrange follow-up care after discharge, to relay information about a patient, and/or to request specific procedures or treatment for patients (Macasaet and Zun, 2005). Some of these physicians have advanced training in a specialty area after completing a pediatric residency pediatric residency (e.g., pediatric neurology or cardiology) or residency training in a specialty area followed by specialized pediatric training (e.g. pediatric surgery, orthopedics, or plastic surgery).

The salient problem with specialists is their availability. Over the past several years, many hospitals have experienced great difficulty securing specialists for ED patients of all ages when needed. According to a 2004 survey by ACEP, two-thirds of ED medical directors report shortages of on-call specialists at their hospitals (American College of Emergency Physicians, 2004; Vanlandingham et al., 2005). Numerous other studies and surveys have investigated the shortage of on-call specialists finding that the problem extends across many different specialties and all regions of the country and the problem appears to be worsening (Green et al., 2005; O'Malley et al., 2005;).

Part of the problem is that a general shortage of pediatric subspecialists exists. The number and proportion of pediatric residents choosing advanced training has declined (Health Resources and Services Administration Council on Graduate Medical Education, 2002; O'Leary, 2002). This decline can at least in part be attributed to managed care's focus on primary care, which has led to reduced support for specialist fellowships and reduced reimbursement income for specialists (O'Leary, 2002). The AAP called the supply of pediatric subspecialists "a pressing concern" (American Academy of Pediatrics, 2003).

In August 2001, the National Association of Children's Hospitals and Related Institutions (NACHRI) surveyed member hospitals to gauge perceptions about pediatric subspecialist supply, both nationally and within each hospital's own market, and to assess hospitals' physician recruitment and retention efforts. With a 34 percent response rate, the survey showed that the overall vacancy rate for pediatric subspecialists is 11.1 percent with endocrinology, pulmonology, and neurology as the specialties with the highest rates of vacancy. Respondents

noted that the most difficult specialties to recruit were neurology, gastroenterology, anesthesiology and pulmonology. The most frequent reasons given for the difficulty were an overall shortage of qualified candidates, competition from other provider organizations, and low pay relative to job demands. Reasons cited for the perceived shortage of pediatric subspecialists were a reduced interest on the part of residents in the subspecialties and reimbursement and compensation issues (O’Leary, 2002). Indeed, issues surrounding compensation are an important factor. A study by the California Medical Association showed that over 50 percent of physicians said that they have difficulty receiving reimbursement for *insured* patients at least 50 percent of the time; the problem of payment is greatly exacerbated when the patient is uninsured. To encourage subspecialists to continue taking ED call, some hospitals have begun to paying for this service (Steiger, 2005).

But other forces also contribute to the shortage of on-call specialists to care for patients of all ages. Some also speculate that the younger generation of specialists may be less inclined to take call than their more experienced colleagues in a desire to improve their work-life balance (Salsberg, 2005). Hospital by-laws often require physicians to take ED call for a certain number of years, for example, 15 years, in exchange for admitting privileges. Historically, this arrangement has worked well; it allows hospitals to fill their on-call panel and gives young specialists an opportunity to build up their practices. But with the movement of specialists to large, multi-specialty groups, younger physicians no longer need to rely on ED call to supply patients. Hospitals have less leverage to tie admitting privileges to ED call and many groups discourage members from taking call in the ED (Taheri and Butz, 2004).

Still other physicians drop ED call because of liability concerns. Emergency cases are more risky because the patient is often seriously ill or injured, medical records may be scant or nonexistent, treatment may be rendered after-hours, when resources for care are less readily available and the doctor lacks an established relationship with the child and his/her family. The rapidly rising cost of malpractice insurance is a powerful disincentive for specialists to assume the liability by treating unknown emergency patients, many of whom are uninsured, may be noncompliant with discharge instructions, and may be difficult to contact regarding follow-up (Green et al., 2005). Seventy-five percent of neurosurgeons no longer operate on children because of liability concerns, sharply reducing the availability of those services for pediatric patients (Glabman, 2005).

The availability of on-call specialists is an issue discussed at length in the committee’s companion report, *Hospital-Based Emergency Care: At the Breaking Point*, and specific recommendations are offered. However, one option being discussed by specialty societies is the creation of a specialty in emergency surgery or acute care surgery in which a board certified general surgeon would receive fellowship training in elective and emergency general surgery, trauma surgery, and surgical critical care. In addition to performing what is conventionally considered “general trauma” (neck, thoracic and abdominal injuries), the new acute care surgical specialist could also perform selected and limited neurosurgical and orthopedic procedures, with support from fellow surgical specialists (The Committee to Develop the Reorganized Specialty of Trauma, Surgical Critical Care and Emergency Surgery, 2005). It is anticipated that acute care surgeons would treat both adult and pediatric patients. The proposed curriculum for the new specialty was under development at the time of this writing, but pediatric surgery is likely to be an elective option within the fellowship training.

Nurses

There are between 75,000 and 100,000 nurses working in emergency departments. According to the Emergency Nurses Association (ENA), emergency RNs perform the following tasks: assessment, analysis, nursing diagnosis, planning, implementation of interventions, outcome identification, evaluation of responses, triage and prioritization, emergency operations preparedness, stabilization and resuscitation, and crisis intervention for unique patient populations (e.g., sexual assault survivors) (ENA, 1999).

Nurses in emergency departments are predominantly female (86%), have a median age of 40 and are largely non-Hispanic white (88.5%). ED nurses generally have worked in nursing for less time than other nurses; approximately 30% graduated in the last five years compared to 20.6% of other nurses. Only 11% graduated 26 or more years ago, compared to 22.6% of all nurses (DHHS, 2000). Nurses in emergency departments reported feeling that they are under great stress significantly more often than RNs in other settings. Thirty-seven percent of ED RNs reported feeling under great stress “almost every day” compared to 30% of other RNs. Surveys show that nurses in the ED tend to be more pressed for time and have heavier workloads than nurses working in other settings (New York State Education Department, 2003).

Training. To become a nurse, an individual typically completes one of two courses of study, an Associate Degree Nurse (ASN) or a Bachelor of Science Nurse (BSN). The ADN course is typically a two-year degree program, and is focused on the practical applications of nursing. The BSN is a four-year course of study that expands into the theoretical realms of patient care. In recent years there has been a push to mandate the BSN be a minimum requirement to be a professional nurse. This issue is still under debate. After graduation from one of these programs, nurses must take the board examination to become a registered nurse.

Courses mandated at the basic level include hazardous materials awareness, fire and safety, CPR and infection control. Requirements for more advanced coursework vary from hospital to hospital, although almost all require Advanced Cardiac Life Support for ED nurses working in resuscitation areas or doing IV conscious sedation. Some hospitals require new ED hires to take a critical care course, depending upon their previous experience.

ED nurses wishing for additional credentials in emergency nursing may become Certified Emergency Nurses (CENs), which is awarded to nurses that pass the qualifying examination by the Board of Certification for Emergency Nursing. However, most nurses working in EDs are not certified as CENs. In 2004, 13,115 nurses nationwide were credentialed as CENs. There are also other advanced degree options for nurses including masters and doctoral degree programs with various areas of specialization and practice. Many nursing management positions require advanced degrees.

Some ED nurses specialize in caring for children and may work in pediatric EDs, but there is no certification available in pediatric emergency nursing, and very little data available regarding these nurses. State boards of nursing may require Pediatric Advanced Life Support (PALS) or Advanced Pediatric Life Support (APLS) for nurses providing conscious sedation. Pediatric EDs are likely to require advanced pediatric courses for their nurses, and may even require advanced training in neonatal resuscitation for nurses. There are also a number of other pediatric continuing education courses that some ED nurses may participate in including the Emergency Nursing Pediatric Course. It is unclear how many nurses are required to participate in pediatric continuing education and how often that training is required.

Staffing Challenges. The nursing shortage in both hospital and non hospital settings has been the subject of press reports and research articles for years (DHHS, 2002). Although there have been nursing shortages in the past, many believe that the current shortage is different in that it is not rooted in cyclical changes (Schriver et al., 2003). Today, fewer individuals are choosing nursing as a profession than in the past, in part due to the increased professional opportunities for women and the limited number of nursing education slots due to a shortage of nursing faculty. The nursing shortage has led to problems for hospitals and medical centers in all units and the problem is only expected to worsen in the future as the demand for nursing services increases with the aging of the population. The importance of adequate sized nursing staff cannot be overstated. A number of robust research studies have shown a direct link between nurse staffing levels and patient outcomes (Aiken et al., 2002a,b; Needleman et al., 2002).

EDs are not immune to the nursing shortage. Nationwide, it is estimated that 12% of nursing positions for which hospitals are actively recruiting are in emergency departments. This makes the emergency department the third most common source of nursing position openings in hospitals (following general medical/surgical and critical care units). In a survey of hospitals in New York City, 83 percent reported that they are actively recruiting for nurses in their emergency department (Greater New York Hospital Association, 2004). A 2005 survey of EDs by the Emergency Nurses Association found that 26 percent of EDs had a registered nurse vacancy rate of 10 percent or more (ENA, 2006).

The impact of the nursing shortage and ED patient care has not been effectively evaluated; however, many speculate that the shortage has a negative impact on patient care for two reasons. First, similar to other areas of the hospital, if the ED lacks appropriate nursing levels, patients will not receive the care or attention appropriate. For example, a triage nurse may be overwhelmed by the number of patients he or she has to evaluate and may miss an important sign of a severe illness or injury. And in fact, procedures performed on children less than 5 years of age, for example IV starts and catheterizations, generally require more staffing to keep the child calm and manageable. Second, the nursing shortage adds to the problem of ED crowding. If nurses are not available to staff inpatient beds, admitted patients from the ED may become boarders, waiting for an available bed.

Other Medical Professionals in the ED

A number of other medical professionals may deliver care to children in the ED. It may be surprising to hear that almost 9 percent of ED patients are seen by an EMT (McCaig and Burt, 2005). These EMT-trained ED technicians are able to perform basic emergency care in the ED setting, allowing nurses and physicians more time to treat complex cases and perform more intensive procedures. The scope of practice for such personnel is limited, but has increased in some EDs to include intravenous infusions, splinting, and phlebotomy (Franks et al., 2004).

Approximately seven percent of ED patients are seen by a physicians assistant (PA). This is generally in addition to seeing a physician and/or nurse. PAs provide medical care to patients under the supervision of a physician, and the specialty of PAs is the same as the specialty of their supervising physician. PAs must be granted clinical privileges at the hospital in which they work, and can prescribe medication in most states. There are three PA educational programs in the U.S. offering specializations in emergency medicine, although PAs do not need to graduate from such a program to practice in EDs. The American Association of Physician Assistants (AAPA) reports that 1,775 PAs (9.8%) worked in emergency departments in 2003. Over 1,800 PAs reported a

primary specialty in emergency medicine (10%). The majority of PAs working in EDs are EM specialists (93.6%); less than one percent are pediatric specialists (AAPA, 2003).

Only about two percent of patients see a nurse practitioner during their ED visit (McCaig and Burt, 2005). Nurse practitioners (NPs) are master's prepared registered nurses who provide significant medical care to patients. Some states require NPs to work under the supervision of a physician, others do not. There is no national certification for NPs in emergency care, but they may obtain training in emergency care skills through university-based programs, continuing education, and work experiences (Cole et al., 1999). APNs in emergency settings were most likely to report certifications as a family NP (43%), acute care NP (13%), adult care NP (12%), critical care CNS (9%), or pediatric NP (7%) (ENA, 2003).

In the 1970s, a limited number of hospitals began integrating pharmacists into the emergency department staff. Clinical pharmacy specialists (CPS) that work in emergency departments typically have a doctor of pharmacy degree and have completed a one-year residency. Traditionally, CPSs in EDs helped with medication billing and inventory control, but in recent years, the role of pharmacists in the ED has grown. With the increased number of drugs available and the increased complexity of drug selection, administration and monitoring, some EDs use a pharmacist as part of the care team. Use of pharmacists in the ED can potentially reduce the high number of medication errors that occur in that environment.

Still, the prevalence of pharmacists, particularly full-time pharmacists, in EDs remains low. A 2001 survey of directors of pharmacy in hospitals with at least one accredited pharmacy residency program was conducted in order to ascertain the prevalence and characteristics of pharmaceutical services in EDs nationwide. Only three percent of respondents reported having a dedicated pharmacist in an ED satellite pharmacy. Fourteen percent of respondents reported having a dedicated pharmacist that provides services to emergency department patients. But the demand for pharmacists may grow over the next few years as a result of JCAHO's 2005 National Patient Safety Goals and Requirements, which call for complete and accurate medication reconciliation across the continuum of care (JCAHO, 2005).

Efforts to integrate clinical pharmacists into the emergency department care team have shown some success. For example, one study assessed the impact of a clinical pharmacist integrated into the care team at a level-1 trauma center. Responsibilities of this pharmacist included clinical consultations, patient education, order screening, dispensing drugs, medication preparation, resuscitation response, staff education, patient care, and emergency preparedness. Inclusion of the clinical pharmacist in the care team resulted in improved medical care (reduction in voluntary reporting of medical errors), imparted knowledge to emergency department personnel, and reduced institutional expenditures. By encouraging physicians to modify prescribing practices, the pharmacist reduced the amount of high-cost medications for an estimated savings of \$100,000 over one year (Fairbanks et al., 2004). Another study compared the effectiveness of having a pharmacist collect patients' medication history with the institution's standard nurse-obtained medication history. Results showed that when the pharmacist obtained the medical history, more discrepancies between the patients' reported home medications and the initial hospital orders were identified and a higher percent of patients received clinical interventions. Having pharmacists conduct medical histories was also more time efficient (Nester and Hale, 2002). At another hospital, ED cost savings were realized when pharmacists made clinical interventions, such as medication selection and/or dosing changes. Cost savings were also realized by reducing the ED satellite inventory; pharmacists noted that duplicate

medications in the same drug class were unwarranted for a single- or double-dose regimen (Levy, 1993).

Some pediatric facilities (typically children's hospitals and general hospitals with advanced pediatric capabilities) also employ suture technicians to assist with pediatric wound repair (Apolo and DiCocco, 1988). These technicians, often EMTs or nurses, receive training with general, reconstructive and plastic surgeons on wound repair and use a variety of techniques to reduce pain and anxiety in children needing suturing. Because these technicians provide a large number of sutures (one hospital estimates that suture techs provide between 450 and 700 sutures per month) they are able to achieve a high skill level in suturing. Additionally, the use suture technicians helps free up the time of ED physicians to provide care to other patients (Akron Children's Hospital, 2005).

Skill Retention and Performance

Similar to EMTs, skill retention for ED providers can be a problem. Only about 10 percent of pediatric patients in the ED are classified as "emergent", meaning that care needed to be provided within 15 minutes (McCaig and Burt, 2005). Therefore, only a small percent of ED visits are critical pediatric cases. As a result, deterioration of skills can be a problem. Many emergency department providers have infrequent contact and rarely perform life support interventions for children. Research confirms this concern; one year after CPR training, physician and nurse retention of CPR skills deteriorates and can even fall to pretraining levels (Gass and Curry, 1983; Mancini and Kaye, 1985).

It is difficult to say precisely how well ED providers deliver care to pediatric patients in the absence of reliable data. The limited information on physician performance tends to focus on intubation of pediatric patients in the ED. Some indicate that EM and PEM fellows are generally successful in performing pharmacologically assisted intubation, an airway intervention that is frequently used in the ED (Tayal et al., 1999; Sagarin et al., 2002). However, success rates for neonatal endotracheal intubation were low, despite providers' high levels of confidence in performing the procedure (Falck et al., 2003; Leone et al., 2005). Additionally, a study of pediatric patient encounters during EM resident's pediatric emergency medicine rotation found deficiencies in critical care procedures, resuscitations, child abuse evaluations and neonatal evaluations (Chen et al., 2004). But again, the majority of ED physicians are not EM or PEM physicians and it is difficulty to assess the performance of those physicians.

As mentioned in Chapter 2, we know that the care that children receive in the ED can vary considerably. Substantial differences exist in the management of a number of illnesses and injuries including fever (Isaacman et al., 2001), croup (Hampers and Faries, 2002), splenic injury (Davis et al., 2005), diabetic ketoacidosis (Glaser et al., 1997), bronchiolitis (Mansbach et al., 2005), febrile seizures (Hampers et al., 2000), sedation (Babl et al., 2005) among physicians of different specialties, perhaps due to differences in specialty training. In some of these cases, there are guidelines available to help treatment decisions, but most are not used by the physician (Isaacman et al., 2001; Han et al., 2003; Orr et al., 2006).

SUPPORTING THE WORKFORCE TO IMPROVE PEDIATRIC EMERGENCY CARE

Ensuring an adequate supply of highly trained professionals in every category of emergency care provider is certainly a concern of the committee. In the committee's companion reports on prehospital and ED care, the committee recommends that the federal government undertake a detailed assessment of emergency care workforce capacity, trends, and future needs. This needs assessment should include a look at providers with pediatric expertise. However, in this report, the committee focuses on supporting providers in their ability to deliver appropriate pediatric emergency care. The committee offers a three-pronged approach.

Increasing Pediatric Training

There are no national standards for core competencies for training in pediatric emergency care. Residency programs, medical schools, nursing schools, states, EMS agencies and hospitals have different pediatric education and training requirements and opportunities for providers. In some cases, pediatric training is intensive; however, as discussed above, often pediatric training comprises a small part of total training time.

The committee believes that all emergency care providers should possess a certain level of competency to deliver care to children. Research has shown that pediatric training works, at least initially, to both improve competency and confidence of providers to care for pediatric patients. Improving the confidence of providers may reduce the reluctance on the part of some providers to administer treatment, thereby eliminating some of the disparities in care between adults and children. But continuing education is essential to maintain these skills and competencies. To increase the pediatric emergency care training that providers receive, **the committee recommends that every pediatric and emergency care-related health professional credentialing and certification body define pediatric emergency care competencies and require practitioners to receive the appropriate level of initial and continuing education necessary to achieve and maintain those competencies.** The major professional organizations that create and update core content specific to the emergency medicine curriculum (they include ACEP, SAEM, CORD, ABEM, EMRA, and RRC-EM) should ensure that EM residents receive training appropriate to meet a defined pediatric competency level considering the frequency in which children seek care in EDs. Similar improvements are needed in the emergency medicine curriculum for pediatric residents. The Emergency Nursing Association (ENA) should define a pediatric competency level, review the amount of pediatric training that nurses currently receive, and address any gaps. States should adopt the national standard curriculum developed by NHTSA, which includes pediatric training and pediatric continuing education components. Residency programs, medical and nursing schools and states should make sure that individuals with pediatric expertise are conducting the pediatric training. Further, states and provider organizations should ensure that all certification examinations are designed to test providers' pediatric competencies. Individuals that answer all pediatric questions incorrectly should not receive certification. All of these organizations should also explore ways to test pediatric competencies at regular intervals.

Despite strong growth of EM residency training programs, a large number of emergency physicians, particularly in rural EDs, have not undergone EM residency training. Many nurses working in EDs, particularly in rural settings, have not sought CEN certification and have not taken the Emergency Nursing Pediatric Course. In order to ensure that this group receives proper

pediatric emergency medicine education, JCAHO and state licensing bodies should evaluate ED staff's pediatric training for certification; similarly, pediatricians working in the ED should be assessed on their emergency medicine training.

Provider organizations, such as hospitals and EMS agencies, must also ensure that their workforce is well prepared to handle pediatric patients. Strategies for continuing education should be developed by provider organizations and should reflect the type of setting in which providers work. For example, the continuing education offerings at a dedicated pediatric emergency department may be very different from the continuing education needed at a general ED. These continuing education classes must be conducted regularly as skill maintenance declines over a relatively short time period. Furthermore, education courses should contain a major focus on the care of infants and young children as they constitute the largest single group of pediatric ED visits and require care that is most different from adults.

Continuing education courses are critical for all emergency care providers, particularly those providers that rarely see children, and hospitals that lack pediatric specialists. Even if critically ill pediatric patients are transported to dedicated pediatric EDs, ED staff at all hospitals need to maintain a basic level of competency to recognize and stabilize critically ill or injured until transport to a higher level of care is available. High fidelity simulation models, to the extent available, should be used for continuing education in order to provide as realistic of an event as possible.

Clinical Practice Guidelines for Pediatric Emergency Care

Treatment patterns for pediatric patients can vary widely across providers. In some cases, this variance in treatment is due to a lack of education on the part of providers. However, often it is because of the absence of evidence-based clinical guidelines for pediatric patients.

Clinical practice guidelines assist providers in decision-making regarding the appropriate care for specific clinical circumstances. Ideally, practice guidelines are based on scientific evidence or predictability. The IOM Committee on Clinical Practice recommended the implementation of evidence-based clinical practice guidelines because they have the potential for improving care. However, only a limited number of nationally recognized pediatric emergency care practice guidelines exist; a 2001 review of the 1,053 practice guidelines in the national Guidelines Clearinghouse concluded that only 15 apply to pediatric emergency care (Moody-Williams et al., 2002). This is troubling since use of guidelines has been shown to improve the quality of care (Grimshaw and Russell, 1993).

The committee believes that clinical guidelines should be science-based through use of an evidence evaluation process. Research indicates that clinical guidelines based on research evidence are more likely to be used than those developed in the absence of strong evidence (Grol et al., 1998). An evidence evaluation process helps ensure that clinical guidelines and standards are based on scientific evidence that is most likely to be correct. Under this process all research studies in a particular area, for example, asthma care in the ED, are reviewed and ranked based on the validity of study findings. Studies using randomized controlled trials are ranked higher than those based on expert opinion. These rankings are then tied to grades of recommendations. For example, a systematic review documenting homogeneity of results from a large number of high-quality randomized controlled trials gives the least biased estimate of the effect of an intervention; results would be given a high recommendation grade and then used in the development of clinical practice guidelines and standards of care. Reviews of studies using less

rigorous methods would be given a lower recommendation grade and would not be used to develop guidelines.

Use of a formal or systematic evidence evaluation process for emergency care research has been limited. However, in 1998 and again in 2005, the Neonatal Resuscitation Program Steering Committee of the AAP and the National Pediatric Resuscitation Subcommittee of the American Heart Association undertook a review of the pediatric resuscitation scientific literature. They evaluated the quality of the evidence that supported practices at the time and changes to those practices. The first evidence evaluation process culminated with the publication of the *Guidelines 2000 for Emergency Cardiovascular Care and Resuscitation: International Consensus on Science* (AAP, Accessed 2005). The second set of guidelines were released in January 2006.

In 2001, HRSA, NHTSA, and RWJ convened a panel of experts in managed care, quality improvement and EMS to review the literature and discuss critical issues related to practice guidelines and performance measurement in pediatric emergency care. The panel recommended the development of pediatric emergency care guidelines and suggested how the guidelines should be developed (e.g., a broad consensus process and a scientific approach) and the characteristics that the guidelines should have (e.g., they should be flexible and avoid undue complexity). In 2002, the EMS-C program initiated the Clinical Practice Guidelines for Pediatric Emergency Care demonstration project, which provided funding to two projects to help develop practice guidelines. One project is investigating re-hydration of children with moderate dehydration due to acute gastroenteritis; the other is evaluating the use of the National Heart, Lung and Blood (NHLBI) pediatric asthma guideline in five adult emergency rooms and investigating patient outcomes (MCHB, 2004b). The committee believes that more efforts like these are necessary. **The committee recommends that the Department of Health and Human Services collaborate with professional organizations to convene a panel of individuals with multidisciplinary expertise to develop, evaluate, and update pediatric emergency care clinical practice guidelines and standards of care.** There are a number of agencies within DHHS that could lead the effort including the FDA, HRSA, and AHRQ. Funding for the effort should be provided by DHHS. It will be up to the specialists from various professional organizations to evaluate the evidence in order to develop, evaluate, and update the clinical guidelines. Guidelines and standards of care should be multi-disciplinary and multi-organizational efforts in order to promote consensus and uniformity. The more organizations that are involved in the development, the more likely the guidelines are to be used in practice in various disciplines.

However, unless there is a commitment to funding pediatric emergency medicine research, there will not be an adequate evidence base to derive practice guidelines. The issue of research and funding for research is discussed in depth in Chapter 7.

Pediatric Leadership in EMS Agencies and EDs

Simply recommending more training and the development of guidelines is not enough. Someone must be responsible at the provider level for assuring that continuing education opportunities are available and well attended. Similarly, the development of clinical guidelines is useless without the widespread adoption of them by providers. The committee believes that pediatric leadership within each provider organization is needed in order to assure these steps. Therefore, **the committee recommends that EMS agencies appoint a pediatric emergency coordinator and EDs appoint two pediatric emergency coordinators – one a physician – to**

provide pediatric leadership for the organization. Hospitals may choose personnel for the coordinator positions based on available resources; often this will be a physician and nurse, but other models are possible (e.g., a physician and EMT-P). The activities of the pediatric coordinators should be a component of medical oversight.

The pediatric coordinator position is not necessarily intended to be a full-time position, but instead a shared role. Still, the coordinators would have a number of responsibilities that include ensuring adequate skill and knowledge of fellow ED or EMS providers; overseeing pediatric quality improvement initiatives; assuring the availability of pediatric medications, equipment, supplies; assuring that fellow providers follow clinical practice guidelines; representing the pediatric perspective in the development of hospital or EMS protocols or procedures, for example, for family-centered care; participating in pediatric research efforts; and developing prevention programs for the hospital or EMS agency. The pediatric coordinator would monitor pediatric care issues and raise concerns to the organization's leadership when a problem with pediatric care is identified. For example, if medication errors for children in the ED appear to be rising, the pediatric coordinators should bring this to the attention of hospital administrators. Additionally, pediatric coordinators may liaison with community hospitals lacking pediatric resources to provide quality improvement efforts and education.

There are a couple of reasons why it is important for hospitals to have two pediatric coordinators. First, the coordinator positions are not full-time positions, but shared roles. But there are many responsibilities that the committee assigns to pediatric coordinators – enough that 2 pediatric coordinators are necessary. Second, for hospitals, it is important to have a physician serve as a pediatric coordinator, rather than having a lone nurse or EMT pediatric coordinator. While the nurse-physician relationship has generally changed over time from an authoritarian relationship to a collaborative one (Pavlovich-Danis et al., 2005), remnants of the old dynamic may prevent some physicians from amiably taking suggestions for improving of pediatric care from nurses or EMTs and vice versa. Certainly both coordinators should collaborate on pediatric improvement initiatives within the ED.

The concept of a pediatric coordinator is not new. In fact, since 1983, all Los Angeles hospitals designated as Emergency Departments Approved for Pediatrics (ADAPs) are required to have a pediatric liaison nurse (PdLN) on staff, similar to the pediatric coordinator proposed position here. Additionally, the 2001 *Guidelines for Preparedness for the Care of Children in the Emergency Department* from AAP and ACEP contained a recommendation regarding the use of a physician coordinator and nurse coordinator for the care of children. The guidelines stipulate that the physician coordinator may be a staff physician with other responsibilities in the ED, but should meet the guidelines for credentialing as a specialist in emergency care, pediatric emergency medicine, or pediatrics and have a special interest, knowledge, and skill in emergency medical care of children. The guidelines stipulate that the nursing coordinator should demonstrate an interest, knowledge, and skill in emergency care and resuscitation of infants and children as demonstrated by training, clinical experience, or focused continuing nursing education. This position includes duties such as coordinating pediatric quality improvement, serving as a liaison to in-hospital and out-of-hospital pediatric care committees, facilitating nursing continuing education in pediatrics (AAP, 2001). Pediatric coordinators for EMS agencies appear to be less common, but are necessary to advocate for improved competencies and the availability of resources for pediatric patients. Preferably, prehospital pediatric coordinators will be EMT-Ps with the interest, knowledge, and skills necessary for delivering care to children.

EMS pediatric coordinators would have many of the same responsibilities as physician and nurse pediatric coordinators.

One children's hospital currently employs two full time coordinators who are responsible for both EMS and hospital-based emergency care services. The hospital-based coordinator, an EMT-P, spends the majority of his time coordinating the PALS program and other education programs within the hospital. He also leads a task force, which examines all resuscitation events and reviews policies and procedures for resuscitation. Part of his duties includes making sure resuscitation equipment is available and that all crash carts are uniform across all hospital floors. The coordinator reports to the administrator of the ED as well as the division chief of emergency medicine. The second coordinator is focused primarily on coordinating PALS and other continuing education courses for prehospital providers (Personal communication, D. LaCovey, March 13, 2006).

Approximately 18 percent of hospitals have a pediatric physician coordinator on staff; 12 percent have a nurse coordinator (Gausche-Hill et al., 2004). However, in Los Angeles, the hospitals that are best prepared for pediatric emergencies—those designated as Emergency Departments Approved for Pediatrics (EDAP) hospitals—are required to have pediatric coordinator positions. But pediatric coordinators are arguably most important for smaller EDs and EMS agencies that lack strong pediatric expertise. These are the EMS agencies and EDs that are in need of immediate pediatric leadership. These EDs may not be able to staff the pediatric coordinator position with a physician that is an EM physician or a physician with pediatric expertise; however, the position should be given to a physician with the interest and desire to improve pediatric emergency care within the facility.

RECOMMENDATIONS

4.1 Every pediatric and emergency care-related health professional credentialing and certification body should define pediatric emergency care competencies and require practitioners to receive the appropriate level of initial and continuing education necessary to achieve and maintain those competencies.

4.2 The Department of Health and Human Services should collaborate with professional organizations to convene a panel of individuals with multidisciplinary expertise to develop, evaluate, and update pediatric emergency care clinical practice guidelines and standards of care.

4.3 EMS agencies should appoint a pediatric emergency coordinator and hospitals should appoint two pediatric emergency coordinators – one a physician – to provide pediatric leadership for the organization.

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5

Improving the Quality of Pediatric Emergency Care

Providing high quality emergency care services to children requires an infrastructure designed to support care to pediatric patients. In Chapter 2 we discussed how many provider organizations, both EMS agencies and hospitals, lack recommended pediatric equipment and supplies for children. Addressing these basic deficiencies is an important first step. However, as technology improves and our knowledge of quality in healthcare expands, our expectations for provider preparedness go well beyond simply having the right sized equipment and appropriately labeled medications. We expect provider organizations to have safeguards in place to protect pediatric patients from the hazards of EMS and ED environments. We expect that technological and information systems advances adopted by provider organizations will be appropriate for children as well as adults. And we expect care to be provided in a way that is evidence-based, protocol driven, and respectful to children and their parents or guardians.

The chapter begins with an overview of the threats to patient safety in the ED and EMS environments and the implications for patient care. The committee believes that emergency care provider organizations—both EMS agencies and hospitals—must take active steps to address threats to quality and safety of pediatric emergency care services in order to reduce the burden of illness and injury to patients.

PATIENT SAFETY IN THE EMERGENCY CARE SETTING

Emergency care services are delivered in an environment where the need for haste, the distraction of frequent interruptions and clinical uncertainty abound, thus potentially exposing patients to a number of threats to patient safety. Children are, of course, at great risk under these circumstances because of their physical and developmental vulnerabilities, their inability to accurately describe their symptoms and past medical history, and because they may require care from providers who are not accustomed to treating pediatric patients.

Emergency departments (EDs) are high-risk areas for medical care for patients of all ages. The nature of their mission and the multiple challenges they confront increases the risk of medical errors and adverse events (Leape et al., 1991; IOM, 2000; Vinen, 2000; Weingart et al., 2000). Thomas et al., in their study of admissions to hospitals in Colorado and Utah, found that the hospital department with the highest proportion of negligent adverse events (52.6 percent) was the ED (Thomas et al., 2000). An earlier study, by Trautlein et al., found that 15 to 20 percent of hospital malpractice claims are a result of errors in the ED, most of which involve serious injury or death (Trautlein et al., 1984).

There are several reasons why the ED is a high-risk area for errors. First, many EDs face excessive crowding—resulting in a noisy, even chaotic environment with frequent workflow interruptions. The large volume of patients result in many being evaluated, treated, and housed in the ED hallways creates situations that are fraught with opportunities for error (Cosby, 2003; Selbst et al., 2004; Weiss et al., 2004). ED patients do not arrive on a scheduled basis. Therefore, ED volumes can fluctuate a great deal, which makes it difficult for EDs to make staffing adjustments to meet sudden shifts in demand (Chamberlain et al., 2004).

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Second, ED personnel often work under a great deal of stress. They are required to see a broad case mix of patients and make rapid clinical decisions with little time and often without sufficient patient information (Selbst et al., 2004). Although most physicians manage one patient at a time (in the O.R., clinic, diagnostic suite or outpatient surgical center) emergency physicians are often responsible for the simultaneous management of ten to 20 patients or more with a variety of problems and different levels of acuity. This is such an intrinsic part of emergency medical practice that the oral board exam administered by ABEM requires examinees to properly handle three hypothetical cases simultaneously. No other specialty incorporates “multiple patient encounters” in their board certification examination process.

In addition to caring for multiple patients, there are often competing demands on emergency care providers’ time—in addition to examining patients and providing treatment, they may have to handle emergency medical services calls, help manage patient flow, listen to patients’ and family members complaints about waiting times and delays in care, track down missing laboratory or radiology results, and the like. ED physicians are frequently interrupted while working. In many cases, these interruptions result in a break in the physician’s focus on his or her primary task (Chisholm et al., 2001).

In contrast to outpatient clinics and doctors’ offices, EDs operate 24-hours a day. The social and circadian stresses involved in consistently staffing the emergency department on a 24/7 basis makes ED physicians, nurses, and support staff particularly subject to fatigue, further increasing opportunities for mental errors (Vinen, 2000; Weinger and Ancoli-Israel, 2002; Chamberlain et al., 2004; Selbst et al., 2004). A study of the effect of sleep-deprivation on experienced emergency physicians revealed that physicians working night shifts demonstrated a decrease in the speed of intubation and subjective alertness when compared with their day-shift work (Smith-Coggins et al., 1997).

Patient hand-offs from one provider to another mid-treatment can result in loss or distortion of important clinical information, thus providing increased opportunities for errors (Croskerry, 2000; Stiell et al., 2003; Chamberlain et al., 2004; Selbst et al., 2004). Physicians, nurses, and other clinicians working on the same shift often fail to communicate effectively, further increasing the chance for errors to occur (Risser et al., 1999; Croskerry, 2000; Cosby, 2003; Selbst et al., 2004; White et al., 2004). In fact, poor communication and teamwork failures are a significant problem in the ED. White and colleagues (2004) noted that communication issues were associated with 30 percent of the ED risk management files they studied, and appeared to contribute directly to adverse medical outcomes in 20 percent of those cases (White et al., 2004). In addition, a 1999 study of the contribution of teamwork failures to clinical errors found that 8 of the 12 deaths in their review could have been prevented if appropriate teamwork action had been taken (Risser et al., 1999). Risser and colleagues (1999) noted that the most frequently cited primary contributor to clinical error in the ED (35 percent) was the failure to cross-monitor the actions of team members (Risser et al., 1999).

Another problem faced by clinicians in the ED is lack of access to complete and accurate medical histories for the patients they are treating (Schenkel, 2000; Cosby, 2003; Chamberlain et al., 2004; Selbst et al., 2004; White et al., 2004). In most cases, ED physicians do not have access to a patient’s medical record or even to records of previous visits to that or other area EDs. This problem can be compounded by poor information flow from the patient to the caregiver—due to the patient’s age, mental health status, use of debilitating drugs or alcohol, language, culture, or apprehension and anxiety over the need for emergency care.

Less research has been conducted on threats to patient safety in the EMS environment (O'Connor et al., 2002), though the EMS environment is similar to the ED environment in many ways (Fairbanks, 2004): the fast-paced nature of the work, stressful environment for providers, and the shift work and 24/7 coverage that contributes to provider fatigue. EMTs also lack complete and/or accurate medical histories of patients.

However, EMS personnel must also contend with a different set of challenges. They often have to provide patient care in unusual locations, such as on the side of a road or highway or close to a crash scene. EMS personnel also have fewer options for back-up. In many EDs there are physicians to make diagnosis and develop treatment plans; nurses to start IVs and administer medications; technicians to take patients' blood pressure and pulse; social workers to talk with families; a secretary to complete billing information; and specialists that can be called in to assist with complex interventions; however, EMTs and paramedics in the field have no backup, other than perhaps the muscle and moral support of first responding firefighters or other rescue personnel. Sometimes EMTs perform all of these tasks alone as a first responder or in the back of an ambulance. As such, the EMS environment lacks even the meager redundancies and system protections found in the ED that occur with a team approach to patient care. Additionally, much of the equipment used by EMTs was designed for in-hospital use and has not been well adapted for the EMS environment (Fairbanks, 2004).

Most of these factors contribute to a potentially unsafe emergency care environment for all patients, not just children. However, there are other factors that complicate care to children more than adults. First, some children are preverbal and cannot self-report their symptoms. Many children have multiple caregivers, which increases the likelihood that providers will be given an incomplete or inaccurate medical and medication history. Also, children are likely to be accompanied by parents or guardians suffering from great anxiety, which requires staff to attend to their concerns while also staying focused on the patient (Chamberlain et al., 2004). Young children, particularly those who are frightened or in pain, are unable to cooperate with the examiner, or understand the process of care, and may actively resist the performance of painful or uncomfortable procedures. This requires pediatric providers to use a variety of tactics, including use of short acting sedatives and other hazardous drugs, to successfully complete treatment.

Timeliness represents another important challenge for pediatric patients in the emergency care setting. The emergency care system must be organized to eliminate unnecessary delays in triage and treatment. Because of their unique anatomical and physiological differences, children can get into trouble physiologically much faster than adults. If children do not receive effective emergency care in a timely manner, certain illnesses and injuries can lead to serious consequences, even death, relatively quickly.

There are many examples. An infant or young child's thermoregulatory system is less capable of cooling their bodies so a young child's body temperature can rise 3 to 5 times faster than an adult's, making infants and young children more susceptible to heat stroke (Null, 2005). An infant left in an enclosed automobile in hot weather will become hyperthermic very quickly. Hypothermia also occurs very quickly in children because they have thin skin, less insulating body fat, and a high body surface area to mass ratio. They can become hyperthermic in situations where an adult would not. If not quickly diagnosed, the condition leads to problems with resuscitation (American College of Emergency Physicians and American Academy of Pediatrics, 2006).

Meningococccema, or blood stream infection, is a potentially-life threatening illness that occurs abruptly and progresses rapidly. Cases are rare, but occur most often in children younger than age 5 (Kapes, 2005). Meningococccemia can lead to death more quickly than any other infectious disease, so early recognition is critical to implement prompt therapy and supportive care. Treatment must begin quickly because irreversible shock and death may occur within hours of the onset of symptoms (Tanzi and Silverberg, 2005). However, symptoms (fever, chills, sore throat) often resemble other conditions. Approximately 20 percent of children who develop meningococccemia do not survive (Children's Hospital Boston, 2005b).

Another example is shock. Pediatric practitioners treating acutely ill children from neonates to young adults are faced with multiple causes of shock (e.g., trauma, infection, anaphylaxis). Hypovolemic shock results from a deficiency of blood volume and is a leading cause of pediatric mortality in the U.S. Whereas an adult can lose 500 ccs of blood without much effect, losing only one half this amount of blood in infants will result in death. Delay in recognizing and quickly treating a state of shock can lead to widespread multiple system organ failure and death (Schwarz, 2006). In a study of nearly 100 patients over a 10-year period, researchers were able to determine that when community hospitals, primary care physicians and families recognized and treated children for shock prior to coming to the hospital, the mortality rate decreased dramatically. However, shock tends to be under-recognized and under-treated by emergency providers (Han et al., 2003).

Children are also more susceptible to smoke inhalation and carbon monoxide toxicity than adults because of their higher metabolic rates and smaller volume of distribution for the carbon monoxide (American College of Emergency Physicians and American Academy of Pediatrics, 2003). They experience symptoms more quickly than adults, but because the symptoms of carbon monoxide poisoning are similar to those associated with the flu (without the fever) and food poisoning (Children's Hospital Boston, 2005a), carbon monoxide poisoning is often treated improperly in children. However, a child's continued exposure to carbon monoxide can lead to neurological disorders, cardiac arrest, and death.

Although these represent just a few examples of pediatric conditions that require prompt identification and treatment, one thing common to many of the examples is that diagnosis may be delayed if symptoms resemble other, more common, problems. Because children can maintain normal physiology using compensatory mechanisms until they can no longer compensate, at which time they deteriorate quickly, they are particularly vulnerable if treatment is not started promptly. For example, an infant or child may have a normal blood pressure and be in compensated shock. They compensate by increasing heart rate and clamping down on extremity arteries to shunt blood to the central circulation. Therefore, subtle signs, such as increase in heart rate and cool extremities must be recognized promptly.

However, parents, guardians or primary care physicians may not recognize the need for immediate emergency care and emergency care providers may not be able to quickly determine the severity of illness or injury. In fact, at least one study has shown that the level of agreement in triage assignment for pediatric patients in the ED is not high, and varies based on the level of pediatric training (Maldonado and Avner, 2004). But early identification of worrisome signs and symptoms is paramount. For example, while vomiting is rather common in children, it may be caused by gastroenteritis, which is generally less serious, or by many life threatening conditions, such as meningitis, encephalitis, intussusception or other conditions that can result in significant morbidity or mortality if not evaluated and managed quickly (D'Agostino, 2002; Fleisher and Ludwig, 2006).

Another pediatric concern with timeliness has to do with the often long waiting times associated with ED visits. As mentioned in Chapter 2, ED crowding has become a daily occurrence in many hospitals. NHAMCS data indicate that in 2003, the average waiting time for all patients (children and adults) to see a physician was 46 minutes (McCaig and Burt, 2005). Data from 2000 demonstrate the differences in wait time according to patient acuity. On average, patients waited 24 minutes for a visit classified as “emergent,” 38 minutes for an “urgent” visit, 56 minutes for a “semiurgent” visit, and 67 minutes for a “nonurgent” visit (McCaig and Ly, 2002). Prolonged wait time may result in protracted pain for all patients (Derlet and Richards, 2000; Derlet et al., 2001), but for pediatric patients there is another concern. In busy EDs that serve both adults and children, children may be exposed to inappropriate and frightening scenes, such as violence, severe injury, and/or threatening language. Adult emergency departments are generally not well-suited for providing a comforting or reassuring environment for children.

Evidence of Compromised Safety for Pediatric Patients

Given this potentially perilous emergency care environment, how often do medical errors occur in pediatric patients? Surprisingly, the answer to that question is unknown. In fact, there is little high-quality data on the epidemiology of medical errors in children, particularly within the emergency care system. Instead, there are a few, typically small, studies that demonstrate that care is compromised during several different stages of an ED visit. For example, providers often triage patients inaccurately (Selbst et al., 2004). Errors in specimen collection methods (Walsh-Kelly et al., 1997) and interpretation of radiographs are also a concern (Walsh-Kelly et al., 1995). Not surprising, children with special medical needs or who are technology dependent are significantly more likely to experience a medical error than other children (Slonim et al., 2003).

One of the most telling studies on the quality of pediatric care comes from a recent drill conducted in 35 EDs (including 5 trauma centers) in North Carolina. Using life-size child mannequins, researchers staged “mock codes” and presented each team with a vignette describing patients’ symptoms. Nearly all of the EDs failed to properly stabilize seriously injured children during trauma simulations. Thirty-four hospitals failed to administer dextrose properly to a child in hypoglycemic shock (a life-threatening drop in blood sugar); 34 failed to correctly warm a hypothermic child; 31 failed to order proper administration of IV fluids; 24 failed to attempt or succeed at accessing a child’s bloodstream through a bone (a critical alternative for rapidly delivering fluids and medicines to sick children); and 23 failed to prepare appropriate medications, monitoring equipment and personnel needed to transport a child safely within the hospital. On the other hand, many hospitals were successful at calling appropriate individuals for assistance, initial airway assessment, initial bag-mask ventilation, ordering appropriate imaging tests, and conducting initial vital signs assessment (Hunt et al., 2006).

There have been no published studies describing the nature or extent of medical errors in the EMS environment. However, in one research effort, 15 paramedics were interviewed about adverse events and near misses; all had multiple events to report. In sum, 61 events were described, 23 percent of which involved a child. The major types of errors were mistakes in clinical judgment (54 percent), errors in skill performance (21 percent), and medication errors (15 percent). Only one-third of the errors were reported to anyone (Fairbanks and Crittenden, 2006). In another small study, which tested 14 paramedics ability on use a manual defibrillator, several paramedics defibrillated when they intended to cardiovert. This is a potentially fatal error and in some cases, participants were not aware they had made the mistake. The researchers

attributed the error to defibrillators' poor interface design (Fairbanks et al., 2004; Fairbanks 2004).

However, the best evidence of medical errors and compromised safety concern medication errors and adverse drug events in children. Prescribing errors occur more frequently in the ED than in any other part of the hospital and more frequently in the care of children than adults. Medication errors were the most commonly reported type of error at one pediatric ED (Selbst et al., 1999). In a retrospective study of over 1500 charts for children treated in a pediatric ED, prescribing errors were identified in 10 percent of patient charts (Kozer et al., 2002). These errors occurred more frequently during overnight hours (4 AM to 8 PM) and on weekends and were more often made by trainees. Another study evaluated medication errors with respect to antipyretics and found that 22% of acetaminophen doses ordered were outside of the recommended 10-15 milligrams/kilogram/dose recommendation (Losek, 2004). Another study of medication errors among acutely ill and injured children presenting to rural EDs revealed errors in 48 percent of patient charts (Marcin et al., 2005). More seriously ill children are more likely to experience a prescribing error than those with less serious illnesses or injuries (Kozer et al., 2002).

Not surprisingly, the limited evidence available also indicates that medication errors occur frequently in the EMS environment. In a study that assessed the medication calculation skills of 109 paramedics, the overall performance was poor. On average, the paramedics got 51 percent of the test questions correct. Medication infusions were calculated incorrectly in one-third of cases (Hubble and Paschal, 2000; Fairbanks, 2004).

Challenges Associated with Prescribing and Administering Medications to Children in an Emergency Setting

Perhaps the first and foremost problem associated with medications and children is that many medications are frequently prescribed to children "off label," meaning that they have not been approved for pediatric use by the FDA. Once a drug is approved for use by the FDA, further studies to determine safety and efficacy in infants and children are rarely conducted for the majority of drugs (Rapkin, 1999). The result is that emergency providers have to prescribe medications to children without full understanding of the risks, benefits or implications. One example is the use of medications to treat depression in children. Data indicate that psychiatric emergencies are on the rise for children and adolescents, yet there is only one medication, fluoxetine, approved for pediatric use. Still, others are frequently prescribed. The dosages, efficacy, and safety of these medications have not been well established. Although there is some evidence that one of those drugs, paroxetine, may lead to a higher risk of suicide, the research is thin and it is unclear why there is a greater risk associated with paroxetine and other drugs in comparison to fluoxetine.

Medications designed for adults may not be suitable for children because of differences in pharmacokinetics and pharmacodynamics. Pharmacokinetics refers to what the body does to a drug and children's bodies absorb, distribute, metabolize and eliminate medications differently than adults. Additionally, the pharmacodynamics of the drug (what the drug does to the body) differs between children and adults. But the pharmacokinetics and pharmacodynamics also differ as children develop, so the needs of a premature infant, full term infant, child, and adolescent can vary greatly. [Morphine provides a good example. In order to achieve a morphine steady-state serum concentration of 10 ng/mL, the infusion rate in microgram/kg/hr is 5 for neonates, 8.5 at

one month of age, 13.5 at 3 months, 18 at one year, and 16 for 1-3 year old children after non-cardiac surgery in an ICU (Bouwmeester et al., 2004).

Currently, emergency care professionals have few evidence-based guidelines and information to assist them with the prescribing of medications for infants, children, and adolescents (Mace et al., 2004). For example, there is currently no consensus on optimal guidelines for medications for pediatric conscious sedation and in fact, sometimes these medications are given to children in combination with other drugs. Adverse drug events are common, particularly for antibiotics (e.g., ceftriaxone, clindamycin, amoxicillin) opioids (e.g., morphine, hydromorphone, acetaminophen with codeine), and anticonvulsants (e.g., phenytoin, phenobarbital, valproic acid); drugs in these classes are commonly prescribed to children in an emergency setting. Because of the startling knowledge gap and the frequent use of medications in children in the emergency setting, **the committee recommends that the Department of Health and Human Services fund studies on the efficacy, safety, and health outcomes of medications used for infants, children, and adolescents in emergency care settings in order to improve patient safety.** There are a number of different agencies within DHHS that could lead the effort including the FDA, HRSA, and AHRQ. Congress has already taken some action in this area by passing two laws that provide incentives for Best Pharmaceuticals for Children Act of 2002 (BPCA) or require the Pediatric Research Equity Act of 2003 (PREA) drug manufacturers to conduct studies on the effect of drugs when used for pediatric patients. Under BCPA the manufacturer takes the initiative for conducting pediatrics studies and requests six month patent extension from the FDA; however, this may not occur for drugs with limited market potential. PREA applies only to new molecular entities or new drugs where FDA can require performance of pediatric studies by the manufacturer unless exceptions are granted. There is currently no regulation providing incentive to or requiring the manufacturer to perform pediatric studies for the vast majority of drugs on the market in the generic form used in pediatric patients.

But even for the small group of medications where pediatric guidelines are available, there are a number of pitfalls that can occur at the prescribing, dispensing, administration, and monitoring stages that can result in medication errors and adverse drug events. Most adverse drug events for pediatric patients are a result of errors that occur at the prescribing stage—and they often involve incorrect dosing (IOM, 2000; Kaushal et al., 2001; Selbst et al., 2004; Chamberlain et al., 2004). Doses for pediatric patients must be calculated based on patient's weight and therefore must be drawn up specifically for each patient. But the calculations needed to draw up the dosing are complicated, and errors are common (Selbst et al., 2004). Patient weight can be and often is obtained or recorded incorrectly (Selbst et al., 1999). Among the most serious dosing errors are 10-fold errors which occur when a decimal point is missing or misread. There are several examples of children receiving ten or hundred times the intended dosage of a certain medication, which have led to fatalities; in one case, a baby was given 15 milligrams of morphine instead of the intended 0.15 milligrams—a hundred fold difference in dosing (Goldstein, 2001).

Other errors from dosage can occur if there is confusion between milligrams (mg) and micrograms (mcg) or milligrams (mg) and milliliters (mL). Additionally, errors are common with combination products, for example, Tylenol with codeine; it may be unclear whether the dosage is for the Tylenol or the codeine. And finally, dosage errors may occur when a product is prepared in two different ways and the concentrations are different. For example, Tylenol comes in a syrup and a drop but the concentrations differ.

The process of dispensing and administering medications for children, unlike adults, relies much more heavily on manual compounding of liquid medications and administration to patients who are unable to perform their own medication safety checks. This may well make the dispensing and administering of medications more error-prone for children. Additionally, errors can occur during the dispensing stage if drugs that look or sound alike are confused, for example, Zantac and Zyrtec and Tobrex and Tobradex. Additionally, the packing of two medications may look alike and contribute to errors at the dispensing stage (Levine et al., 2001; Selbst et al., 2004). Most EDs do not have a pharmacist on staff to review orders or assist with medication use (Selbst et al., 2004). At the administration phase, a drug may be delivered twice if the first is not promptly recorded in the medical record.

To reduce the high frequency of medication errors that occur in pediatric emergency care patients, **the committee recommends that the Department of Health and Human Services and National Highway Traffic Safety Administration fund the development of medication dosage guidelines, formulations, labeling, and administration techniques for the emergency care setting to maximize effectiveness and safety for infants, children and adolescents. EMS agencies and hospitals should implement these guidelines, formulations, and techniques into practice.** The agencies could commission research studies and/or convene a panel of experts to achieve these tasks. The Office of Emergency Medical Services within NHTSA is a natural leader of this effort; within DHHS, there are a number of agencies that could lead the effort including the FDA, HRSA, and AHRQ. Implementing the proposed guidelines will not only improve patient safety, but will potentially reduce providers' liability claims since medication errors have been shown to be the second most frequent and second most expensive event causing liability claims (Physician Insurers Association of America, 1993).

Improving Pediatric Patient Safety

The task of ED and EMS providers – to care for patients of all types often with limited patient information and in a difficult, crowded environment—is enormous and many providers and organizations are up to that task. However, there is enough evidence to suggest action to improve patient safety. **The committee recommends that hospitals and EMS agencies implement evidence-based approaches to reduce errors in emergency and trauma care for children.** Those organizations that give guidance to providers, such as government agencies and professional organizations, should encourage providers to implement measures to protect patient safety. Continued research is needed in order to determine the best strategies for improving patient safety in prehospital and ED care; however, these strategies should focus on the factors that contribute to the deterioration of performance, such as crowding, communication and information, and provider resources.

There are several promising strategies that various hospitals and EMS agencies have tried with some success that could be replicated in other organizations. These initiatives have the potential to help all patients, not just pediatric patients. Here we classify the strategies into 3 groups: provider policies, provider training, and technologies. Ideally, organizations will adopt all three of these strategies. Just a few examples of each type are provided here.

Provider Policies

One of the problems associated with reducing the incidence of medical errors is that it is unknown how often errors occur and what the most important triggers of errors are. Provider initiatives developed to raise the awareness of medical errors have shown some potential though

these programs must be coupled with limits on provider liability in order to encourage participation. For example, one hospital created and implemented the “Good Catch Reporting Program”. Under the program, all staff are required to report suspected and identified medical errors and near misses without fear of reprisal. Senior hospital leadership appointed a Patient Safety Manager who reports to the Chief Nurse and reviews all errors and near misses. This information is used to develop system improvements for patient safety. Within the first three months of the program, reporting of near misses doubled (Salisbury, 2005). This initiative could also be applied to the EMS environment.

EMS and hospital administrators have a number of opportunities to examine and specifically develop policies to address the areas in which they believe shortcomings in patient safety exist. One hospital created the “Look Alike/Sound Alike Project” in which a second person is required to verify all medications prior to the administration of drugs to a patient. Additionally, a pharmacist separated all “look alike/sound alike” medications in the pharmacy and clinics. Since the project was implemented, no look alike/sound alike medication errors have been identified (Salisbury, 2005).

Training

Energized by successes in the aviation industry where teamwork training has led to reductions in errors and improved performance (Risser et al., 1999; Sprague 1999), several organizations have promoted the concept of teamwork training for health professionals. The similarities between pilots and doctors—highly trained technically, accustomed to viewing themselves as bearers of ultimate authority and responsibility, independent yet increasingly dependent on others of varying skill level—suggests that teamwork training may be influential in reducing errors in the medical field (Sprague, 1999). Research on the impact of teamwork training in the ED is limited but promising. MedTeams, a DoD project that introduced teamwork training in to healthcare, developed an Emergency Team Coordination Course (ETCC), an 8 hour didactic course taught for physicians, nurses, technicians and support personnel. An evaluation of the course revealed considerable success. EDs using the ETCC experienced a 67 percent increase in error averting behavior and a 58 percent reduction in observable errors (Risser et al., 1999; Shapiro et al., 2004).

Training initiatives that use simulation exercises have been shown to improve performance (Chorpra et al., 1994; Shapiro et al., 2004). Simulation training involves giving emergency care providers practice performing tasks in lifelike circumstances using human models or virtual reality with feedback from skilled observers, other team members, and video cameras. Some hospitals and academic medical centers use robotic human simulators (for example, an infant patient simulator can be used to train providers for intubation) so that providers can experience high-risk, low-frequency events. These human simulators, fully analogous to the flight simulators used by pilots—allow care providers to manage a wide range of clinical scenarios and learn from mistakes without harming a real patient (ECRI, 2005). The modern human patient simulator is extremely realistic with anatomically correct clinical signs and ability to communicate (Reznek et al., 2002).

Pediatric human simulators are in use in a limited number of hospitals. For example, at the University of Michigan, simulation is used to train EMTs and pediatric residents in standardized pediatric resuscitation courses. An attending physician developed the Pediatric Mock Code Program where the pediatric human patient simulator is used during actual pediatric code

activations. Evaluation and training is provided to pediatric residents as well as other code team members including nurses, pharmacists and respiratory therapists. The program evaluates resuscitation skills, team interaction and team leadership skills using a variety of scenarios representing the critically ill or injured child in the arrest and pre-arrest state (University of Michigan Health System, 2005).

Evidence of the effectiveness of simulation-based training is limited and has primarily focused on adult patient settings. However, use and testing of pediatric human patient simulators could be a promising method of pediatric training, particularly since many providers infrequently encounter critically ill or injured patients in practice; use of a simulator can help providers maintain pediatric skills. However, there is presently limited access to simulation training technologies in hospitals much less EMS environments. Mobile simulation apparatus will be needed in order to bring this training to providers in the field, particularly those in rural areas (NHTSA, 2002).

Technology

To further promote safety, recent attention has been given to identifying medications, patients, and providers with barcodes. By implementing technology that reads these barcodes, a computer system can confirm that the right medication is being given to the right patient at the right time and warn the provider of any safety issues. But progress on this technology remains stalled, as the pharmaceutical industry tries to find a standard method to identify their medications (Kaushal and Bates, 2002). A review of the controlled studies available shows time savings and error reduction with the use of bar codes, however further study is needed (Oren et al., 2003). There is also hope that the increased use of electronic health records, computerized physician order entry, decision-support systems, and the like will help improve patient safety, thus making it easier for emergency care providers to make correct diagnoses and provide proper treatment to their patients (Cosby, 2003). Indeed, all have been shown effective in reducing errors in small evaluations of the tools for patients of all ages (Hunt et al., 1998; Bates et al., 1999; Bizovi et al., 2002; Buller-Close et al., 2003); however, results have not been universally positive (Han et al., 2005). The next section describes some of these technologies and discusses the need to design them for use on pediatric patients.

ADVANCEMENTS IN TECHNOLOGY AND INFORMATION SYSTEMS

Technology is also likely to advance the way in which care is delivered in the prehospital and ED setting. New technologies designed to accelerate diagnosis and workflow—advanced imaging modalities, rapid diagnostic tests, laboratory automation, EMS technologies, patient tracking tools, and new triage models—and improve treatment—ultrasonography, tympanocentesis, needle-less drug administration, and innovations in procedural sedation—are likely to be adopted.

As these new technologies are introduced, it is critical to consider how they help (and whether they may bring harm to) pediatric patients. While this seems like a rather obvious consideration, history is ripe with examples of medical technologies that were originally developed for adults, but used on children with unintended consequences. Devices are typically developed for adults because adults constitute a much larger share of the market for medical services. For similar reasons, postmarket surveillance efforts of medical devices is focused on

adults, especially older adults, rather than children. Also, medical product regulation and patient safety efforts tend to focus more on pharmaceuticals than medical devices (IOM, 2005).

When detrimental effects on children are discovered postmarket, adjustments are eventually made to the technologies, making them safer for pediatric use. One example is the infusion pump, introduced over 30 years ago, which delivers medications and fluids intravenously. As originally designed, the devices had a wide range of acceptable programming parameters. For example, they could be programmed to deliver a drop or two every hour or one liter or more in an hour. They were designed for maximum flexibility; they could be used on an adult ICU patient one day and on a premature infant the next. Because the technology relied on human intelligence for programming, naturally, errors occurred. For example, in a neonatal ICU, an infusion rate was programmed to 304 ml/hr when the physician intended the rate to be 3.4 ml/hr. In many cases, critical errors were made based on one single wrong button press (Reves, 2003).

Advancement in infusion technology led to the introduction of “smart pumps,” which are widely used today. Smart pumps utilize software that checks programmed doses. The software contains information on drugs, their usual concentrations, dosing units, and dosing limits. When the practitioner uses the pump, he or she programs it for use in a designated area (e.g., adult ICU, NICU), and the pump is automatically configured for use on adults or children. Additional safeguards are also built into the pumps, for example, alerting the user if the dosage exceeds the hospital’s established limit and not allowing the user to use the patient’s weight if the drug is not dosed according to weight (Reves, 2003).

A market for pediatric technologies, equipment, and supplies must be stimulated so that products are initially designed to meet the needs of pediatric patients, rather than adapted from products originally designed and intended for use on adult patients. The market for pediatric-designed products has not been well-developed in part because providers have not been compelled to purchase pediatric-specific products. Emergency providers should be made aware of the potential shortcomings of products designed for adults and adapted for children in order to stimulate demand. To advance this effort, **the committee recommends that federal agencies and private industry fund research on pediatric-specific technologies and equipment used by emergency and trauma care personnel.**

This is not the first recommendation of its kind. The 2005 IOM report, *Safe Medical Devices for Children*, emphasized the need for the FDA, NIH, and AHRQ to define a research agenda and priorities for the evaluation of the short- and long-term safety and effectiveness of medical devices for children (IOM, 2005). The report also called for the FDA to work with industry and others to focus more attention on adverse events involving the use of medical devices for children and update product labeling to promptly reflect safety-related findings. Emergency providers should be able to take comfort in knowing that the equipment they are using on pediatric patients is safe and effective. Development and testing of new products is needed in order to give providers this assurance.

Federal agencies and private industry also need to take a careful look at the technologies already in place and available for use on infants, children, and adolescents. There are a number of devices and technologies that are being used on pediatric patients when it is unclear whether the technologies in the aggregate do more good than harm for children. One example is the growing use of pediatric computed tomography (CT), which is a tool that assists ED providers in diagnosing illness and injury in children. Two to three million CT scans are performed on children annually, which represents a seven-fold increase in the past ten years (Doheny, 2003), much of which is due to increased availability of CTs. One problem with the use of CT is the

radiation exposure. Exposure is more detrimental to children than adults because children are more sensitive to radiation than adults and they have longer life expectancy and therefore a larger window of opportunity to develop a cancer of their lifetime. The same radiation dose given to a neonate is several times more likely to produce a cancer over the child's lifetime than compared to a 40-year-old adult (National Cancer Institute and The Society for Pediatric Radiology, 2002). Research indicates that pediatric CT scans are used too liberally in the ED, often to appease parents or guardians that request them (Doheny, 2003). Additionally, practitioners often fail to adjust the exposure parameters when giving a CT to a pediatric patient. As a result, in 2002, the National Cancer Institute and Society for Pediatric Radiology issued a guide to physicians instructing them how to minimize children's exposure to radiation. They recommended only performing CT scans when necessary, limiting the region of the body to be scanned, adjusting exposure parameters based on the child's size and weight, and minimizing the use of multiple scans (National Cancer Institute and The Society for Pediatric Radiology, 2002). Children receiving scans at adult hospitals may receive a higher dose of radiation than those scanned at children's hospitals because the machine is kept on default settings typically intended for adult patients.

Another technology that is already in use with unclear implications for children is the Automated External Defibrillator (AED), often used by first responders in public settings. AEDs are programmed to deliver adult-dose shocks to individuals in ventricular fibrillation (VF) cardiac arrest. As AEDs were introduced in office buildings, airports, and other public places, none were designed for use in children under age 8 and none were cleared by FDA for use in children. Additionally, there was no data regarding the safety and efficacy of AEDs in children. However, new AEDs with pediatric cables and pads have been designed so that some of the current is directed away so that the pediatric patient receives a lower level of energy (Brown et al., 2004). The American Heart Association (AHA) and National Association of EMS Physicians (NAEMSP) have said that AEDs may be used with CPR in children ages 1 to 8 in cardiac arrest (Markenson and Domeier, 2003; Samson et al., 2003) and the AHA recommends the use of CPR with AEDs for treatment of cardiac arrest in children above age eight (Atkins et al., 1998). The FDA has cleared the marketing of specially modified AEDs for use on infants and children younger than age eight (Automated Defibrillator Cleared, 2001). But today there is still uncertainty about the appropriate use of AEDs in children. A recent advisory statement from the International Liaison Committee on Resuscitation states that use of newer AED models with pediatric capabilities can be used on children over age 1, but only a limited number of studies have looked at the impact of AEDs on children. Although the incidence of sudden cardiac arrest among children is rare, it is estimated that AEDs could assist approximately 15 high school students per year if placed in schools (Brown et al., 2004). A number of organizations including AHA, NAEMSP, AAP, and ACEP developed a joint statement on AEDs in schools in 2004 that outlines recommendations for the use of AEDs in schools (Hazinski et al., 2004).

One thing common to all of the examples in this section is that the technologies were not originally designed for use in children, but were used on children in practice. In the absence of pediatric-specific technologies, providers may be compelled to use adult technologies on children thinking that the benefits outweigh the risk; certainly in many cases, use of the adult technology may be better than foregoing treatment for the pediatric patient altogether (National Cancer Institute and The Society for Pediatric Radiology, 2002). However, encouraging the development and testing of pediatric specific technologies is key to ensuring that children receive the best treatment for their condition.

A similar issue exists in the development of information technology (IT) systems. Hospitals, EMS systems, and government entities are beginning to make substantial investments in health IT systems that may improve the quality and efficiency of emergency care delivery for all patients, but there are benefits specific to pediatrics as well. Information systems that make immunization records of children available to emergency care providers have the potential to greatly improve the efficiency and effectiveness of care. Additionally, some children with special health care needs have sizable medical records, the details of which could be made available to emergency care providers under certain IT systems.

Because of the unique nature of pediatric emergency care relative to adult care, specific consideration of pediatric needs during the design of the systems is critical in order to ensure that the systems are appropriate for the pediatric patient. For example, clinical decision support systems must incorporate the various threats to children's health and diseases common to children; systems designed for adult care currently do not do so. The lack of uniform agreement on standard pediatric doses is at least part of the reason for the usual absence of pediatric-specific dosing tables powering most commercially available computerized physician order entry tools. Without standard pediatric doses and requirements that these dosage rules are built into computerized prescribing tools, children will fail to fully reap the benefit of information technology in the medication delivery process. Also, electronic health records must be designed to allow providers to record measurements on a sufficiently granular scale appropriate for newborns and infants (i.e., rounding to the nearest 10th of a kilogram or recording age by month rather than year) (Shiffman et al., 2001).

While studies indicate great benefits of the advances in information systems, the safety, impact, and risks of these systems on pediatric patients have received little attention (Lehmann, 2003). Pediatric experts are needed in the design of these products, not only to ensure that the data collected and produced by the information systems are appropriate for children, but also to make sure that they are designed suitably for the input of data by providers of care to pediatric patients. Pediatric performance measures should be monitored before and after the implementation of new information systems. For example, at least one study revealed an increase in pediatric mortality after the implementation of a computerized physician order entry system, which was expected to reduce errors in the care of pediatric patients (Han et al., 2005).

The committee's companion report on hospital-based emergency care discusses advancements in health information technology in more depth, including the need for systems to be appropriately designed for patients of all ages.

FAMILY-CENTERED CARE

One of the six aims for quality improvement identified by the IOM's Committee on Healthcare Quality was patient-centeredness. This means that care should encompass the qualities of compassion, empathy, and responsiveness to the needs, values, and preferences of the individual patient (IOM, 2001). In the case of pediatrics, parents or guardians are recognized as the child's primary source of strength and support and play an integral role in the health and well being of the child. The increasing recognition of the importance of meeting the psychosocial and developmental needs of children and of the role of families in promoting the health and well-being of their children has led to the concept of "family-centered care" (Eichner et al., 2003). In this section we describe the concept of family-centered care and the benefits of that care. Unfortunately, few EDs and EMS agencies have written policies or guidelines for family centered care in place, and few providers are trained in family-centered care (Loyacono, 2001;

MacLean et al., 2003). Because the family-centered approach to care can mutually benefit the patient, family and provider, the committee supports the widespread adoption of family-centered care by the emergency care system, including hospitals and EMS agencies. **The committee recommends that EMS agencies and hospitals integrate family-centered care into emergency care practice.** Those organizations that give guidance to providers, such as government agencies and professional organizations, should demonstrate leadership in this area by promoting the use of family centered guidelines.

The concept of family-centered care evolved between 1980 and 1990 under the leadership of parent advisory groups, health professionals, the MCHB and the Office of the Surgeon General. It serves as a contrast to the more traditional medical model of care that health care is oriented to diseases and disability, health providers know best how to treat problems, and family members should comply with treatment recommendations (Baren, 2001). There are several definitions of family-centered care, but they all essentially recognize that providers should acknowledge and use family's knowledge of their child's condition and the family's skills and presence when caring for a child (Boudreaux et al., 2002). The core principles of family-centered care include:

- Treating patients and families with dignity and respect
- Communication of unbiased information
- Patient and family participation in experiences that enhance control and independence and build on their strengths
- Collaboration in the delivery of care, policy and program development, and professional education (ENA, HRSA, and EMSC, 2000).

Family-centered care is supported by a growing body of research showing the need to ensure the involvement of patients and families in their own health care decisions, to better inform families of treatment options, and to improve patient and families' access to information (Eichner et al., 2003). A number of studies have found some evidence of improved health outcomes, patient and family satisfaction, and provider satisfaction with the introduction of family-centered care (Meyers et al., 1998, 2000; Boie et al., 1999; Boudreaux et al., 2002; Saunders et al., 2003; Moreland, 2005). It is especially important when emergency providers have a pediatric patient with special health care needs; because of their frequent interactions with medical providers and deep familiarity with their child's condition, parents may be in a better position to diagnose the problem than emergency care providers. The development and implementation of family-centered care requires multiple components of care delivery, policies and procedures, the care environment, and personnel practices.

Collaboration with Families in the EMS and ED Environment

Often a parent or guardian is present when EMTs arrive at the scene or a child arrives at the ED. Emergency providers encounter families at a very stressful time. The family-centered approach to care revolves around collaboration with families, keeping them informed about the child's condition, prognosis, and treatment (National Association of Emergency Medical Technicians, 2000a). For EMTs, simply explaining the function of equipment, procedures being performed, and their effect is important so that family members can be better prepared to make decisions about care, such as termination of resuscitation. Potential benefits include decreased patient and family anxiety and combativeness, decreased liability issues if parents/guardians were involved in decision making, and easing the consent process for organ donation if

parents/guardians are aware of everything that has been done (National Association of Emergency Medical Technicians, 2000b).

The family-centered care approach to emergency services also includes giving families the option of being present during invasive procedures, so long as the safety of the patient and medical providers are not compromised. Families have traditionally been excluded because of concerns that the parents/guardians may lose emotional control and interrupt care, lack of staff to meet family needs, insufficient room at the bedside, increased risk of litigation, family-imposed limitations to the training of medical residents, and the potential that providers' skills would be affected because of discomfort with the parents' presence. But heightened awareness and new research has revealed that these concerns are overstated and that there are multiple benefits to family presence: it removes doubt about what is happening to the child and reinforces that everything possible was done; it reduces anxiety and fear (Wolfram and Turner, 1996; Wolfram et al., 1997); it engenders feelings of supporting and helping the patient; it sustains patient-family connectedness; it engenders feelings of being helpful to the health care staff; and it facilitates the grieving process (Doyle et al., 1987; MacLean et al., 2003). In addition, the existing literature indicates that family presence does not negatively impact the ability of the providers to perform invasive procedures or clinician anxiety (Bauchner and Vinci, 1996; Wolfram and Turner, 1996; Sacchetti et al., 2005); however at least one study showed that family presence during resuscitation was occasionally stressful and anxiety provoking for providers (Hanson and Strawser, 1992).

Research on this issue suggests that families want to be given the option to be present during invasive procedures and resuscitations, and when given the option often take it (Bauchner et al., 1991; Haimi-Cohen et al., 1996; Sacchetti et al., 1996; Boie et al., 1999; Boudreaux et al., 2002). Family members that were present for a procedure report favorable experiences and believe that their presence benefited the patient and their own emotional response to the incident (Boudreaux et al., 2002).

While families overwhelmingly support family-centered policies, providers have a mixed opinion of the practice of family presence. Often parental or guardian inclusion goes against the culture of emergency care providers. An example is the Children's Hospital of Philadelphia's pediatric/neonatal ground transport team, which historically had a policy of excluding parents from the transport of a child in a ground ambulance. The transport team cited a number of reasons for the policy: difficulty caring for the patient if the parent needs attention, potential trouble dealing with a belligerent or hysterical parent, difficulty controlling the child if a parent is present and anxiety of the transport team regarding medical interventions while being watched by a parent. In 1995, the transport team explored the issue of allowing parents to ride in the ground ambulance and surveyed parents that were allowed to accompany their child and those not allowed to accompany their child. Overwhelmingly results showed that parents prefer to accompany their child during transport. The research team also surveyed pediatric transport team managers from a number of different children's hospitals. They found diverse opinions and practices regarding parental accompaniment during transport. There was no clear consensus regarding whether parents should be allowed to ride with their child during the transport (Woodward and Fleegler, 2001).

Provider opinions regarding family presence varies by invasiveness of procedure and providers' experience. A recent survey of ED faculty, nurses, and pediatric residents at an urban children's hospital found that the ED staff generally supported family member presence during minor procedures, but expressed concern regarding the effects of family presence on the family

and the success of the procedure. Most attending physicians and nurses supported family presence during high invasive procedures, but most residents did not (Fein et al., 2004). This study and others have shown that more experienced practitioners tend to be more comfortable allowing family presence during procedures than those with less experience (Mitchell and Lynch, 1997; Meyers et al., 2000; O'Brien et al., 2002; Fein et al., 2004).

Studies also indicate that nurses are more likely to support family presence policies than physicians (Chalk, 1995; Helmer et al., 2000; Fein et al., 2004). In 1994 the ENA passed a resolution supporting family member presence at bedside during invasive procedures and/or resuscitation. Other organizations that explicitly support family-centered care, including EMS-C, ACEP, and AAST, have not developed official resolutions on parental presence during invasive procedures (Boudreaux et al., 2002). A 2002 survey of critical care and emergency nurses revealed that, despite the frequency of requests from family members to be present during an invasive procedure, nearly all emergency departments have no written policy or guidelines for family presence (MacLean et al., 2003).

A few studies of family-centered care have found evidence of improvements in staff satisfaction, but most focus on primary care delivery or inpatient care (Eichner et al., 2003). The exception is a 2001 study found that when family-centered care is the cornerstone of culture in a pediatric emergency department, staff members have more positive feelings about their work than do staff members in an emergency department that does not emphasize emotional support for families (Hemmelgarn et al., 2001).

The family-centered approach requires a shift in thinking for emergency providers typically trained to rapidly assess, treat and/or transport patients (National Association of Emergency Medical Technicians, 2000b). A lack of training on why and how to communicate with families can be a barrier to the adoption of family-centered approaches. The committee recognizes the value of family-centered pediatric emergency care and encourages provider organizations to take steps to educate practitioners and develop protocols for adopting family-centered care. Family presence during invasive procedures and resuscitations remains controversial (Sacchetti et al., 2005), but policies should be considered by institutions. Family presence for more minor procedures, such as wound repair, is overwhelmingly supported by both patients and providers and should be reflected in providers' treatment protocols.

Resources exist for EMS agencies and hospitals to help guide the implementation of family-centered practices. For example, *On the Same Team* is a training tool for EMTs designed to assist them in becoming more proficient in engaging family members in the care of their loved ones. In 1997, the EMS-C National Resource Center in collaboration with the Institute for Family-Centered Care (IFCC) developed an assessment tool to evaluate family-centered practices. There are separate tools for prehospital emergency care and care in the emergency department. More recently, the IFCC partnered with the American Hospital Association to produce a resource for practitioners wanting to advance the practice of family-centered care (AHA, 2005). The provision of family-centered care is also advanced in the Pediatric Advanced Life Support (PALS) manual, *Advanced Pediatric Life Support (APLS): Pediatric Emergency Medicine Resource*, and the American Heart Association's guidelines for CPR (Knapp and Mulligan-Smith, 2005). Guidelines for implementing family-centered care were also produced in a report from the National Consensus Conference on Family Presence During Pediatric Cardiopulmonary Resuscitation and Procedures (Henderson and Knapp, 2005).

Family-Centered ED Environment

Another important component of family-centered care is creating an environment in the emergency department that is both family- and child-friendly. However, a minority of hospitals have separate pediatric emergency departments (Gausche-Hill et al., 2004). The majority of hospitals treat both children and adults in the same area, creating an uncomfortable environment for parents or guardians and a frightening one for children if they are in the waiting room with bleeding or intoxicated adults.

Attention to creating a family-centered environment has grown in recent years. The 2001 EMS-C Program Guide for Improving Family-Centered Care contains a framework for improving the environment and design of emergency rooms for children and their families. The guide encourages emergency departments to reflect on whether their departments are family-centered, by answering a number of questions, such as: Is the waiting area large enough, with enough comfortable seating available, for all children and adults who may be waiting, even if several adults and children accompany one child? Are examination, treatment, and procedure rooms designed to accommodate parents or guardians who wish to remain with their child? Can families easily find their way from the emergency room to other areas of the hospital including radiology, laboratories, pharmacy, admitting office, patient care units and cafeteria?

Because of the emotional impact of an emergency department visit can have on a patient and parent/guardian, the outside and the interior should be inviting and make the patient and family feel comfortable. Working with hospital staff, patients, and parents, designers of pediatric emergency departments have offered several pieces of advice for designing the interior of a pediatric emergency department. First, the normal environment for children does not include bright primary colors; it is often better to create a calming environment than a stimulating one. Second, lighting that is appropriate for an exam is not helpful to parents' or guardians' frayed nerves. Distractions, such as TVs, radios will be welcome to families that are waiting. Third, children should feel that they can master an environment and not be overwhelmed or intimidated by it. One way to facilitate this is to design the room with the scale of a child. Examples include wall sconces 24 inches above the floor and a rail system detailed to accommodate the sightline of a four-year old. Lower ceilings might also be appropriate (Pence, 2000; Hanson, 2001).

Many hospital inpatient units, particular in pediatric centers, use child life programs and specialists to address the psycho-social aspects of hospitalization for the pediatric patient and parents or caregivers (AAP, 2000). The programs and services help reduce emotional disturbances in children and help them anticipate and manage through difficult procedures. Evidence has shown that these programs can reduce stress and aid recovery (Wolfer et al., 1998). It is unclear how prevalent these programs are in EDs, though a mid-1990s survey of large children's hospitals found that six of 44 EDs had at least one full time child life specialist on staff (Krebel et al., 1996). Evidence is limited on the impact of child life services in the ED setting, though it appears to have potential.

Cultural Competency

Another component of family-centered care is cultural competency. According to the EMS-C Program, "cultural competence includes possessing the appropriate knowledge, skills, and capacity to provide emergency services to children in a manner that demonstrates respect, sensitivity, and understanding of the unique cultural differences within, among, and between groups" (EMS-C National Resource Center, 1999).

Only a few studies have been able to draw a direct link between cultural competence and health care improvement, though expert opinion strongly suggests a connection between cultural competence, quality of care and reducing racial and ethnic disparities (Betancourt et al., 2002). These studies are not specific to pediatric patients, but cultural competency is an important issue for the emergency care system in general, not just services for children, particularly because the racial/ethnic distribution of emergency care providers is not well-matched to the racial/ethnic distribution of the population, and even less well-matched to the population that uses emergency services most frequently. This disparity can only be expected to increase as the U.S. population continues to diversify at a much faster rate than most health professions and occupations (Heron and Haley, 2001; Cone et al., 2003).

One of the biggest challenges for emergency providers is language barriers. Professional interpreters are often not available in the field or at an ED. Indeed, interpreters are frequently not used in the ED, even when thought necessary by a patient or provider (Baker et al., 1996). When providers cannot obtain adequate information from a patient interview, they tend to use more resources, such as increasing lab and radiographic investigations. One study of language barriers in a pediatric emergency department revealed that a physician-family language barrier was associated with a higher rate of resource utilization for diagnostic studies and increased ED visit times (Hampers et al., 1999).

One special concern is the use of children as interpreters for their own care or the care of their parents/guardians when they speak English, but their parent(s)/guardian(s) do/does not. Use of children as medical interpreters is common practice in many immigrant-rich areas (Burke, 2005), but in many cases, the information that needs to be interpreted is beyond the child's comprehension and may be unseemly for them (Yee, 2005). Children in this role take on a heavy emotional responsibility. Additionally, use of an untrained interpreter can lead to medical errors. In one study, error rate was highest for the youngest interpreter, an 11-year old (Flores et al., 2003). Some states have regulations that prevent children from serving as medical interpreters for their parents/guardians, but these rules may not apply in emergency situations. The traditional subordinate role of children can be reversed when children are used as interpreters and in some cultures, can be seen as a threat to parent authority and therefore a barrier to care (National Association of Emergency Medical Technicians, 2000b).

But the challenge goes beyond language barriers. Providers need to be aware of the various cultures residing in their catchment areas in order to be prepared to serve them. Also, understanding different family structures can help avoid hostile reactions as a result of an inadvertent disrespect toward families (National Association of Emergency Medical Technicians, 2000b). Provider's actions can affect patient perceptions of care. A survey of adult patients presenting to an ED with one of six chief complaints found that non-English speakers were less satisfied with their care in the ED, less willing to return to the same ED if they had a problem they felt required emergency care, and reported more problems with emergency care (Carrasquillo et al., 1999).

Failure to appreciate the importance of culture and language in pediatric emergencies can result in multiple adverse consequences, including difficulties with informed consent, miscommunication, inadequate understanding of diagnoses and treatment by families, dissatisfaction with care, preventable morbidity and mortality, unnecessary child abuse evaluations, lower quality care, clinician bias, and ethnic disparities in prescriptions, analgesia, test ordering, and diagnostic evaluation (Flores et al., 2002). The National Association of Emergency Medical Technicians emphasizes the use communication strategies to assuage some

of the cultural barriers to care that may arise. Examples of these strategies include: identifying themselves to the patient and family members, identifying a team member to interact with the family members on each call, asking how the patient and family would like to be addressed, using courtesy titles, and watching for verbal and non-verbal cues from families about the amount of information they want and whether they understand what is being explained to them (National Association of Emergency Medical Technicians, 2000b).

Adolescents

Less research on patient- and family-centered care has been conducted in regard to adolescents. In fact, relatively little is known about their health care preferences or expectations (Britto et al., 2004). A study of adolescents with chronic illness suggests that aspects of interpersonal care are most important to adolescents' judgment of quality. Physician honesty and attention to pain are of critical importance to adolescents. They also want to participate in their own care and have their views taken seriously by providers (Britto et al., 2004).

But teens tend to find the ED a fast-paced, confusing, and frightening place, according to results from a focus group of teens in four cities. Respondents reacted negatively to the idea of emergency care personnel approaching them at the hospital and engaging them in discussions of violence or personal safety (Dowd et al., 2000). This presents a real challenge to emergency providers since teens often present with conditions resulting from violence, alcohol or drug use. Most EDs do not provide preventive screenings or counseling to adolescents (Wilson and Klein, 2000). Physicians tend to find adolescent patients "frustrating" and adolescents, according to one study, receive less than optimal care in the emergency room (March and Jay, 1993). Yet, brief interventional counseling for adolescents may be of value. A prevention effort at one ED targeted to injured adolescents resulted in greater use of seatbelts and bicycle helmets (Johnston et al., 2002).

Certainly more research is necessary in order to provide emergency services to teens in a way that is both patient-centered and effective. But an understanding of the psychosocial and developmental issues that characterize adolescence may help staff respond more effectively for adolescent patients (March and Jay, 1993).

RECOMMENDATIONS

5.1 The Department of Health and Human Services should fund studies on the efficacy, safety, and health outcomes of medications used for infants, children, and adolescents in emergency care settings in order to improve patient safety.

5.2 The Department of Health and Human Services and the National Highway Traffic Safety Administration should fund the development of medication dosage guidelines, formulations, labeling, and administration techniques for the emergency care setting to maximize effectiveness and safety for infants, children and adolescents. EMS agencies and hospitals should implement these guidelines, formulations, and techniques into practice.

5.3 Hospitals and EMS agencies should implement evidence-based approaches to reduce errors in emergency and trauma care for children.

5.4 Federal agencies and private industry should fund research on pediatric-specific technologies and equipment used by emergency and trauma care personnel.

5.5 EMS agencies and hospitals should integrate family-centered care into emergency care practice.

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6

Improving Emergency Preparedness and Response for Children Involved in Disasters

During the development of this report, the most destructive natural disaster in our nation's history occurred. On August 29, 2005, Hurricane Katrina struck the Gulf Coast of Louisiana and Mississippi leaving over 1,300 people dead, countless injured and over 1 million individuals displaced. The aftermath of the hurricane created a humanitarian crisis unparalleled by history in the U.S. with federal disaster declarations covering 90,000 square miles (Associated Press 2005a,c). Over 4,500 children were reported missing to the National Center for Missing and Exploited Children after the storm; a month later, only half of those children had been located (Ong, 2005).

Hurricane Katrina is an extreme example of a disaster in terms of its scope and impact; most disaster incidents tend to be smaller in size and affect a fraction of the number of people. However, all disasters present special challenges for emergency providers. These types of incidents create a sharp imbalance between the supply and demand for existing resources (Noji, 1996). The coordination of personnel, equipment, and medical capacity involved in responding to a disaster in a timely manner presents a number of difficulties. Understaffed and overcrowded EDs are unlikely to be able to absorb an influx of patients from a disaster (Shute and Marcus 2001). EMS systems lacking sufficient resources even for day-to-day operations will be overwhelmed in the event of a large-scale disaster. Deficiencies in the emergency care system for children that are evident during normal operations—lack of pediatric equipment, medication and supplies and a lack of pediatric training—are greatly exacerbated in the event of a disaster. Overall, evidence indicates that our nation's emergency care system is poorly prepared for disasters (Schur et al., 2004). Deficiencies have been identified in a number of areas including:

- **Surge Capacity.** Surge capacity refers to a hospital's ability to manage a sudden, unexpected increase in patient volume that would otherwise severely challenge or exceed its normal capacity (Hick et al., 2004). Few American hospitals have the capacity to handle the increased volume of patients likely to result in a large-scale disaster incident or an epidemic, particularly if the patients are infants or small children (Kaji and Lweis, 2004; Oster and Chaffee, 2004).
- **Surveillance.** In public health parlance, surveillance refers to the ability to collect and analyze morbidity, mortality, and other relevant ED data in order to identify and control health threats. There are few automatic, real-time surveillance systems in operation across the U.S. that can accurately alert public health officials to an impending crisis (GAO, 2003a).
- **Coordination/Communication.** In the event of an attack, emergency care personnel may have to coordinate their efforts with personnel from other hospitals, EMS agencies, and public safety agencies such as fire and police; a high level of coordination is required. However, communication systems are often not secure or reliable in the event of a disaster or public health emergency. Many communication systems are incompatible across regions or even across agencies in the same community (GAO, 2001).

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- **Training.** The medical and non-medical needs of victims of a disaster or public health emergency may vary from the type of care normally delivered by emergency care providers. Emergency personnel must be able to recognize and meet these needs. Overwhelmingly, research indicates that academic, on the job, and continuing education training in disaster response for emergency care personnel are not sufficient, particularly when it comes to treating victims of chemical, biological, and nuclear events (Treat et al., 2001; GAO, 2003a; Rivera and Char, 2004).
- **Protective equipment.** Protective equipment refers to clothing and garments, respiratory equipment, and other barriers designed to shield emergency care personnel from chemical, biological, or other physical hazards. Evidence suggests that many emergency care providers are inadequately equipped for routine practice. However, disasters make it difficult or impossible for providers to follow even normal safety procedures (Jackson et al., 2004).

Since September 11th, much attention has been paid to disaster preparedness. While significant resources have been spent on protecting and securing our infrastructure, fewer resources have been devoted to improving the emergency care system's readiness (National Advisory Committee on Children and Terrorism, 2003; Sears, 2005). EMS systems, for example, have received only 4 to 6 percent of federal disaster preparedness funds from DHS and DHHS (GAO, 2003b; Center for Catastrophe Preparedness and Response, 2005). Funding for hospital preparedness has been limited, and slow to reach hospitals (McHugh et al., 2004). Even less has been done to safeguard the health and well-being of children (National Advisory Committee on Children and Terrorism, 2003), the most vulnerable age group in many types of disasters (National Center for Disaster Preparedness, 2003).

Though it is still too early to assemble all of the lessons learned from Hurricane Katrina, we have learned enough from this hurricane and other natural disasters to recognize that improved pediatric planning for disasters is necessary. In Chapter three, the committee emphasized the integration of pediatric planning for emergency care and disasters at the regional level. In this chapter, the committee focuses on concrete actions that federal agencies and regional emergency care systems should take to address pediatric needs in the event of a disaster. However, the chapter first begins with a look at what is known about the challenges of caring for children in disasters and the efforts that have been made in recent years to improve preparedness for treating pediatric victims in the event of a major disaster.

The term "disaster" indicates a low probability but high impact event that causes a large number of individuals to become ill or injured. The International Federation of Red Cross and Red Crescent Societies defines a disaster as an event that causes more than ten deaths, affects more than 100 people, or leads to an appeal by those affected for assistance (Bravata et al., 2004). This report expands the definition in the context of hospital-based emergency and trauma care to include any event that creates a significant, short-term spike in the demand for emergency care services which requires extraordinary measures to adequately address.

CHILDREN AND DISASTERS

Children react differently than adults to medical emergencies because of their anatomical, physiological, developmental and emotional differences. This is true in disasters, too. Indeed, because of these differences, children are among the most vulnerable individuals in the event of a disaster.

Children are more prone to injury in a fire, biological or a chemical attack because they take more breaths per minute and their breathing zone is closer to the ground. They also have thinner skin, which provides less protection and allows greater absorption of toxic chemicals (AAP, 2002). They are also more vulnerable to the effects of infectious agents that produce vomiting and/or diarrhea because they have less fluid reserve than adults and can become dehydrated faster (Illinois Emergency Medical Services for Children, 2005; CNN.com, 2005). If they sustain burns, children have a greater likelihood of life-threatening fluid loss and susceptibility to secondary infections (Shannon, 2004). Additionally, if they sustain injuries that cause blood loss, children develop irreversible shock and die more quickly than adults (AAP, 2002). Finally, very young children's cognitive and motor abilities also limit their ability to escape dangerous situations.

Younger patients also require specialized equipment and different approaches to treatment in the event of a disaster. Children cannot be properly decontaminated in adult decontamination units (National Center for Disaster Preparedness, 2003) because rescuers need to be able to adjust the water temperature and water pressure to suit the needs of children (e.g., provide high-volume, low-pressure, heated water). Rescuers should also have child-size clothing on-hand for after the decontamination (National Association of State EMS Directors, 2004). Children require different antibiotics and different dosages to counter many chemical and biological agents (National Center for Disaster Preparedness, 2003). Natural disasters pose a different set of challenges than manmade disasters, but the challenge is no less. Hurricane Katrina highlighted the social service needs of children during evacuation and sheltering—identification, separation, special food (formula), clothing and sanitation (diapers) and sleeping accommodations (cribs) must be available (Foltin et al., forthcoming).

Like adults, children require mental health services after a disaster incident, though these services must be age appropriate. The most common indicators of distress in children are change in their behavior, for example, going from being an outgoing child to shy and withdrawn, and behavior regression, where past behaviors such as thumb sucking or baby-talk reemerge. But children's reactions vary, based on their age, cognitive level, family's proximity and reactions to the disaster, and whether exposure to the disaster was direct or not. Preschool aged children lack the skills needed to cope with stress and the reactions of their parents strongly impact them. They worry about abandonment, whether they have lost a toy, a favorite pet, or a family member. School aged children understand the concept of permanent change and loss, and will therefore suffer from fears and anxieties. They may become preoccupied by the disaster and want to discuss the details at length, sometimes getting in the way of other activities. Preadolescents want to know that their fears are appropriate and shared by others. Adolescents have childlike reactions mixed with adult responses. They may feel overwhelmed by their emotions and therefore be unable to discuss them with their family. They also may show more acting out and risk-taking behaviors than normal (NIMH, 2001).

Evidence from Previous Disasters

There are only a handful of published articles that discuss the effects of disasters on children and the specific needs of children in disasters (National Center for Disaster Preparedness, 2003). Primarily they provide insight into the epidemiology of pediatric injury after a disaster. An example is an article that discussed ED visits at Miami Children's Hospital in the weeks following Hurricane Andrew, which struck 30 miles south of Miami, FL in 1994. In the week following the hurricane, the hospital experienced a 41 percent increase in ED visits, or an average of 57 additional patients per day. The ED also saw an increase in patients over age 18 (2.4% compared to 1%). This is likely because of the loss of electricity and structural damage that occurred after the storm, leaving few options for medical care beyond EDs for local residents and rescuers alike (Quinn et al., 1994).

Although this hurricane was an extraordinary event, the medical needs of children affected by hurricanes and other large scale natural disasters are rather ordinary. Conditions such as acute gastroenteritis, impetigo (bacterial skin infection), and open wounds were diagnosed more frequently in the week following the hurricane, and genitourinary problems, nonspecific abdominal pain, and soft tissue injuries were seen less often. In the second week after the hurricane, the ED noted increases in dermatologic problems, including cellulitis, and in injuries, including open wounds; a decrease was noted in respiratory problems, including upper respiratory infections. However, patient volume returned to normal levels in the second week after the hurricane (Quinn et al., 1994). The increase in open wounds seen in the weeks following the hurricane was largely due to incidents related to the clean up period after the storm. But open wound management is a time-consuming task, particularly for uncooperative and frightened pediatric patients, so additional physician staffing was necessary. The percentage of open wounds was higher in week 2 relative to week 1, likely reflecting children's increasing curiosity about their changed environment.

Other studies of single incidents show that in the event of a school bus crash, head, neck, and spine injuries are common (Lapner et al., 2003). An analysis of pediatric deaths and injuries after the Oklahoma City bombing in 1995 provided some information on the spectrum of pediatric injuries after a bomb blast, which produced a high incidence of cranial injuries. Among the 19 children who died in the blast, the most common injuries were skull fractures, cerebral evisceration, abdominal or thoracic injuries, amputations, arm and leg fractures and burns. All had extensive cutaneous contusions, avulsions, and lacerations. Understanding the spectrum of injuries that occur after a disaster not only helps emergency providers better anticipate what to expect from pediatric victims of a disaster, but also provides insight into possible prevention measure that could be taken to mitigate the affects of disasters. For example, changes to the design of school buses may mitigate some of the injuries likely to occur in the event of a crash (Lapner et al., 2003).

Some of the studies also provide insight into how well emergency care systems respond to pediatric patients in a disaster. After the Avianca plane crash on Long Island, NY in 1990, which carried 25 children among its 160 passengers, records were obtained on the 22 child survivors of the crash. The county had a disaster plan in place for transport decisions, which stated that cases involving severe burns, severe trauma, or severed limbs must be transported to hospitals capable of providing care for those injuries. The plan also called for EMS to distribute the balance of casualties with serious injuries to the closest hospitals, while individuals with minor injuries were supposed to be transported further away. However, only four of the seven critically injured

children were treated at an available tertiary care trauma center or pediatric center. The remaining five pediatric patients were transported to Level III trauma facilities with limited capabilities for treating severely injured children. Two were subsequently transported to more appropriate facilities. The closest Level I pediatric center, which was quipped with a helipad, received no patients from the crash. It is unclear why the transport destinations were unrelated to the severity of injury (van Amerongen et al., 1993).

While the majority of studies of pediatric disaster victims indicate that trauma is a major risk, the experience of Hurricane Katrina indicates that is not always the case. Initial reports from front-line medical providers at the Astrodome in Houston, TX, which served as a shelter for 23,000 hurricane evacuees, revealed an almost complete absence of trauma cases (Mattox, 2005). Some disaster and mass casualty guidelines are so heavily based in trauma planning that they may not be appropriate for all disaster scenarios. In the immediate aftermath of Hurricane Katrina, emergency care providers from disaster management teams initially dealt with a lot of cases with exacerbations of asthma and diabetes. Reportedly a “huge” number of people needed prescription refills. By day four in the Astrodome, gastroenteritis became a common ailment, one that is potentially more severe in infants and the elderly. Cholera was also a concern (Mattox, 2005).

Pediatric Disaster Planning and Current State of Preparedness

The needs of children in disaster planning have traditionally been overlooked. Historically, the military was considered to be the single target of potential biological, chemical, and radiological attacks, so the focus for training, equipment and facilities was on the care of healthy young adults (National Center for Disaster Preparedness, 2003). But even initial guidelines for civilian disaster preparedness were not appropriate for the care of children (National Center for Disaster Preparedness, 2003). A 1997 Federal Emergency Management (FEMA) survey found that none of the states incorporated pediatric components in their disaster plans at that time (National Advisory Committee on Children and Terrorism, 2003; Illinois Emergency Medical Services for Children, 2005).

Recognizing the absence of pediatric attention in disaster planning, the first field triage model developed specifically for children was created in 1995 then subsequently revised in 2001. Triage is a primary and critical component of disaster management since resources must quickly be put to their most efficient use in order to do the greatest good for the greatest number of casualties. The pediatric triage model, called JumpSTART, is modeled after the adult triage tool START and helps prehospital providers make decisions so under- and over-triage is minimized (Romig, 2002). JumpSTART is widely used today and allows emergency workers to triage children within 30 seconds. However, JumpSTART is the product of “expert consensus”—it has not been empirically validated and therefore is not evidence-based (Ohio Pediatric Disaster Preparedness Committee, 2004).

Attention to the issue of pediatric disaster preparedness grew considerably after September 11, 2001. A number of initiatives to address pediatric disaster planning and preparedness began to emerge. The American Academy of Pediatrics created a Task Force on Terrorism in October 2001 consisting of 12 pediatricians (Hicks, 2003). The task force was developed to ensure that pediatricians and other providers have the information they need as it becomes available and that children’s needs are considered in all planning efforts. In 2006, the task force is expected to publish the Pediatric Terrorism and Disaster Preparedness Resource for AAP members, which is

designed to give practical advice and information on best practices to pediatricians and other providers in the area of disaster preparedness.

In February 2003, a three-day national consensus conference was held to discuss the particular vulnerabilities of children to terrorist attacks and possible responses. It represented one of the first efforts to define issues in pediatric disaster preparedness. The conference was sponsored by AHRQ and MCHB and was attended by nearly 70 subject matter experts as well as representatives from government agencies and professional organizations. Conferees developed recommendations on a number of broad and specific issues and published them later that year. (National Center for Disaster Preparedness, 2003). However, because of a lack of evidence, the recommendations are largely a product of expert consensus.

Around the same time, the National Advisory Committee on Children and Terrorism (NACCT) released a report to the Secretary of HHS with a number of recommendations for areas in need of funding and program development. The NACCT was created by Congress through the Public Health Security and Bioterrorism Preparedness and Response Act of 2002. The goal of the NACCT was to prepare a comprehensive public health strategy to ensure the safety of children and to meet their needs in the face of the threat of terrorism. Unfortunately, the majority of the recommendations developed by the NACCT have not been implemented. In July 2005, an expert meeting on pediatric bioterrorism preparedness was convened to review the 2003 NACCT recommendations and update steps for moving forward. The meeting attendees agreed that there is a need to move quickly to disseminate the 2003 NACCT report recommendations and that pediatric bioterrorism preparedness must be placed on the forefront of the national agenda.

However, there is some evidence of progress at the federal level for pediatric disaster preparedness. HRSA has set a benchmark for all states to establish a system that allows for the triage, treatment, and disposition of 500 adult and pediatric patients per 1 million population who suffer from acute illness or trauma requiring hospitalization from a biological, chemical, radiological, or explosive terrorist incident (AHRQ, 2004). Inclusion of pediatric patients in the benchmark language was a direct result of lobbying by the pediatric community. Additionally, guidance for the bio-terrorism grants offered by HRSA, AHRQ, and the Office of Domestic Preparedness indicate that all projects should consider the needs of children.

Disaster preparedness has also been a key area of focus for the EMS-C Program. The program has particularly focused on the inclusion of pediatric issues in state disaster plans since a 1997 FEMA survey indicated that no states incorporated pediatric components in their state disaster plans. One of the objectives in the Emergency Medical Services for Children 5-Year Plan, 2001-2005, was to "Increase to 100% the number of states, Tribal Reservations, or Federal Territories that include pediatric issues in State emergency disaster plans" (DHHS et al., 2000). By 2003, at least 13 states formally assigned a pediatric representative to the state disaster preparedness committees. More detailed information on state disaster plans was available in 2004 in a report from the National Association of EMS Directors (NAEMSD). Through a survey of all states and territories (46 of 56 state directors responded), the NAEMSD found that states continued to fall short of including the needs of children in their state plans. For example, only 85 percent of respondents noted that, according to their state plan, hospitals must have sufficient pediatric equipment and medications, as well as capacity for appropriate assessment, treatment and decontamination of children exposed to radiological, chemical or biological agents. More troubling, only six states said that hospitals are currently equipped with this equipment and medication (National Association of State EMS Directors, 2004). Many state respondents indicated that they were in the process of improving the pediatric components of their state plan.

This effort will likely be assisted by a model pediatric component for state disaster plans, which was being developed under an EMS-C program targeted issue grant at the time of this writing.

While there is clearly more work to be done at the federal and state level with regard to pediatric disaster preparedness, progress is needed at the regional and provider level, too. For example, a study of the EMS agencies in Arkansas revealed that only one-quarter of EMS agencies with a written plan for responding to mass casualty events have specific provisions in their plans for the care of children (Dick et al., 2004). There are a number of important issues that regions and providers must consider as they develop disaster plans. For example, in developing regional disaster plans, many planning bodies have identified shelter sites for the public. However, few have taken the necessary steps to ensure that these sites have the resources—diapers, formula, and other pediatric supplies in place—that will be required if children are sheltered at these locations. Additionally, protocols are being developed to guide emergency care providers on how to conduct a mass decontamination, but the protocols infrequently consider the needs of children, for example, the strength of the water stream, water temperature, and who (parent versus rescuer) should carry an infant or a young child through the decontamination unit. The absence of these considerations and others point to the importance of having pediatric representation on planning bodies involved in emergency care, trauma, and disaster planning.

Another consideration is the extent to which emergency care and other medical providers should educate the public regarding care of children in disasters. Well meaning but misinformed parents may not act in the best interest or safety of their children. For example, after postal workers in New York City were exposed to anthrax spores in 2001, some of workers said that they intended to give the antibiotics that they received (Cipro in most cases), to their children “to protect them from anthrax”. Not only is anthrax not contagious, the antibiotics given to the postal workers were never intended for use in children. Additionally, some workers said they were reluctant to hug or touch their children out of fear that they might transfer the anthrax spores (Aghababian, 2002).

IMPROVING PEDIATRIC RESPONSE TO DISASTERS

Evidence indicates that our emergency care system is not well prepared for disasters involving children and that the needs of children in disasters are frequently overlooked. This is not necessarily an indication that planners do not recognize or appreciate the needs of children, but rather a sign that planners are overwhelmed by the number of competing needs. There are so many shortcomings in disaster preparedness that children’s needs often fall to the wayside. The committee believes that pediatric concerns should be pushed to the forefront and recommends that **federal agencies (the Department of Health and Human Services, the National Highway Traffic Safety Administration, and the Department of Homeland Security) in partnership with states and regional planning bodies and emergency care provider organizations convene a panel of individuals with multidisciplinary expertise to develop strategies for addressing pediatric needs in the event of a disaster.** The committee offers a number of specific areas in which these strategies should be focused in the sections that follow.

Minimizing Separation of Families

Hurricane Katrina highlighted a critical problem associated with evacuation and sheltering in the event of a disaster – the separation of children from their parents. As caregivers and children fled first from the impending hurricane and were later moved from evacuation shelters, many children became separated in the chaos. For almost a week, sixteen-year-old Reshad B. was separated from his grandmother, his primary caregiver. The two were separated during the chaotic evacuation of the Louisiana Superdome, which served as a shelter for ten thousand New Orleans residents during the hurricane. He was taken to Texas while she was transported to Kentucky. For nearly a week, Rashad lived in a Houston shelter not knowing what happened to his grandmother. They were reunited through the efforts of the National Center for Missing and Exploited Children (Associated Press, 2005b).

There are hundreds of stories like that of Reshad B. Even weeks after the storm, Texas Child Protective Service workers reported caring for almost 50 unaccompanied children in shelters (Associated Press, 2005b). Others were temporarily placed in foster care. While organizations like the National Center for Missing and Exploited Children and the Red Cross as well as state agencies actively worked to reunite families, and could report many examples of successes, too many children remained separated from their family members months after the storm. One of the challenges for officials was not knowing whether the missing child or parent survived the storm, since many of the recovered bodies were not identified for a prolonged period of time. Another challenge is reuniting young, pre-verbal children with their parents. These children are too young to give rescuers and social workers their name or identify family members in photographs.

There are currently no clear guidelines that direct planning in the event of parent-child separation (Freishtat, 2002). **The committee recommends that policymakers develop strategies to minimize parent-child separation and improved methods for reunifying separated children with their families.** There are a number of issues for policymakers and planners to consider. First, in the event of a disaster, particularly one that occurs suddenly without warning, children may be away from their parents in the custody of a school, day care center, babysitter or other non-family caretaker; older children may be with friends or even alone. Disaster plans should not assume that children are in the custody of their parents when a disaster strikes. Second, during evacuations and sheltering, care should be taken to minimize the separation of children from their caretakers. Emergency workers overseeing evacuation and sheltering should – to the extent possible – see that children remain paired with a parent or caretaker at all times. If children must be separated from their parents, for example, if they must be triaged to different medical institutions, emergency workers should get complete identification information on the child from the parent before the separation occurs. Emergency workers should also assign an individual to the task of overseeing the child until the government or family assumes custody.

Third, the steps taken to reunite families – registering children and adults and running pictures of missing children on television – are reactive and should be evaluated (Foltin et al., forthcoming). Steps to make the identification of children easier in the future, though widespread use of identification bracelets, name tags or other means, should be considered. More sophisticated technologies should also be explored, for example, electronic tracking devices that contain a child's identification, medical conditions, and medications would be helpful to officials trying to reunite families. But even if all children are easily identified, there will still be a need for the reactive steps to reunify families if they are separated. Ideally, the most efficient and

effective strategies should be used, but those strategies must take into account the loss of electricity and communication that may occur after a disaster. Planning for such efforts will have to take into account the non-traditional family structures that many children have. Simply matching a child to a parent may not be sufficient. Non-custodial parents or other relatives may need assurance of a child's whereabouts after a disaster as well.

These concerns are not hypothetical. Approximately 4,000 foster children were affected by the Hurricane Katrina (Freddy Mac Foundation, 2005). One official from Louisiana's Department of Social Services reported that approximately one-fourth (approximately 500) foster children in the custody of the state had not been located almost a month after the storm (Cottman, 2005). The majority of foster children remained with their foster parents, but 1,000 of those families lost their homes and were displaced to other cities around the country (Freddy Mac Foundation, 2005).

Enhancing Pediatric Disaster Expertise

One of the major challenges of disaster planning and response for children is that the number of emergency providers specifically trained and equipped to handle children is limited. Although most community hospitals have pediatricians and emergency department physicians on staff, they may not have the specialized training and resources needed to care for children in the event of a disaster. It is speculated that most children's hospitals possess these resources, but they have done little specific planning or practice around managing chemical, biological, radiological, and nuclear exposure for children (National Advisory Committee on Children and Terrorism, 2003).

Emergency providers and other first responders that have limited experience dealing with children may have a very difficult time performing in the event of a disaster. For example, a provider in a disaster may be drawn to give attention to a deceased child because of emotions; however, that provider must leave the child to address the medical needs of survivors, whether they are children or adults. All emergency providers and first responders should receive pediatric disaster training. One resource available to emergency providers is the Pediatric Disaster Life Support (PDLs). A product of expert consensus, PDLs is a two-day training program that was developed to enable EMS and ED providers (physicians and nurses) to better care for pediatric victims of a disaster. Created through an EMS-C grant, the course focuses heavily on the impact of natural disasters on children, but a portion is devoted to school violence (e.g., the Columbine School shootings is used as a case study) and intentional disasters, including terrorism (Aghababian, 2002). However, this course has not been widely adopted. It is estimated that about several hundred providers from approximately 10 states have received PDLs training. The course is currently being revised to incorporate knowledge gained from more recent disasters involving children over the past 10 years (Personal communication, R. Aghababian, February 28, 2006). Pediatric disaster education should be widely accessible and an important component of training for all emergency care providers.

While prehospital and ED personnel staffing EMS and hospitals are key healthcare providers in the event of a disaster, the DHS National Disaster Medical System (NDMS) will deploy Disaster Medical Assistance Teams (DMATs) to the site of the incident to provide additional medical support. A DMAT is a group of professional and para-professional medical personnel that provide medical care during a disaster or other event (National Disaster Medical System, 2005). DMAT teams typically consist of 35 physicians, nurses, EMTs, and support personnel (Lawrence, 2002). After arriving on site, DMAT teams triage and stabilize injured people, assist

with the transfer of patients to hospitals in other areas, and set up temporary clinics for disaster victims.

In 2004, there were 43 DMAT teams across the country (Mace and Bern, 2004; Mace and Jones, 2004); two of these DMAT teams are specialized pediatric teams. DMATs are organized by a sponsor, usually a major medical center, health department, or disaster organization. The sponsor signs a memorandum of agreement to recruit volunteer team members, coordinate the team training, and dispatch the team (National Disaster Medical System, 2005). The teams are able to provide care at the disaster site for up to 72 hours without resupply (Lawrence, 2002). There is a standardized training program for all field teams, which includes a pediatric component (National Disaster Medical System, 2005).

The limited studies that have been conducted on DMAT teams indicate two important findings with regard to pediatric patients: pediatric patients constitute a considerable percentage of the DMAT patients and the DMAT pediatric training and resources need improvement. In an analysis of patients treated in New Mexico's DMAT field clinics during four recent natural disasters, pediatric patients represented a third of all patients treated by the team (Nufer and Gnauck, 2004). The median age of the pediatric patients was four. The authors concluded that based on the experience from these four disasters (2 hurricanes, an earthquake, and a flood), DMAT teams should be adequately prepared to treat pediatric patients, particularly young patients (Nufer and Gnauck, 2004).

However, there is reason to be concerned that DMAT teams are not sufficiently prepared to treat pediatric patients. In the study of New Mexico's DMAT patient encounters, researchers found that the youngest children, those 0 to 2 months were sent to the hospital more frequently than other age groups and that the triage category was more frequently missing for the younger age groups. The researchers suggest that this may signal a lack of provider comfort caring for younger age groups (Nufer and Gnauck, 2004), something that previous studies have also suggested (Glaeser et al., 2000).

While DMAT training involves a pediatric component, DMAT team leaders do not express strong confidence in the area of pediatrics. In 2003, DMAT team leaders were asked to rate DMAT pediatric training and abilities. The responses (Table 6-1) were not as positive as one would hope. The survey found that DMAT teams were not fully prepared for pediatric patients. Pediatric treatment tools missing most frequently from DMAT teams was backboards (missing in 62% of teams), a Broselow tape (46%), pediatric medications (38%), cervical collars (38%). Pediatric burn management, pediatric pain management, psychosocial/mental health issues, and pediatric mock code practices were missing from curriculum for 40 percent of DMAT teams (Mace and Bern, 2004).

TABLE 6-1 DMAT Pediatric Preparedness

Question to DMAT Leaders	Average Response (Likert Scale 1 = not at all, 6 = a great degree)
How well does the standardized DMAT curriculum meet the needs of pediatric patients	3.33 (+/-0.25)
How well is the team prepared for pediatric patients	3.91 (+/-0.22)
How well team responds to a disaster with pediatric patients	3.94 (+/-0.31)
How well equipped to respond to a disaster with pediatric patients	3.22 (+/-0.24)
How well is pediatric equipment organized	3.08 (+/-0.29)
Agree that system needs more pediatric specialty teams	3.37 (+/-0.31)
Agree that current teams need more pediatric training	3.68 (+/-0.34)

SOURCE: Mace and Bern, 2004.

The survey also provided insight into the DMAT members and their training and experience with regard to pediatric patients. The majority of DMAT physicians (74 percent) reported that they specialize in emergency medicine. Slightly more than half (54 percent) of physicians, 40 percent of nurses, 44 percent of mid-level providers (nurse practitioners and physicians assistants), and 44 percent of paramedics reported that they work with children on a daily basis.

Many of the problems apparent in the emergency care system for children are also apparent on DMAT teams (lack of equipment and training). In order to address these shortcomings, **the committee recommends the development of strategies to improve the level of pediatric expertise on DMATs and other organized disaster response teams.** This can be accomplished through improving pediatric training required of teams, equipping them with appropriate pediatric resources, and taking active steps to recruit pediatricians and pediatric emergency medicine physicians on DMAT teams.

Improving Pediatric Surge Capacity

While children represent approximately 25 percent of the U.S. population (U.S. Census Bureau, 2004), they consume a smaller proportion of inpatient hospital services (Freishtat, 2002). Since most children are relatively healthy, the U.S. hospital system is designed for a large number of adults, not children (Holbrook, 1991; Freishtat, 2002). As a result, in comparison to adults, there are fewer pediatric hospital beds, pediatric specialists, and providers with experience caring for critically ill and injured children (Freishtat, 2002). In the event of a disaster, the capacity of the health care system to care for a large number of children is likely to be inadequate. **The committee recommends the development of disaster plans that address pediatric surge capacity for both injured and non-injured children.**

Although much of the focus has been on large-scale disasters, even modest incidents have the potential to push system resources to its limits. For example, the Rhode Island nightclub fire in 2003 generated a number of victims that required supplemental staff and specialized resources that overwhelmed local capacity (Hick et al., 2004). A total of 273 victims sought care at local

hospitals. The closest hospital to the nightclub (3 miles away), Rhode Island's second largest, is a 359 bed acute care hospital that handles 58,000 ED visits per year. It received 82 patients of which 25 percent were admitted and 25 percent transferred to other hospitals. A level 1 trauma center located 12 miles away from the nightclub received 68 patients; approximately 63 percent of whom were admitted (Gutman et al., 2003). A number of other Rhode Island hospitals as well as Mass General, University of Massachusetts Medical Center, and Shriners Hospital for Children, also received patients. It was only the second time that Shriners opened their doors to adult patients (Ginaitt, 2005).

What would have happened if the fire had occurred in a venue filled with children? The most proximate hospitals may not normally care for children but must still be ready to receive some victims. Children's hospitals, those with pediatric emergency departments, and others designated as having the capabilities will be looked upon to provide the majority of care to critical children, but their resources and capacities may be stretched to the limit. Other hospitals need to be prepared to handle the more minor pediatric patients and stabilize critical patients until they can be transported to a pediatric center. Pediatric centers should have predetermined means to communicate with one another to share patients in the event critical patients need to be evacuated. DMAT teams may be able to offer local emergency care providers some relief, but with only two pediatric specialty DMAT teams in the country, their reach is limited in the event of a large-scale event.

A review of one pediatric disaster in England provides some insight into what could happen in the absence of regional planning for pediatric disasters. In 1993, a double-decker bus full of school children was involved in a crash. Two children were killed and 56 were injured. Notification of the crash was given to the local hospital just as the first victims began to arrive. Forty-two injured children were taken to the ED at that local hospital. Most of the injuries were minor in nature, though 15 children were admitted. Four children had serious head injuries and two required neurosurgical intervention. Although the hospital had a disaster plan in place, the lack of advance notification, the rapid influx of patients, and the lack of providers familiar with handling pediatric trauma injuries created difficulties (Wass et al., 1994). This incident also serves to highlight the importance of preparedness of all hospitals for pediatric emergencies – particularly in areas that lack pediatric centers.

But disaster planning must also take into account children that are not hurt, but need evacuation and sheltering. Earlier we discussed the importance of having pediatric resources (formula, diapers) available in shelter locations. Steps to ensure that those are on hand must be taken before the disaster strikes. Pediatric expertise in planning is critical to ensure that evacuation and sheltering plans can meet the needs of children, particularly those with special needs, as they are operationalized. Disaster plans should include protocols for schools and day care centers and other places where children congregate. Planners need to think about where children might be during different times of day. For example, had the September 11th attacks occurred a half hour earlier, while over 500,000 New York City school children were in transit to school, where would the bus drivers have taken these children? Would the places that were selected be adequately equipped to handle the surge of children?

Promoting Specific Therapies for Children

We know that children affected by disasters have a number of medical, mental health, and social service needs that must be met. However, under the current system, services appropriate for children may not be available. As we described in Chapter 5, medications are not always

available or appropriate for use in children; that is also the case for antidotes in the event of a terrorist attack. Additionally, resources and therapies that have been developed specifically for children might not be accessible when needed.

Potassium iodide prevents thyroid cancer in children and it is highly recommended that children receive it in the event of exposure to radioactive material. However, potassium iodide is currently only available in tablet form and therefore cannot be readily administered to infants and very young children. The pill can be dissolved in water, but since the fluid is so salty, it must be mixed with something to disguise the taste. The tablet can be crushed and mixed with raspberry syrup, low fat chocolate milk, or other drinks, but these mixtures will only keep for 7 days and must be stored in a refrigerator. To be useful, parents would have to crush a new tablet every seven days in order to have it on hand when needed (U.S. Food and Drug Administration 2006). However, even if parents went through these steps every 7 days, the stability of the potassium iodide is not well known when mixed with other liquids.

There are also issues related to the strategic national stockpile (SNS), which would be used in the event of a disaster that is severe enough to deplete local resources. Within the SNS are 12-hour push packages that contain pharmaceuticals, antidotes, and medical supplies designed for use during the early hours of an event. They are positioned in strategically located, secure warehouses ready for immediate deployment in the event of a disaster (CDC, 2004). Historically, the SNS did not meet the needs of most children, but that has changed somewhat. Today, there are pediatric representatives on every SNS advisory committee and every new item for the SNS is reviewed for pediatric implications. However, the SNS must comply with FDA labeling requirements and if a medication is not approved for children, it cannot be included in the push packages for children. Since most antidotes for terrorism are designed for adult use, and not approved by the FDA for pediatric patients, they are not available for pediatric use (Markenson, 2005). Even with pediatric representation on advisory committees, pediatric concerns are not fully addressed in push packs because of the absence of approved antidotes for children.

There are also controversies regarding the use of Mark 1 kits for children. Mark 1 kits contain two antidotes, atropine and pralidoxime chloride, which are effective if a person is exposed to certain types of nerve gas. The consensus in the medical community is that this treatment is appropriate for infants and children with severe, life-threatening nerve agent toxicity (National Center for Disaster Preparedness, 2004). However, there are no protocols for providers with regard to using a Mark 1 kit on children because it is not approved by the FDA. Pediatric dosing for atropine was approved by the FDA in June 2003, but it remains unclear how emergency providers should treat children exposed to nerve gas – some may give children only the pediatric dose of atropine, while others may give children the full dose in the Mark 1 kit. The Mark 1 kit is not a unique example—there are no specific pediatric dosage guidelines for a large number of drugs in disaster situations.

There is also some evidence that children's mental health needs often go unmet after a disaster. According to a survey of parents, it is estimated that approximately 18 percent of children (age 6–17) in New York City had severe or very severe post traumatic stress reactions after September 11, 2001, but only 10 percent received counseling (Fairbrother et al., 2003). A survey of New York City public school children showed similar results; 8–15% of the students showed elevated rates of posttraumatic stress disorder, major depression, separation anxiety, panic, and/or conduct disorders. Approximately two-thirds of children with probable post-traumatic stress disorder may not have received mental health services (Hoven et al., 2002). The

system's capacity to identify and treat the large number of children needing those services should be expanded.

Hurricane Katrina highlighted the vast social service needs of all displaced victims, regardless of age. It would be a challenge for disaster planners to address all the social service needs associated with a disaster of that magnitude; however, the development of evacuation plans should determine how children can attend schools in different areas; the availability health care services pediatric capacity in the national stockpile resources, ways to expedite Medicaid enrollment; and long-term sheltering options available for children. These are difficult issues for disaster planners to address, though they must be considered. **The committee recommends the development of and improved access to specific medical and mental health therapies, as well as social services, for children the event of a disaster.**

Pediatric Disaster Drills

It is widely believed that medical professionals do not receive as much disaster preparedness training as they should (AAMC, 2003; National Association of State Emergency Medical Services Directors, 2005). ACEP has reported that the lack of bioterrorism training for medical responders is so severe that patient treatment may be seriously compromised (Maniece-Harrison, 2005). It is perhaps not surprising then that pediatric training is particularly lacking. In fact, most bioterrorism training initiatives make no reference to the needs of children (Maniece-Harrison, 2005).

Disaster drills have long been a centerpiece of disaster preparedness efforts for all types of emergency responders. Drills have proven to be effective in training hospital provider staff to respond to mass casualty incidents (Hsu et al., 2004), and are required of most hospitals. The Joint Commission on the Accreditations of Healthcare Organizations' (JCAHO) 2006 hospital accreditation standards require hospitals to conduct 2 drills per year, four to eight months apart, one of which must include an influx of volunteers or simulated patients. Hospitals must also participate in at least one communitywide practice drill per year to assess the communication, coordination, and effectiveness of hospital and community command structures (JCAHO, 2005).

However JCAHO requirements do not specifically address conducting disaster drills with children. And in fact, many disaster drills do not include pediatric patients in disaster drills. For example, one hospital held a disaster drill for a mock earthquake and a pediatric patient was simulated by a five-gallon water bottle with a list of symptoms taped to it (Fields, 2003)! Obviously, this is a poor method of simulating a pediatric patient. But some disaster drills do not consider children at all. Most (68 percent) of DMAT teams include pediatric patients in disaster drill scenarios (Mace and Bern, 2004), but it is significant that 32 percent do not. An assessment of EMS agencies in Arkansas found that few EMS agencies had participated in school disaster drills or had planned for school response (Dick et al., 2004).

The exception to this is, of course, children's hospitals, where all drills involve the influx of critical pediatric patients. For example, in September 2003, Children's Hospital of Atlanta held a drill where they received 20 critically injured pediatric patients. Children's hospitals are among the most prepared, but the vast majority of children are not seen in children's hospitals but rather in general hospitals.

With few exceptions, most natural and human made disasters will affect children as well as adults, and there is no better way to expose weaknesses in current preparedness than to demonstrate how poorly children fare in disaster drills. Therefore, disaster drills should include a meaningful pediatric component. Children are often located in large groups (schools, day care

centers) (Romig, 2002), and it is unclear how the system would respond if a disaster incident occurs at one of those locations and a large number of children required care. To address this shortcoming in disaster preparedness, **the committee recommends the development of policies that ensure that disaster drills include a pediatric mass casualty incident at least once every two years.**

RECOMMENDATION

6.1 Federal agencies (the Department of Health and Human Services, the National Highway Traffic Safety Administration, and the Department of Homeland Security) in partnership with state and regional planning bodies and emergency care providers should convene a panel with multidisciplinary expertise to develop strategies for addressing pediatric needs in the event of a disaster. This effort should encompass the following:

- **Development of strategies to minimize parent-child separation and improved methods for reuniting separated children with their families.**
- **Development of strategies to improve the level of pediatric expertise on Disaster Medical Assistance Teams and other organized disaster response teams.**
- **Development of disaster plans that address pediatric surge capacity for both injured and non-injured children.**
- **Development of and improved access to specific medical and mental health therapies, as well as social services, for children in the event of a disaster.**
- **Development of policies that ensure that disaster drills include a pediatric mass casualty incident at least once every 2 years.**

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Building the Evidence Base for Pediatric Emergency Care

Pediatric emergency care is a young field, and as such, research in the field began relatively recently. Even in the late 1970s, there were no pediatric emergency medicine textbooks or journals (Ludwig, 2001). Considerable progress has been made since that time and these advancements should be celebrated. However, the advancement of knowledge in pediatric emergency care must not slow. Indeed, many unanswered questions remain about the best way to organize and deliver emergency care to children.

The committee decided to devote an entire chapter to research because of the great potential and importance that it has to improve the quality, organization, and delivery of pediatric emergency care. The payoff from increased pediatric emergency care research, while difficult to quantify, will result in lives being saved, morbidity decreasing, and a more efficient and effective emergency care system. The chapter begins with a retrospective on pediatric emergency care research from the 1980s through present day and continues with a discussion of why advancing the state of knowledge remains critical today. We then turn to some of the barriers to pediatric emergency care research that hinder progress, and propose ways to overcome those barriers.

EARLY DEVELOPMENT OF PEDIATRIC EMERGENCY CARE RESEARCH

As noted in Chapter 2, attention to deficiencies in the pediatric emergency care system gained recognition in the 1980s, and as a result, a variety of organizations began to take action. A number of studies were published that provided information on the demographic characteristics of children who were using emergency services, the kinds of illnesses and injuries they experienced, and the readiness of providers to care for them. These studies were generally single-site research projects initiated at children's hospitals, medical schools, and/or local departments of health. For example, published research described the epidemiology of cardiac arrest and resuscitation in children in suburban King County, WA (Eisenberg et al., 1983); pediatric emergencies in Minneapolis, MN; and pediatric versus adult death rates in the field in Los Angeles County (Seidel et al., 1984).

Emerging information on pediatric injuries and illnesses and early indications of inadequacies in the emergency care system to address pediatric needs played a large part in the U.S. government's decision to create the EMS-C Program in 1984. EMS-C was among the first government agencies to support pediatric emergency care data collection. EMS-C's early project activities included collection of data on pediatric emergencies to assess the need for specialized pediatric programs. Some of the major pediatric emergency care research published in the late 1980s continued to show shortcomings in the emergency care system for children (Seidel, 1986ab; Seidel et al., 1991), including differences in deaths for children in rural versus urban settings (Gausche et al., 1989a,b); however, there were also studies published that focused on ways to improve the system for children, for example: creation of a specialized pediatric emergency care system in Los Angeles (Henderson, 1988); creation of a new method, the Broselow Tape, for estimating pediatric weight and drug dosages (Lubitz et al., 1988); and development of an accurate pediatric trauma score (Ramenofsky et al., 1988).

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The 1993 IOM Report, *Emergency Medical Services for Children*, called attention to the need for pediatric emergency care research by highlighting information gaps in pediatric emergency care knowledge. The gap covered the most basic questions about the emergency care services with regard to children:

- What is the structure of the system?
- Who uses the system?
- For what is the system used?
- What services or procedures are provided to patients?
- When are services provided?
- What are the outcomes of using the system?
- What are the global costs of the system?
- How well does the system perform?

The 1993 IOM report noted that “research is essential to validate the clinical merit of care that is given, to identify better kinds of care, to devise better ways to deliver that care, and to learn where best to direct prevention activities” (IOM, 1993). The report contained a research agenda and called for the development of a uniform data set that would be used by states to collect, analyze, and report to EMS; include all elements of a national uniform data set; describe the nature of EMS provided to children; and link data generated by separate parts of EMS (IOM, 1993).

After the release of the IOM report, the EMS-C Program established the National EMS Data Analysis Resource Center (NEDARC) to help grantees and state EMS offices develop capabilities to collect, analyze, and utilize EMS and other data to improve the delivery of emergency and trauma care. Specifically, NEDARC staff provide research design consultation, information on data collection (e.g., which elements to collect, hardware/software issues, confidentiality issues, etc.), information on statistics, general analysis of data, and probabilistic linkage (MCHB, 2004a).

Also in the 1990s, the first infrastructure for multi-center pediatric emergency care research was established. The American Academy of Pediatrics’ Section on Emergency Medicine created the Pediatric Emergency Medicine Collaborative Research Committee (PEM CRC) to support and facilitate collaborative Pediatric EM research. The PEM CRC’s infrastructure is privately funded and has served as the platform for many research projects, the majority of which are clinical (PECARN, 2003; AAP, 2005). At least seven articles supported by the PEM CRC were published between 1994 and 2004 (AAP, 2005).

Perhaps the most significant development for pediatric emergency care research occurred when the EMS-C Program created the Pediatric Emergency Care Applied Research Network (PECARN). PECARN is a collaborative research group consisting of hospital emergency departments organized into nodes, with central coordination from a Steering Committee (PECARN, 2003, 2005). PECARN aims to conduct multicenter, randomized trials and observational studies on a variety of pediatric emergency care issues. There are four Regional Node Centers, each of which coordinates five to eight Hospital Emergency Department Affiliates (HEDAs). The strength of PECARN lies in the annual number of patient encounters it covers – 810,000 ill and injured children - with wide geographic and hospital representation. Additionally, PECARN involves senior-level pediatric emergency medicine researchers and clinicians with expertise in epidemiology, statistics, and health services research. While the PECARN project is

still in its early phases, it appears to offer significant promise in advancing pediatric emergency care research. A research agenda specific for multi-institutional studies is being developed by the PECARN Steering Committee and will be available later in 2006 (Personal communication, D. Kavanaugh, May 10, 2006).

But one important shortcoming of PECARN is that the network has conducted little research in the prehospital environment. The one exception is a current study on cervical spine injury, which involves an investigation of immobilization practices of prehospital providers. The study involves focus groups with prehospital providers to evaluate their opinions on immobilization practice and their willingness to participate in research that evaluates their practice retrospectively. PECARN has recently established an out-of-hospital working group to develop EMS research ideas for the network. However, research in prehospital pediatric emergency care has lagged far behind that of ED-based pediatric emergency care, both within PECARN and in other research efforts.

Data indicate that the volume of research conducted on pediatric emergency care has grown considerably. A review by Spandorfer and colleagues (2003) of pediatric emergency medicine research abstracts submitted to national scientific meetings of the American Psychological Association (APA), American College of Emergency Physicians (ACEP), American Academy of Pediatrics (AAP), and the Society for Academic Emergency Medicine (SAEM) indicates that there was a substantial increase in research conducted in pediatric emergency medicine between 1987 and 1999. There was also an increase in the number of population-based and multi-center clinical trials. Additionally, the number of trials that were randomized and blinded grew over time; unfortunately, this represents only 7 percent of pediatric emergency care studies published during the full time period. But the design of studies varied little between 1987 and 1999; there was no increase in the proportion of studies that were prospective or in those that used an analytic study design (Spandorfer et al., 2003). However, the use of statistics of greater sophistication became more prevalent over time (Spandorfer et al., 2003). Between 1993 and 2002 the following five journals published slightly more than half of the published articles related to pediatric emergency care: *Pediatric Emergency Care*, *Pediatrics*, *Annals of Emergency Medicine*, *Pediatric Clinics of North America*, and *Archives of Pediatrics and Adolescent Medicine* (Gough et al., 2004).

CONTINUED NEED FOR RESEARCH

Although the amount of research conducted in pediatric emergency care has increased considerably over the past 25 years, a significant information gap remains. Indeed, the information gap that exists today includes many of the broad, systems-level questions identified as research priorities by the 1993 IOM Committee on Pediatric Emergency Medical Services. Additionally, many new, unanswered questions have emerged in the last 10 years as our understanding of the determinants of quality care delivery has improved. In this section we review progress in addressing the information gap that existed in 1993 and identify some other areas where research can contribute to the betterment of care. Finally, we discuss the rationale for devoting resources to address the information gap that remains today.

Progress on Closing the Information Gap Identified in 1993

The 1993 IOM Committee on Pediatric Emergency Medical Services identified several important questions about the pediatric emergency care that could not be answered at that time.

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Despite the increase in research activity and funding since 1993, these questions not only remain salient; they are also largely unanswered.

1. What is the Structure of the System?

There is no central resource that contains reliable information on the number and characteristics of the facilities, emergency care providers, and services available in the system. However, different organizations that represent emergency providers collect some basic information. For example, the American Hospital Association keeps a tally of the total number of emergency departments in the country, and the National Association of Children's Hospitals and Related Institutions keeps a list of the number of children's hospitals. Additionally, we have a general idea from surveys of the percentage of EMS agencies are fire-based versus stand-alone EMS. However, this information is only the first step in understanding the structure of the emergency care system. Information on the capabilities and services available from each provider remains elusive, as does information on how the structure varies within and across states and regions.

2. Who Uses the System?

3. For What is the System Used?

4. What Services or Procedures are Provided to Patients?

5. When are Services Provided?

We are able to answer all of these questions today with regard to children's use of emergency departments; however, these questions remain unanswered with respect to patients using the prehospital (i.e., EMS) system. One important source of information on ED utilization is the the federal National Hospital Ambulatory Medical Care Survey (NHAMCS), which has collected nationally representative information on ED visits since 1992. NHAMCS allows researchers to study use of EDs by patient characteristics including age, race, and insurance status. The data also contain information on reason for the visit and triage category (for example, immediate, urgent, nonurgent). The data contain information on the physician's diagnosis for each patient, as well as the diagnostic, screening, surgical, counseling, educational, and therapy services that were performed during the visit. Additionally, NHAMCS collects information on time – when the patient arrived at the ED, how long they waited, and when they left.

Another important data source is the State Emergency Department Databases (SEDD), part of the Healthcare Cost and Utilization Project (HCUP) sponsored by the Agency for Healthcare Research and Quality (AHRQ). The SEDD captures information on all ED visits that do not require admission and allows for the analysis of data at the state or, in many cases, county level. The SEDD contain more than 100 clinical and non-clinical variables including diagnoses, procedures, patient demographics, expected payer source, charges, hospital identifiers, and county identifiers. As of September 2005, 13 states participated in the SEDD and data from most of those states are available for years 1999 to 2002 (AHRQ, 2005).

In contrast to these in-hospital data systems, data collection on use of EMS services has progressed slowly. At the local level, most data on EMS are collected on paper, although many systems are beginning to transition to electronic systems. Because EMS information systems are produced by a variety of vendors and each state defines its own data elements, there is little uniformity or consistency of data collection across agencies (Mears, 2005). As a result, a national database on EMS utilization does not exist, although one is in development. The

National EMS Information System (NEMSIS) is an initiative funded by the National Highway Traffic Safety Administration (NHTSA) and the Health Resources and Services Administration (HRSA) to develop a national EMS database. As of 2003, 40 states have agreed to participate in NEMSIS. But it is important to note that participation at the state level does not insure local participation. The NEMSIS database is not yet operational.

6. What are the Outcomes of Using the System?

Information on outcomes from the emergency care system is limited. Process outcomes, such as hospital admission or referral to a tertiary care facility are important to understand how patients move through the system. Some limited data is available for ED patients through the NHAMCS, which contains information on disposition of the patient, including whether the patient was admitted to the hospital, intensive care unit/critical care unit, or an observation unit. However, NHAMCS does not include data on hospital outcomes. Combining the SEDD with another data source within HCUP allows researchers to determine the percent of patients that are admitted and the treatments received on the inpatient side.

But a great hindrance to addressing questions about outcomes is that many data systems cannot be linked. In other words, a child's parents may contact 911, be met by a first responding fire engine, transported by EMS and delivered to a hospital ED, but information on the patient beyond each point of the hand-off is rarely available to earlier organizations in the chain. The absence of uniform incident numbers and other methods of achieving data linkage hinder researchers from gathering information on clinical outcomes, which is often of greater importance than measures of the process of care. Clinical outcomes, based on hospital disposition, functional status at discharge, patient well-being, morbidity, and mortality are often only available when specifically studied by a supported research initiative, such as PECARN. Still our knowledge of optimal treatment patterns for many pediatric interventions is limited. Those on the prehospital environment are even less obtainable.

7. What are the Global Costs of the System?

The global costs of the system are unknown. The direct and indirect economic costs of operating an emergency care system as well as the monetary savings over time that could be realized by the successful expansion of pediatric emergency care improvement initiatives are of key interest, but few studies have explored such questions (DHHS et al., 1997).

8. How Well Does the System Perform?

Information on system performance is limited. Performance measurement for emergency care services has received growing attention, but as of yet, there are few opportunities for researchers to gather information on system performance at the local or state levels, much less nationally.

The Growing Information Gap

We know considerably more about pediatric emergency care than we did in 1993, but the information gap has widened as more areas of importance have emerged. The quality framework developed by the Institute of Medicine's Committee on the Quality of Healthcare in America is now widely used to evaluate the adequacy and safety of health care delivery. In Chapter 2, we used the quality framework to provide an overview of the state of pediatric emergency care

under the current system. But as that chapter explained, the information necessary to fully evaluate the pediatric emergency care system is lacking. The information gap of today contains the following additional questions:

- **How safe is pediatric emergency care?** How often do medical errors occur? How often are patients harmed from the receipt of emergency care services? Which aspects of pediatric emergency care are least safe? Which aspects are most safe?
- **How effective is pediatric emergency care?** How much care being delivered is not supported by evidence? What areas of pediatric emergency care lack evidence the most?
- **How patient-centered is pediatric emergency care?** How often do providers consider the wishes of patient and their families in treatment decisions? What percent of EMS agencies and hospitals have patient-centered policies? What percent of EDs have a patient-centered environment? How often are parents/guardians satisfied with the emergency care provided to their children?
- **How timely is pediatric emergency care?** How long do pediatric patients wait for prehospital services? How quickly are patients transported to EDs?
- **How efficient is pediatric emergency care?** Is pediatric emergency care cost-effective? How often is ineffective care delivered? How much waste exists in the emergency care system? What is the value of that waste?
- **How equitable is pediatric emergency care?** How does the availability and quality of care delivered vary based on patients' gender, age, race, ethnicity, income, education, geographic location, or disability?

Three Types of Research

Pressing gaps remain in our understanding of emergency care with respect to all three types of research: basic, translational, and health service delivery. Because emergency medicine is defined by time and place, rather than body part of disease process, research is often mischaracterized as being strictly translational in nature. But emergency medicine requires both basic discovery and translation of those discoveries to the clinical setting.

Basic science research is research aimed at increasing the fundamental understanding of a subject. It typically involves the study of the anatomy, physiology, cells, molecules and genes. Results from basic science investigations do not immediately provide results that are relevant for the delivery of emergency care, but it leads to a better understanding of diseases and provides the knowledge that helps eventually find new ways to diagnose, treat, and prevent different types of illnesses or injuries. An example is recent studies that have demonstrated the detrimental effect that brain injury has on an animal's ability to compensate for hemorrhage (Lewelt, 1980, 1982; Ishige, 1987, 1988; Yuan, 1991a,b; DeWitt, 1992a,b; Fulton, 1993). These findings have, at least in part, laid the foundation for some of the current Brain Trauma Foundation Guidelines.

Basic research projects involving pediatric emergency medicine could include: the pathophysiology of acute respiratory failure; minimizing the risk of secondary ischemic brain injury during limited resuscitation from hemorrhagic shock and traumatic brain injury; and pathophysiology and treatment of traumatic spinal cord injury.

Translational research represents the most active area of emergency care research. This is because of the wide range of patients, diseases, and interventions seen by EMTs and physicians in emergency practice. They are afforded a unique window on the state of treatment options available, including their shortcomings. This gives them both motivation and opportunity for

focused effort on translating research into better modes of treatment. An example is recent translational work by Sanders and others which investigated alternative CPR techniques to determine the optimal ratio of chest compressions to ventilations during CPR (Berg, 1995, 1997, 2001; Sanders, 2002; Kern, 2002). Their data demonstrated improved neurologic outcomes with a higher ratio of chest compressions to ventilations (100:2) as compared with standard CPR (compression: ventilation ratio of 15:2). These data, as well as other observations, lead to changes in the American Heart Association guidelines for CPR.

However, it has been noted that the U.S. healthcare system has had a poor performance record of utilizing demonstrated effective and safe therapies into routine clinical practice (Lenfant, 2003). With increasing recognition that simply establishing the safety and efficacy of a new therapy is insufficient to ensure its widespread use, many institutes within the NIH, as well as AHRQ (which leads these efforts) have increasingly emphasized the importance of translating research into practice. This is an important area which deserves special emphasis within emergency care health services research as well.

Examples of pediatric translational research include: the efficacy, safety and dosage guidelines of medications for infants, children, adolescents; development of evidenced based protocols for common pediatric conditions (fever, for example); effectiveness of new interventions, such as ultrasonography, needleless drug administration, and innovations in procedural sedation; and evaluating the pharmacokinetics and efficacy of promising clinical therapies to treat pediatric acute traumatic brain injury.

Emergency medicine by definition requires timely and efficient approaches to delivery of services. The impact of the organization and mode of delivery has long been recognized to have major impact on the quality of care and outcomes. But the organization and delivery of services is perhaps the weakest link in the emergency care evidence base. Even settled doctrine such as the value of paramedics in the field has been recently overturned. This then represents a formative and essential area for health services research. Some of the key research questions in pediatric service delivery include: the feasibility and cost-effectiveness of implementing mental health or child abuse screening of pediatric patients in the emergency department; the causes and solutions for missed diagnosis in the ED; identifying which components of pediatric trauma systems impact outcomes and cost-effectiveness; and the impact on ED crowding, boarding, and diversion on pediatric patients.

Health Promotion and Injury Prevention

Injury prevention is important for all age groups, but it is particularly important in the pediatric age group (See Box 7-1) (IOM, 1985). Injury is not only the leading cause of death for children, accounting for more deaths of children aged 1-18 than all causes of disease combined, but it also accounts for more years of potential life lost than any other health problem (Baker et al., 1992). Injuries are also the most common cause of pediatric ED visits (McCaig and Ly, 2002). Although not commonly linked to public health prevention activities, the potential role of emergency care providers in prevention has been recognized (Maclean, 1993). Patient encounters with EMS and ED providers offer a unique opportunity for preventive education, referred to as the “teachable moment”. The 1996 consensus document commissioned by NHTSA, *Emergency Medical Services: Agenda for the Future*, discussed the importance of EMS systems to be engaged in injury and illness prevention programs designed to address regional needs (NHTSA, 1996). Emergency Department providers have similarly been encouraged to play a key role in injury control and prevention (Mace et al., 2001; ACEP, 2002; DHHS et al., 2000).

While emergency providers' historical role in prevention has focused on surveillance and research, it also plays a small but growing role in delivering preventive care and education. In fact, in 49 states and territories, emergency care personnel are utilized for injury prevention activities (MCHB, 2004b). The benefits of injury prevention activities (i.e., decrease in health care consumption, reduced costs, lower morbidity and mortality) have all been well established for certain prevention strategies; however, the extent to which prevention activities carried out by emergency care providers reduce the burden of illness and injury in children and/or produce savings is currently not well understood. There have been few research efforts conducted to evaluate the effectiveness of ED based injury control and prevention interventions for children and their parents (Mace et al., 2001; Johnston et al., 2002). As a result, it is difficult to determine the extent to which emergency providers should be pressed to undertake such activities. Because little support has been provided to injury prevention research, it is unclear which prevention strategies are likely to produce to the greatest benefit.

BOX 7-1 Airbags and Children

Just as new medical technologies and information systems must be designed with pediatric patients in mind, prevention efforts must also consider the potential implications for children. Passenger side airbags represent an example of a prevention effort that was designed for adults, but resulted in unintended harm to child passengers.

Since the early 1970s, air bags, in concert with seat belts, have saved thousands of lives (McCaffrey et al., 1999). Because of their potential to reduce the burden of injury, dual air bags were required as standard equipment in all cars and light trucks in the U.S. in the late 1990s. However, many children, as many as 35 percent of child passengers in the 1990s, ride unrestrained in automobiles (National Center for Statistics and Analysis and NHTSA, 2005). As the number of vehicles equipped with dual air bags increased, federal regulators noted a sharp increase in the number of fatal injuries to children resulting from air-bag deployments. Many of these injuries stemmed from children being unrestrained or improperly restrained, but a small number of children who were properly restrained in the front seat were killed by deployment of airbags (CDC, 1996).

Because airbags must deploy at the moment of impact in order to catch an unrestrained passenger, they literally explode open—fully inflating within milliseconds. The speed of airbag deployment can exceed 140 to 200 miles per hour. Children placed in the front passenger seat are at much higher risk for being harmed by air bag deployment than adults for several reasons: they are more likely to be moving around or leaning forward in their seat, even if restrained; children placed in the front seat in a forward facing child restraint are several inches closer to the air bag than adults; children may shift closer to the airbag during pre-crash braking because their feet do not touch the floor and therefore they cannot brace themselves; a child's head and neck are more likely to be struck by the deploying air bag, and most important of all, infants placed in the front seat in a rear-facing child safety seat are inadvertently within striking distance of the airbag.

After reviewing the early pediatric injury and fatality data from air bags, the National Transportation Safety Board released a number of safety recommendations regarding the safe transport of children in automobiles with airbags. For example, infants should ride in rear-facing child-safety seats in the back seat. Children under age 12 should be properly secured in the back seat as well. For older children, shoulder belts should not be worn behind the back or under the arm. Additionally, the vehicle seat should be set as far back as far as possible (CDC, 1996). Additionally, NHTSA enacted regulatory measures to address the problem, including labeling requirements for vehicles and child safety seats and specifications for air-bag cutoff switches (CDC, 1995). In 2002, the American Academy of Pediatrics issued guidelines for counseling parents about the most appropriate care safety seats and positioning child passengers (AAP, 2002).

Justification for Increasing Pediatric Emergency Care Research

There is a lot we do not know about our emergency care system, particularly with regard to pediatric care. But there are also a lot of other unanswered questions within the health care system; what makes pediatric emergency care *worthy* of the scarce resources needed to address those unanswered questions?

In 1993, Frederick Rivara proposed a set of criteria for selecting research topics in general pediatrics, but his criteria are easily applied across all health research efforts. According to Rivara, research should focus on problems that (1) occur frequently, (2) are severe, and (3) could potentially be alleviated by doing something about it (Rivara, 1993). Pediatric emergency care research meets all three of these criteria. First, utilization data from individual EMS agencies and national data from the NHAMCS indicate heavy reliance on the emergency care system for pediatric patients. Children visited emergency departments close to 30 million times in 2003. Pediatric patients account for approximately 27 percent of all ED visits and 5 to 10 percent of all EMS transports. The frequency in which emergency care providers encounter pediatric patients contributes to the need for research in this area.

Second, while the majority of calls to EMS and visits to the ED do not involve life-threatening emergencies, the system must be well prepared for sick and injured children. The severity of illnesses and injuries that emergency providers encounter—some of which are life threatening—provides ample justification for efforts to improve research.

Finally, the potential to overcome deficiencies in the emergency care system through research is real. The EMS-C Program, though its network of grant coordinators at each state, has the infrastructure to help incorporate changes in practice that are suggested by new research, as will the new federal lead agency for emergency care proposed in Chapter 3. The potential for change will be even greater in communities that adopt the regionalized system of emergency care services proposed in Chapter 3, under which the coordination and organization of the system will be stronger.

ADDRESSING BARRIERS TO PEDIATRIC EMERGENCY CARE RESEARCH

The barriers that presently hinder emergency care research in general also apply to pediatric emergency care research. Among the most commonly cited barriers are: (1) inadequate funding streams (ACEP Research Committee, 2005); (2) limited availability of data, especially in the prehospital environment; and (3) a shortage of adequately-trained investigators with sufficient protected time to develop a clearly defined research focus (Stern, 2001; Lewis, 2004). Additional barriers exist to the conduct of prehospital emergency care. Survey data show that EMTs identified both a lack of interest and lack of knowledge about the purpose of research to be major barriers (Singh et al., 2004).

In order to address these barriers, **the committee recommends that the Secretary of DHHS conduct a study to examine the gaps and opportunities in emergency care research, including pediatric emergency care, and recommend a strategy for the optimal organization and funding of the research effort. This study should include: consideration of training of new investigators; development of multi-center research networks, involvement of emergency care researchers in the grant review and research advisory processes; and improved research coordination through a dedicated center or institute. Congress and federal agencies involved in emergency and trauma care research (including DOT, DHHS, DHS, and DoD) should implement the study's recommendations.**

Limited Funding for Pediatric Emergency Care Research

In order to improve the evidence-base for pediatric emergency care interventions, there is a need for larger, multi-center studies that can provide greater statistical power and more complexity in terms of analytic design and questions investigated. These more sophisticated studies require significant amounts of funding support (Havel, 2004). However, funding for research in emergency medicine has traditionally been very limited and is highly competitive.

Some progress has been made by pediatric emergency medicine researchers to secure federal funding for research, particularly with the introduction of PECARN, but funding continues to remain a critical barrier. Of the federal funds available for emergency care research, a limited amount is directed toward pediatric studies. In 2004, the Society for Academic Emergency Medicine (SAEM) identified a total of only 106 federal grants from various agencies covering a wide range of emergency care topics. Of these, only 11 were focused on pediatrics and 4 were focused on prehospital care. Of the 11 grants focused on pediatrics, only one was a basic science investigation (ACEP Research Committee, 2005).

A key characteristic of much of emergency care research is its tendency to cross multiple specialty domains. Emergency care research is often not based on a single disease entity, and simultaneously incorporates characteristics of both efficacy and health services research. This has made it difficult for emergency medicine researchers to obtain training grants from the siloed funding structure of the NIH, the largest single source of support of biomedical research in the world (IOM, 2004). The broad nature of emergency medicine research does not fit well into the highly specific focus of individual NIH institutes. According to a 2005 ACEP report on emergency medicine research, “even institutes with a potential focus on emergency medicine, such as the National Institute of General Medical Sciences (NIGMS) [which includes a trauma research center and trauma training program], view funding emergency medicine training programs with skepticism.” The ACEP Research Committee made a formal inquiry to the NIGMS program director regarding funding specifically for emergency medicine research. The program director described several barriers. For example, the NIGMS budget dedicated to training has remained constant while trainee costs have risen. These budgetary pressures led to a reduction in the total number of trainees that the institute could support. In the absence of increased funding, it is highly unlikely that the NIGMS will initiate a new category of training programs to foster the development of emergency care researchers. The program director also noted that although emergency medicine research covers medical issues that are within the missions of many individual institutes, it is doubtful that any single institute will support a generic program covering multiple research or training areas, as would be necessarily covered by a training program in emergency care research (ACEP Research Committee, 2005). The same problems exist for pediatric emergency care research.

As the above recommendation suggests, specific opportunities and funding streams for pediatric emergency care research should be identified and prioritized. This funding should address emergency medical and trauma care of both children and adults, including prehospital, ED, disaster medicine, critical care, mental health emergencies, and prevention. Projects should include a full range of relevant research: basic science, translational research, clinical outcome studies with emphasis on the generation and testing of evidence-based prediction rules, health services delivery research, behavioral/mental health studies and education research.

One of the impediments to emergency care grant funding at federal agencies has been the lack of emergency care researchers involved in the development of intramural and extramural research strategies and on grant review panels. This is partly because of the cross-cutting nature

of the discipline, described above. It is also due in part to the newness of the fields of trauma and emergency medicine, and the lack of a large cadre of mature investigators, as discussed in the next section. While the development of investigators is a critical imperative for the field, the number of mature investigators is growing and should have a greater presence in grant review processes in the future. This should occur naturally as a greater effort to support emergency care research is made by the NIH and other federal funders.

There should also be enhanced cooperation between federal agencies to develop multi-agency research announcements, and to coordinate funding for pediatric emergency care research projects. There is a precedent for this sort of activity. In response to the 1993 IOM report, which called for an increase in research funding for pediatric emergency care, a multi-agency announcement was released in 2001 to improve the quality and quantity of research related to emergency medical services for children. The announcement included AHRQ, HRSA's Maternal and Child Health Bureau, the Centers for Disease Control and Prevention's (CDC's) National Institute for Occupational Safety and Health, and four NIH Institutes: the National Institute of Child Health and Human Development, the National Institute on Drug Abuse, the National Institute on Mental Health, and the National Institute of Nursing Research. In 2002, eight funded projects cited the announcement as their point of referral in their proposal; in 2003, seven research awards were made where the announcement was the initial contact for the investigators (data courtesy of Isabelle Melese d'Hospital, EMSC Program). The program announcement expired in January 2004, but in April 2005, a similar multi-agency program announcement was released.

Collaboration should extend beyond federal agencies to include foundations and other sources of support (See Box 7-2). While the total funding for pediatric emergency care research is limited, the dollars flow from a large number of different sources including state block grants, private foundations, professional societies, and industry, although these funding streams are not always reliable and they almost always tend to be fragmented. These funding organizations should coordinate resources that support PEC research so that the dollars are directed to the most appropriate studies and overlap is avoided.

Not only do non-federal organizations represent a potential source of research support, but they may also provide essential venues for the diffusion of new pediatric research findings. For example, the Pediatric Academic Societies annual meeting is a venue for sharing information about interdisciplinary areas of pediatric medicine. Similarly, the annual meetings of the Society of Academic Emergency Medicine, Emergency Nurses Association, and National Association of EMTs represent opportunities for pediatric emergency care researchers to disseminate new information to emergency care providers.

BOX 7-2 Potential Sources of Support for Pediatric Emergency Care Research

Although federal support for pediatric emergency care research is rather limited, there are a number of government agencies that, due to their mission, could be potential supporters of pediatric emergency care research. Each of these agencies listed below should better define and expand their role in supporting pediatric emergency care research. A short description of each government agency is provided. Potential foundation and industry sources are also identified.

Federal Agencies

Several government agencies are involved in clinical and health services research. Although the funding is not typically targeted specifically for pediatric emergency care research, PEC researchers may be able to tailor their research topic to match the agency's substantive area of interest, for example mental health, cardiac care, or injury. Within the federal government, the following agencies can and should play an important role in pediatric emergency care research:

1. National Institutes of Health (NIH). The NIH is the main federal organization for health and behavioral research. The NIH consists of 27 separate institutes and centers that conduct and acquire both basic and applied behavioral and biomedical research. It supports the research of non-Federal scientists in universities, medical schools, hospitals, and research institutions throughout the country and abroad.

The NIH does not have an institute or center focused specifically on emergency services. However, emergency medicine research may be appropriate for any of the individual institutes or centers within NIH, depending on the research topic. For example, the National Heart, Lung, and Blood Institute (NHLBI) has encouraged the submission of research applications on topics that include studies that develop and evaluate programs using the ED to introduce effective asthma management strategies and epidemiological studies to identify risk factors for emergency department visits. Support for studies on pediatric emergency care could potentially be obtained from the National Institute for Child Health and Human Development (NICHD). NICHD has encouraged research applications that examine outcomes of emergency care for acutely ill children and care of suicidal children and adolescents. As of July 2004, two-thirds of NICHD grants were for projects related to pediatric critical care, and one-third were for pediatric rehabilitation studies.

Although the NIH budget has expanded in recent years, this has not translated to an increase in funds for emergency medicine research. Emergency medicine has traditionally faced larger hurdles to compete for NIH funding compared to other medical fields (Marx, 2004).

2. Department of Health and Human Services (DHHS). There are a number of agencies within DHHS that are potential supporters of pediatric emergency care research.

Agency for Healthcare Research and Quality (AHRQ). The mission of AHRQ is to improve the quality, safety, efficiency, and effectiveness of healthcare. Unlike the NIH, which tends to fund work that is more clinical, AHRQ tends to fund health services research. In 2004, AHRQ received an allocation of \$304 million to be used to fund a variety of health services and outcomes research, continuing the ongoing collection of key data characterizing the provision of healthcare in the U.S., and for a variety of specific activities mandated by Congress. For example, the 2005 AHRQ administration request includes \$84 million for patient safety research, \$50 million for information technology, and may include \$50 million for effectiveness evaluation of prescription drugs. Because funding to AHRQ is increasingly tied to specific activities, progressively fewer funds have been available to support investigator-initiated research and research training. Nonetheless, AHRQ remains a major source of funds for health services and outcomes research, with an intense focus on "translating research into practice." The development of methods to effectively translate new research findings into clinical practice is particularly important in emergency care and, to its credit, AHRQ has funded some important studies in this area, including a pediatric airway management project (Gausche et al., 2000). A number of emergency care specialists have served on standing grant review panels and special emphasis panels for AHRQ.

Health Resources and Services Administration (HRSA). HRSA's mission is to improve health care access. It awards grants and contracts primarily to support programs and demonstration initiatives. HRSA's Maternal and Child Health Bureau has a dedicated funding source for pediatric emergency services under its EMS-C Program, which is jointly funded with the National Highway Traffic Safety Administration. The EMS-C program provides support for the Pediatric Emergency Care Applied Research Network (PECARN), described in more detail later in the chapter.

HRSA's office of Rural Health Policy also supports research efforts through its Rural Health Research Center (RHRC) Program. The program is dedicated entirely to producing policy-relevant research on health care in rural areas. Eight centers have cooperative agreements with HRSA to conduct this research and each year, specific research topics for the Centers are selected jointly by the research center directors and the HRSA staff. Although the majority of studies are not focused on emergency care, one examined access to emergency medical services; and others have looked at how changes in the health care system affect emergency department use.

Indian Health Service (IHS). IHS is the federal government's primary advocate for American Indian health delivery services. IHS manages prehospital emergency medical services activities through contractual arrangements with tribal groups, which direct in total approximately 75 EMS programs involving some 600 emergency medical technicians. The EMS-C Program, MCHB, and HRSA contracted with the IHS to develop a set of activities designed to obtain information on the capabilities of American Indian tribes to serve children in emergency situations. IHS will conduct a national assessment of all American Indian tribal emergency medical services programs to obtain information needed by MCHB to assess the state of readiness of American Indian tribes to serve children in emergency situations (EMS-C National Resource Center, 1999).

Centers for Disease Control and Prevention (CDC). CDC is the lead federal agency for protecting the health and safety. Its focus is on disease prevention and control, environmental health, and health promotion and education activities designed to improve the health of U.S. residents. CDC works with partners to detect and investigate health problems and conduct research to enhance prevention (CDC, 2004).

Like the NIH, the CDC is organized by Centers, Institutes, and Offices. The individual centers, institutes and offices respond individually in their areas of expertise and pool their resources and expertise on cross-cutting issues and specific health threats. The National Center for Injury Prevention and Control (NCIPC) is the lead federal agency in the federal government for injury prevention. Its extramural research program funds and monitors research in all three phases of injury control: prevention, acute care, and rehabilitation. The program also funds research in the two major disciplines used in injury control research: biomechanics and epidemiology. Research supported by the program focuses on the broad-based need to control morbidity, disability, death, and costs associated with injury.

The CDC's recently completed Injury Research Agenda was developed with extensive input from academic research centers, national nonprofit organizations, and other federal agencies with a stake in injury prevention. The document will guide research in seven areas of injury prevention and control. The current plan for the implementation of the agenda is to seek \$250 million in appropriations over five years to support research in six broad areas, all of which are directly relevant to emergency care research. Emergency providers are well positioned to interact with CDC on various efforts including participation in extramural and intramural projects, serving on advisory and grant review committees, and providing input on the agency's recommendations. (Carden et al., 1998).

Centers for Medicare and Medicaid Services (CMS). CMS is the agency responsible for administering the Medicare program and, in partnership with states, the Medicaid and SCHIP programs. CMS supports a number of research projects in an effort to provide better services to program beneficiaries. Many of the research studies currently funded by CMS involve children enrolled in Medicaid and SCHIP, but none are specific to emergency care services.

3. Department of Transportation (DOT). The National Highway Traffic Safety Administration (NHTSA) within DOT has a mission to reduce death and disability as well as health care costs resulting from motor vehicle crashes, medical emergencies, or other injury incidents. NHTSA's EMS Office enhances emergency medical care for those injured in motor vehicle crashes and acknowledges that to ensure optimal care for crash victims, EMS systems must be prepared to provide a comprehensive range of community health services. Therefore the agency's EMS support is directed broadly to a range of system needs. It is closely aligned with the Maternal and Child Health Bureau (MCHB) to support the EMS-C Program. Along with the MCHB, the EMS Division commissioned the *EMS Research Agenda for the Future*, which describes the history and current status of EMS research. The Agenda also describes strategies for improving the quality and quantity of EMS research with the goal of providing a scientific foundation upon which to base current and future prehospital care.

4. Department of Defense (DOD). The military provides care to more than 3.5 million children. The DoD and HRSA work together to explore pediatric access and quality improvement issues in emergency care in the developing managed care delivery system. Additionally, in 1990, Congress mandated the DOD to conduct a special study of pediatric EMS systems within its military treatment facilities as a part of a national initiative to improve the quality of children's medical services. The goals of the study continue to be relevant and include assessing emergency medical services, evaluating the effectiveness of these services within the DoD, and identifying specific opportunities for improvement (DHHS et al., 2000).

5. Department of Homeland Security (DHS). The mission of DHS is to secure the homeland. Within that broad mission, the Federal Emergency Management Agency (FEMA) is the Federal coordinating agency responsible for emergency preparedness, response, recovery, and mitigation. FEMA works with other Federal, State, and local agencies to coordinate response and recovery operations following a major disaster. It also has a FEMA for Kids Program, which provides resources for children and families on-line. Within FEMA, the U.S. Fire Administration (USFA) is involved in prevention programs, for example, a public safety campaign to reduce fire deaths of infants and toddlers. FEMA does not appear to commission many research studies but certainly is a relevant participant in the provision of emergency care services for children, particularly as they relate to disasters.

Private Organizations

Some private organizations have dedicated funding to emergency services research. The financial support available from these organizations is typically more limited than the federal sources; however, some of the private organizations have funding that is targeted specifically for emergency services or emergency medicine research.

The Emergency Medicine Foundation (EMF) was created in 1973 as the education and research arm of ACEP. The Foundation, which is organized as a not-for-profit, is unique in that it awards funding for education and research solely in the area of emergency medicine. Funding for EMF grants comes from donations from individual emergency physicians, physician groups, corporations and other foundations. ACEP underwrites all of the administrative expenses of the EMF. EMF grant funding has grown considerably since the foundation's inception. During the first grant cycle in 1981-1982, EMF awarded 2 grants for \$8,500. In 2004-2005, EMF awarded 18 grants totaling almost \$500,000 (Pollack and Cairns, 1999).

The Society of Academic Emergency Medicine (SAEM) operates its own Research Fund, supported by donations from members. The Research Fund has about \$2 million in reserves and SAEM hopes to expand the fund to increase the number of grants awarded (Society of Academic Emergency Medicine, 2004). The Fund supports several different types of research grants to promote the development of research skills rather than any particular research project.

The National Emergency Medicine Association (NEMA) also offers grants to emergency medicine researchers. The organization is committed to trauma prevention and the delivery of quality medical services at each stage of trauma with an emphasis on first response at the time of the emergency. NEMA grants provide funding to hospitals, health clinics, trauma centers, fire departments, and

physicians. Awards go to small, under-funded rural organizations as well as to well-established entities (NEMA website).

For pediatric emergency medicine research, there are additional associations and foundations that may provide financial support. The American Academy of Pediatrics (AAP) Section on Emergency Medicine offers a young investigator award of \$10,000 for a research project that addresses issues pertinent to the acutely ill or injured child. The Section also offers several awards that recognize individuals that have made significant contributions to research in pediatric emergency medicine (AAP, 2003). The Ambulatory Pediatric Association, an organization of academic pediatric health professionals, offers a Young Investigator Grant that provides up to \$10,000 per project to new investigators for research in a number of areas, including pediatric emergency medicine (Christakis et al., 2001). Finally, researchers looking for funding for relatively small projects may be able to find funding from their local tertiary pediatric referral centers (Havel, 2004).

Industry

Industry or corporate funding constitutes a small source of funding for clinical research in pediatric emergency care research. The biomedical industry provides some funding for emergency medicine research, particularly evaluations of new drugs or medical devices. Emergency medicine physicians are in a good position to conduct this work since the ED is the initial site of diagnosis and treatment for many illnesses. This makes it an ideal setting for clinical trials of time-critical pharmaceutical agents, diagnostics, and medical devices (Morris and Manning, 2004).

Dearth of Well-Trained Pediatric Emergency Care Researchers

Many authors have decried the lack of a sufficient pool of well-trained laboratory and patient-oriented investigators in emergency care, and noted that this is a major barrier to emergency care research. Emergency care providers who are also basic science investigators, or who collaborate with such investigators, may serve as an excellent bridge for translating the findings of basic investigations to the emergently-ill patient, and for bringing unanswered questions back to the laboratory. But medical training in the specialties of pediatric emergency medicine, like emergency medicine, is heavily focused on the development of clinical skills, with little time for formal training in research methodology (Biros et al., 1998). Clinical fellowships are more numerous, and more likely to be funded than research fellowships. In 2003, only 12 percent of fellowships in the Society of Academic Emergency Medicine listing appeared to have a primary research focus and only about 70% of those positions were filled. None of them were backed by federal funding from the NIH or other agencies. In addition, only 11 percent of the advertised fellowships offered an advanced degree, such as a PhD, MS, or MPH during the course of fellowship training, though others may offer that option (Pollack et al., 2003).

While some clinical fellowships include a research component, a research training program that does not include two years of dedicated research training (e.g., greater than 80% research time) is unlikely to result in long-term success in today's research climate (NIH, 2003). Formal fellowship training is now a well-recognized requirement when embarking on a successful long-term research-based academic career (Stern, 2001).

As detailed in a report by the ACEP Research Committee, a substantial fraction (27 percent) of all emergency medicine trainees intend to pursue an academic career while, paradoxically, the research and research-training support devoted to emergency medicine and emergency care research and training activities is very low. Of the 1,281 NIH training grants to medical school departments made in 2003, only one was awarded to a department of emergency medicine. The lack of funding is even more striking when it is compared to other medical fields. For example,

less than 9 percent of internal medicine trainees expressed a desire to pursue an academic career, but the NIH awarded 354 training grants to departments of internal medicine in 2003 (ACEP Research Committee, 2005). However, when EM trainees express a desire to pursue academics, it is likely that most envision themselves as clinical educators, rather than federally funded investigators. While existing foundation support has increased the number of well-trained emergency care investigators, a significant increase in the total available research training support will be required to substantially expand the emergency care research capability nationwide.

While research opportunities are limited in emergency medicine training programs, as reported in Chapter 4, most pediatric emergency medicine physicians hold primary board certification in pediatrics, and most of the pediatric emergency medicine fellowships in the U.S. are organized under the pediatric residency review committee governed by the rules of the American Board of Pediatrics (ABP). The ABP requires that pediatric emergency medicine fellowships include a meaningful scholarly project; however, the vast majority of pediatric emergency medicine trainees pursue clinician educator career paths that emphasize clinical service in pediatric emergency medicine and bedside teaching, rather than academic research. Like PEM fellowship programs organized under the emergency medicine residency review committee, pediatric emergency medicine fellowships under the pediatric RRC infrequently result in research intensive academic careers. Historically, these fellowships have not provided research experiences that lead to sustained, independent research contributions following fellowship.

While there is scarce funding for emergency and trauma care researchers, research training for EMS personnel is more limited still. Unlike the medical field where research fellowships exist, there is no clear path to develop research expertise in EMS. As a result, the EMS research is largely fostered by researchers who are trained in emergency medicine (Sayre et al., 2002).

One potential strategy to address this barrier is to promote and fund centers of excellence in emergency and trauma care. Centers of excellence would allow funding for experienced researchers to work with young investigators on projects, supporting mentorship. A series of 2-year “fellowship” opportunities would target promising young researchers to gain skills in research methodology. This goal could be met by establishing Centers of Excellence funded by NIH, expand the availability and appropriateness of K-awards, and expand cooperation between federal, professional society, and foundation partners to fund young investigator awards.

Another strategy is to develop training grants for emergency medicine educators, as well as offer support for training programs to prepare mid-level providers, such as emergency medical technicians (EMTs), nurse practitioners, and physician assistants to conduct and participate in research. Presently midlevel research development grants are restricted to “primary care” specialties, thereby excluding emergency physicians and other providers of emergency care. There is a pressing need for access to training grants, including K23 and K08 applications, specifically targeted for emergency and trauma care researchers. T32 training grants should be offered to the relatively few academic departments or divisions of EM that have established viable lines of federally-funded laboratory clinical and/or health services research. In addition, health care foundations that are concerned about reducing health care disparities and promoting access to care (such as RWJ and KFF) should fund career development awards and fellowship programs for emergency care and trauma physicians.

Data Limitations

One of the challenges of conducting research on emergency care services is that no single institution is likely to have access to sample sizes large enough to answer important questions about critically ill individuals, particularly children. For example, a 10-center study of children with diabetic ketoacidosis identified only 61 cases of cerebral edema during the 15 year study period (Glaser et al., 2001). Similarly, a study intended to produce a decision rule for computed tomography (CT) scanning of the brain found that less than 1% of children with minor head injury required a neurosurgical intervention (Atabaki et al., 1999). Decision rules based on small samples tend to suffer from unacceptably wide confidence intervals, so the validity of the findings are limited (PECARN Members, 2003). There are several options for overcoming these data limitations.

Research Networks

The use of research networks to overcome this challenge has proven to be successful in the past. The large number of patients included in the networks allows researchers to implement trials designed to evaluate rare conditions or complications.

There are a number of primary care research networks in existence. For example, The American Academy of Pediatrics established the Pediatric Research in Office Settings (PROS) Network in 1986. The mission of the Network is to improve the health of children and enhance primary care practice by conducting national collaborative practice-based research. In 2004, the Network included over 1,900 practitioners from over 700 offices in the 50 states, Canada, and Puerto Rico. The network is currently working on a variety of projects, including studies on how practitioners diagnose child abuse in primary care settings, a new way to help parents prevent child violence, and how to improve practice/clinic immunization rates. The Vermont Oxford Network (VON), founded in 1988, includes over 485 neonatal intensive care units in the U.S. and other countries. The Network maintains a database that provides unique, reliable and confidential data to participating units for use in quality management, process improvement, internal audit, and peer review. The VON disseminates the result of its research efforts in medical journals and through a Network publication. The National Cancer Institute at the NIH also has a pediatric research network called the Children's Oncology Group (COG), which was established in 2000. The COG is a clinical trials cooperative group devoted exclusively to childhood and adolescent cancer research. The COG develops and coordinates cancer clinical trials conducted at the 238 member institutions in the U.S., Canada, Europe, and Australia. COG members include over 5000 cancer researchers.

There are also several research networks focused on general aspects of emergency medicine. For example, Emergency ID Net is a CDC funded, interdisciplinary, multi-center, ED-based network for research of emerging infectious diseases, which was established in cooperation with the CDC's National Center for Infectious Diseases. The network is based at 11 university-affiliated, urban hospital EDs with a combined annual patient visit census of more than 900,000 (Talan et al., 1998). Also, the Emergency Medicine Network's Multi-Center Airway Research Collaborative (MARC) performs long-term research on airway disorders, including asthma, chronic obstructive pulmonary disease (COPD), anaphylaxis, pneumonia, and bronchiolitis. Many of the studies investigate both adults and children. In addition, the Emergency Medicine Cardiac Research and Education Group International, an industry-sponsored group centered in Cincinnati, OH, was established in 1989 to conduct multi-center clinical research trials on serum

markers for the early diagnosis of acute myocardial infarction. Since then, the network has grown from 18 researchers in 15 institutions to 44 researchers in 31 academic facilities worldwide. These collaboratives have a well-defined group leadership such as a steering committee or board of directors, have produced multiple publications, and many have received funding support from diverse sources including government, private foundations, and industry. In addition, they tend to perform education and service functions along with research (Pollack et al., 2003).

PECARN is the only large research network focused specifically on pediatric emergency care. It includes four regional nodes with 25 hospitals serving over 800,000 pediatric patients per year. Since the PECARN has been in existence, it has completed a major core data project and several other projects have been federally funded to evaluate such issues as: the efficacy of dexamethasone in the treatment of bronchiolitis; the feasibility of a large trial of hypothermia in the treatment of cardiopulmonary arrest in children; the factors that can contribute to a decision rule for the evaluation and treatment of minor head injury in children; the use of lorazepam for treatment of seizures in children; and cervical spine injuries in children.

An important attribute of these research networks is that they establish an infrastructure for research in a particular area. If they receive the funding needed for sustainability, they not only generate important findings in the field, but also help train and support the development of young investigators. Recognizing the importance of research networks to the knowledge base and the research infrastructure, the committee recommended (above) that the Secretary of HHS conduct study on research gaps and opportunities including a focused look at the development of multi-center research networks. Ideally, research networks should focus on issues including prevention, trauma, and pediatric emergency medicine. And in particular, research networks like PECARN should expand their research into the prehospital environment.

Research networks generally should work toward expanding to more hospitals so that their findings can be better representative of the care that is delivered nationally. For example, PECARN represents children's hospitals disproportionately to the volume of care that children's hospitals provide to pediatric emergency care patients nationally. Since children's hospitals tend to have more pediatric resources than other hospitals, certain findings from PECARN may not be reflective of the care provided at community hospitals nationally. One of the challenges to expanding PECARN beyond children's hospitals is that community hospitals often lack the infrastructure and resources to conduct clinical research. The professional reward structures in community hospitals are often not aligned with the commitment of large amounts of time and effort to research. PECARN and other research networks will have to be creative in achieving representation of the many children who receive care in community hospital EDs. As the network tries to expand its reach, network leaders should also consider how pediatric surgeons, health services researchers, and public health researchers might be better integrated into the network to expand the scope of research generated from PECARN.

The call for the development and enhancement of multi-center research networks is not new. In fact, at both the 1995 Emergency Medicine Research Directors Conference and the 1997 Future of Emergency Medicine Research Conference, participants encouraged the growth of these networks (Pollack et al., 2003).

Trauma Registries

Injury is the leading cause of death and disability in children beyond the first year of life. The optimal clinical management of pediatric injuries may differ significantly from similar injuries in

adults. Despite the prevalence of pediatric trauma, many unanswered questions remain about optimal care for certain subsets of pediatric trauma patients. Trauma registries, which are used to collect, store, and retrieve data concerning trauma patients, can help delineate answers to some of these questions by allowing researchers to study etiologic factors, demographic characteristics, diagnosis, treatments, and clinical outcomes of pediatric patients. Registries can be used to evaluate and improve the quality of care, compare patient outcomes across providers, identify hazardous environments (e.g., dangerous intersections or devices), identify injury trends, prioritize and evaluate public health interventions, provide data for benchmarking and improvement, and monitor trauma system trends (HRSA, 2005). Trauma registries are expensive to develop and maintain, but they are effective in decreasing morbidity and mortality (Shapiro et al., 1994).

There have been a number of different initiatives to develop trauma registries. Today, 37 states maintain a trauma registry; these efforts have been supported by grant funding from HRSA's Trauma-EMS Systems Program, which was recently defunded (HRSA, 2005). This represents an improvement since 1992 when only 24 states operated trauma registries (Shapiro et al., 1994). State trauma registries collect pediatric-specific data; however, there are a number of shortcomings associated with state registries. The registries are not standardized nationally or even statewide in some cases. They vary in a number of ways including the patient inclusion/exclusion criteria, data definitions, and injury severity scoring (HRSA, 2005). Reporting is not mandatory in some states, so state trauma managers estimate that only 70 percent of trauma cases are reported to the state registry (Guice and Cassidy, 2004).

There have been a number of efforts at the national level to develop trauma registries. In 1985, the National Pediatric Trauma Registry (NPTR) was established to study the causes, circumstances, and consequences of injuries to children. The registry, funded by the National Institute for Disability and Rehabilitation Research, contained data on over 10,000 patients pooled from a number of different states. Data from the NPTR allowed researchers to investigate a number of topics including the epidemiology of rural traumatic death in children (Vane and Shackford, 1995), survival rates at pediatric trauma centers (Osler et al., 2001), and characteristics of bicycle-related head injury (Li et al., 1995). However, the registry had several problems that limited the usefulness of the data and created challenges for institutions participating in the data collection process (Smith et al., 2001), for example, the registry was a voluntary system without a clear epidemiologically representative catchment area. The registry stopped collecting data as of February 2002 (Barnett and Saltzman, 2004).

Also in the 1980s, the American College of Surgeons (ACS) was collecting trauma data for their Major Trauma Outcome Study (MTOS), which was operational between 1982 and 1989. Under the MTOS, researchers from 140 hospitals used a standard collection form for data submission. During its eight-year lifetime, the MTOS collected data on 80,000 cases (Fantus and Fildes, 2003). More importantly, the MTOS led to the creation of the National Trauma Data Bank (NTDB). When the MTOS ended, the ACS committed to developing a national trauma registry and the NTDB became operational in 1993 (Pollock, 1995). Today, the NTDB represents the largest aggregation of trauma registry data ever assembled with 1.2 million records from almost 500 trauma centers. The ACS receives support for the NTDB from HRSA, CDC, and NHTSA (American College of Surgeons, 2004).

The NTDB is an impressive effort; numerous research efforts have been undertaken using the data bank. Additionally, ACS releases an annual pediatric report, which includes over 235,000 pediatric records from 474 trauma centers in 43 states, territories, and the District of Columbia.

The ACS has a Pediatric Surgery Specialty Group that works with the national Trauma Data Bank Committee to expand the data bank for children with the goal of receiving data on every pediatric patient treated in every trauma center in the U.S (Fildes, 2005).

There are a couple of important drawbacks to the NTDB. First, it does not allow population estimates. It obtains data from approximately 61 percent of Level I and 51 percent of Level II trauma centers (essentially all submit adult and pediatric data) (Fildes, 2005), but it collects data only from the hospitals that choose to submit data (NHTSA, 2001). However, the NTDB's impressive yearly growth (500,000 new cases in 2002) offsets some of the concerns about its representativeness (NHTSA, 2001). The other problem with the NTDB is that it was not specifically designed to capture certain pediatric data elements.

But the planned advancements for the NTDB are promising. The ACS was awarded a contract from the CDC's National Center for Injury Prevention and Control to develop a nationally-representative sample of U.S. trauma centers that provides data on trauma patients for the NTDB. That data will allow researchers to compute national estimates with high confidence. An important part of this project is the inclusion of non Level I and II hospitals. The project has not yet developed a stratum for pediatric patients, but that is something intended for the future. Additionally, the NTDB will implement a new set of data elements that will be more conducive to the collection of pediatric data; the original set of data elements were not defined to capture pediatric information. For example, the new data dictionary contains a field on safety devices so that the NTDB can collect specific information on child restraints (Personal communication, M. Neal, March 1, 2006).

More recently, another initiative to create a national pediatric trauma registry has begun. In 2002, EMS-C awarded two grants aimed at designing and planning for a National Trauma Registry for Children (NTRC). The goal of the NTRC is "to develop a standardized, nation-wide model to provide accurate estimates of the scope and characteristics of pediatric trauma and to provide a national benchmark for valid comparisons" (Cassidy and Guice, 2005). Resulting data will allow clinical and epidemiological questions to be explored using a more expansive and richer source of information than could be obtained using regional and statewide systems.

Under these grants, researchers identified existing data sources and methods of electronic transfer, defined necessary pediatric data elements and inclusion/exclusion criteria, developed secure data transfer methods, designed a nationally representative sample, and identified methods to ensure hospital participation (Cassidy and Guice, 2005). A third grant was awarded in 2005 to evaluate the quality of pediatric data from state registries that might contribute to the NTRC. However, the implementation of the NTRC has not yet begun. The planning group behind the NTRC is expected to recommend two phases to the NTRC. The first will be a population-based injury surveillance system, which will allow researchers to make population inferences from a statistical sample of national hospitals. The second will be a case contribution component, similar to the original NPTR (Cooper, 2005).

It is important to note that there has been collaboration between staff from the NTDB and the NPTR. In fact, a representative from the NTDB was on the NTRC planning committee and a representative from the NTRC assisted NTDB planners with the development of new data elements more suitable for the collection of pediatric data (Personal communication, M. Neal, March 1, 2006). Despite all of the efforts to enhance the development of trauma systems with interpretive pediatric data, no single trauma registry provides accurate estimates of the scope and characteristics of pediatric trauma (Cassidy and Guice, 2005). However, the committee recognizes that the NTDB constitutes the largest repository of pediatric trauma data anywhere

(Cooper, 2005) and is taking steps to improve its pediatric capacity. The committee is supportive of the continued progress in this area. **The committee recommends that the administrators of statewide and national trauma registries include standard pediatric-specific data elements and provide the data to the NTDB. Additionally, the American College of Surgeons should establish a multidisciplinary pediatric specialty committee to continuously evaluate pediatric-specific data elements for the NTDB and identify areas for pediatric research.** Naturally, the planning committee should include pediatric surgeons, pediatric emergency care researchers, and public health and health services researchers.

RECOMMENDATIONS

7.1 The Secretary of DHSS should conduct a study to examine the gaps and opportunities in emergency care research, including pediatric emergency care, and recommend a strategy for the optimal organization and funding of the research effort. This study should include: consideration of training of new investigators; development of multi-center research networks, involvement of emergency and trauma care researchers in the grant review and research advisory processes; and improved research coordination through a dedicated center or institute. Congress and federal agencies involved in emergency care research (including DOT, DHHS, DHS, and DoD) should implement the study's recommendations.

7.2 Administrators of statewide and national trauma registries should include standard pediatric-specific data elements and provide the data to the NTDB. Additionally, the American College of Surgeons should establish a multidisciplinary pediatric specialty committee to continuously evaluate pediatric-specific data elements for the NTDB and identify areas for pediatric research.

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PREPUBLICATION COPY: UNCORRECTED PROOFS

Appendix A Committee and Subcommittee Membership

Gail Warden, MHA, *Chair*

SUBCOMMITTEES				
Pediatric Emergency Care (PEDS)	Prehospital Emergency Medical Services (EMS)	Hospital-Based Emergency Care (ED)		
David Sundwall, MD - Chair	Shirley Gamble, MBA - Chair	Benjamin Chu, MD, MPH - Chair	Thomas Babor, PhD, MPH	MAIN COMMITTEE
George Foltin, MD	Robert Bass, MD	Stuart Altman, PhD	Robert Gates, MPA	
Darrell Gaskin, PhD	Brent Eastman, MD	Brent Asplin, MD, MPH	William Kelley, MD	
Marianne Gausche-Hill, MD	Arthur Kellermann, MD, MPH	John Halamka, MD	Mark Smith, MD, MBA	
Richard Orr, MD	Jerry Overton, MA	Mary Jagim, RN		
	Nels Sanddal, MS, REMT-B	Peter Layde, MD, MSc		
		Eugene Litvak, PhD		
		John Prescott, MD		
		William Schwab, MD		
Rosalyn Baker	Kaye Bender, PhD, RN	Kenneth Kizer, MD		
Mary Fallat, MD	Herbert Garrison, MD	John Lumpkin, MD		
Jane Knapp, MD	Mary Beth Michos, RN	Daniel Manz, EMT		
Thomas Loyacono, EMT-P	Fred Neis, RN	Joseph Wright, MD		
Milap Nahata, PharmD	Daniel Spaite, MD			
Donna Ojanen Thomas, RN				

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Appendix B

Biographical Information for Main Committee and Pediatric Emergency Care Subcommittee

Gail L. Warden, M.H.A., F.A.C.H.E., MAIN COMMITTEE CHAIR, is President Emeritus of Henry Ford Health System in Detroit, Michigan, one of the nation's leading vertically integrated health care systems.

Warden is an elected member of the Institute of Medicine of the National Academy of Sciences. He served on its Board of Health Care Services, Committee on Quality Health Care in America, and served two terms on the Governing Council. He chairs the board of the National Quality Forum, the Healthcare Research and Development Institute, and the newly created National Center for Healthcare Leadership. Warden co-chairs the National Advisory Committee on Pursuing Perfection: Raising the Bar for Health Care Performance. He is a member of The Robert Wood Johnson Foundation Board of Trustees, the Institute for Healthcare Improvement Board, and the RAND Health Board of Advisors. He is director emeritus and past chairman of the Board of the National Committee on Quality Assurance. In 1997 President Clinton appointed him to the Federal Advisory Commission on Consumer Protection and Quality in the Health Care Industry. In 1995 Warden served as chairman of the American Hospital Association Board of Trustees. He served as a member of the Pew Health Professions Commission, the National Commission on Civic Renewal, and past chairman of the Health Research and Education Trust Board of Directors.

Warden served as president and Chief Executive Officer of Henry Ford Health System from April 1988 until June 2003. Before joining Henry Ford Health System, Warden served as president and chief executive officer of Group Health Cooperative of Puget Sound in Seattle from 1981 to 1988. Prior to that he was executive vice president of the American Hospital Association from 1976 to 1981; and from 1965 to 1976, he served as executive vice president and chief operating officer of Rush-Presbyterian-St. Luke's Medical Center in Chicago.

Warden is a graduate of Dartmouth College and holds an M.H.A. from the University of Michigan. He has an honorary doctorate in public administration from Central Michigan University and is a member of the faculty of the University of Michigan School of Public Health.

David N. Sundwall, M.D., PEDIATRIC SUBCOMMITTEE CHAIR, was nominated by Governor Jon Huntsman Jr. to serve as Executive Director of the Utah State Department of Health (UDOH) on January 3, 2005, and was confirmed for this position by the Utah Senate on January 17, 2005. In this capacity he supervises a workforce of almost 1,400 employees, and a budget of almost \$1.8 billion. Previously, Sundwall served as President of the American Clinical

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Laboratory Association (ACLA) in September 1994, until he was appointed Senior Medical and Scientific Officer in May 2003. Prior to his position at ACLA, he was Vice President and Medical Director of American Healthcare System (AmHS), at that time the largest coalition of not-for-profit multi-hospital systems in the country.

Dr. Sundwall has extensive experience in federal government and national health policy, including: Administrator, Health Resources and Services Administration [HRSA}, Public Health Service, U.S. Department of Health and Human Services (HHS), and Assistant Surgeon General in the Commissioned Corps of the U.S. Public Health Service (1986-1988). During this period, he had adjunct responsibilities at HHS including: Co-Chairman of the HHS Secretary's Task Force on Medical Liability and Malpractice, and was the HHS Secretary's Designee to the National Commission to Prevent Infant Mortality. Dr. Sundwall also served as Director, Health and Human Resources Staff (Majority), U.S. Senate Labor and Human Resources Committee (1981-1986).

Dr. Sundwall was in private medical practice in Murray, Utah from 1973-1975. He has held academic appointments at the Uniformed Services University of the Health Sciences, Bethesda, Maryland; Georgetown University School of Medicine, Washington, DC; and the University of Utah School of Medicine. He is board certified in internal medicine and family practice. He is licensed to practice medicine in the District of Columbia, is a member of the American Medical Association (AMA) and the American Academy of Family Physicians (AAFP), and previously served as volunteer medical staff of Health Care for the Homeless Project.

Stuart H. Altman, Ph.D., is the Sol C. Chaikin Professor of National Health Policy at the Heller Graduate School for Social Policy and Management. He served as dean of the Heller School from 1977 to a 1993. In August of 2005 he again assumed the deanship of the Heller School. Professor Altman has had extensive experience with the federal government, serving as deputy assistant secretary for planning and evaluation/health in the U.S. Department of Health, Education, and Welfare, 1971-76, chairman of the congressionally-mandated Prospective Payment Assessment Commission, 1983-1996, and a member of the Bipartisan Commission on the Future of Medicare, 1999-2001. In addition, from 1973 to 1974, he served as deputy director for health of the President's Cost-of-Living Council and was responsible for developing the council's program on health care cost containment. Dean Altman has testified before various congressional committees on the problems of rising health care costs, Medicare reform and the need to create a national health insurance for the United States. He chaired the Institute of Medicine's Committee on the Changing Market, Managed Care, and the Future Viability of Safety Net Providers. His research activities include several studies concerning the factors causing the recent increases in the use of emergency rooms. He holds a Ph.D. in economics from the University of California, Los Angeles, and has taught at Brown University and the University of California, Berkeley.

Brent R. Asplin, M.D., M.P.H., F.A.C.E.P., is Department Head of Emergency Medicine at Regions Hospital and HealthPartners Research Foundation in St. Paul, MN, and is an Associate Professor and Vice Chair of the Department of Emergency Medicine at the University of Minnesota. After receiving his degree from Mayo Medical School, he completed the University of Pittsburgh's Affiliated Residency in Emergency Medicine. To develop his interests in research

and health care policy, Dr. Asplin completed the Robert Wood Johnson Clinical Scholars Program at the University of Michigan, where he obtained a M.P.H. in Health Management and Policy. He is currently studying methods to improve the reliability and efficiency of health care operations, particularly strategies to improve patient flow in hospital settings.

Thomas F. Babor, Ph.D., M.P.H., spent several years in postdoctoral research training in social psychiatry at Harvard Medical School, and subsequently served as head of social science research at McLean Hospital's Alcohol and Drug Abuse Research Center in Belmont, Massachusetts. In 1982 he moved to the University of Connecticut School of Medicine. He has served as the Scientific Director at the Alcohol Research Center and the interim Chair of the Psychiatry Department.

Dr. Babor's primary interest areas are psychiatric epidemiology and alcohol and drug abuse. In 1998, he became Chair of the Department of Community Medicine and Health Care, where he directs an active research program. Dr. Babor is Regional Editor of the international journal, "Addiction." In addition, he previously served on two Institute of Medicine committees—including "Prevention and Treatment of Alcohol-Related Problems: An Update on Research Opportunities" and "Treatment of Alcohol Problems".

The Honorable **Rosalyn H. Baker** was elected to the Hawaii State Senate in 1994 where she was a member of the Senate Health Committee and served on the Joint Legislative Committee on Long Term Care Financing (1997-98). She has chaired the Senate Committee on Health since 2002 and co-chaired an Interim Legislative Working Group on Universal Healthcare (2003). Prior to serving in the state Senate, she was a member of the Hawaii State House of Representatives (1988-1993). She currently represents the 5th Senatorial District comprising South and West Maui.

The former Vice Chair of the Maui Service Area Board on Mental Health and Substance Abuse, Senator Baker has served the American Cancer Society both as President of the Maui, Moloka'i, Lana'i Unit (1997-2001) and as a member of the Hawaii Pacific Board of Directors (2003-2004). She is the vice chair of the Hawaii Comprehensive Cancer Control Coalition. Among many awards and honors received throughout her career, she was named Legislator of the Year by the Healthcare Association of Hawaii (2004) and Hawaii Long Term Care Association (1998), as well as by the Hawaii Psychological Association for her outstanding contributions to psychology and mental health in the State of Hawaii (2003). She has authored several laws and initiatives improving and expanding access to health care services including emergency medical services throughout the state of Hawaii. In the 2006 session, Sen. Baker authored laws establishing a statewide ban on smoking in public places and places of employment and an increase in the cigarette tax to provide dedicated funding for the Cancer Research Center of Hawaii, trauma and emergency medical services and the community health centers.

Senator Baker holds a B.A. in Political Science and Speech from Southwest Texas State University (now known as Texas State University at San Marcos) and has pursued graduate studies in Political Studies at the University of Southwestern Louisiana (now the University of Louisiana at Lafayette).

Robert R. Bass, M.D., F.A.C.E.P., received his undergraduate and medical degree from the University of North Carolina at Chapel Hill in 1972 and 1975 respectively. Prior to completing his undergraduate education, he was employed as a police officer in Chapel Hill, NC and served as a volunteer member of the South Orange Rescue Squad. Dr. Bass completed an internship and residency in the United States Navy and is currently board certified in both emergency medicine and family medicine. He has served as a medical director for emergency medical services (EMS) systems in Charleston, SC, Houston, TX, Norfolk, VA, and Washington, DC.

Since 1994, he has been the Executive Director of the Maryland Institute for EMS Systems, the state agency responsible for the oversight of Maryland's EMS and trauma system. He is a Clinical Associate Professor of Surgery (Emergency Medicine) at the University of Maryland at Baltimore and is an Associate Professor in the Emergency Health Services Program at the University of Maryland, Baltimore County.

Dr. Bass is currently the President of the National Association of State EMS Officials and a founding member and the Immediate Past-President of the National Association of EMS Physicians. Additionally, he serves on the Board of Director of the American Trauma Society, the University of Maryland Medical System, and is a past Chairman of the EMS Committee of the American College of Emergency Physicians.

Benjamin K. Chu, M.D., M.P.H., was appointed president, Kaiser Foundation Health Plan, Inc. and Kaiser Foundation Hospitals, Southern California Region, in February 2005. Before joining Kaiser Permanente, Dr. Chu was President of the New York City Health and Hospitals Corporation with primary responsibility for management and policy implementation at the Corporation. Prior to that, Dr. Chu was Senior Associate Dean at Columbia University College of Physicians and Surgeons. He has also served as Associate Dean and Vice President for Clinical Affairs at the New York University Medical Center managing and developing the clinical academic hospital network. Dr. Chu is a primary care internist by training with extensive experience as a clinician, administrator and policy advocate for the public hospital sector. He was Senior Vice President for Medical and Professional Affairs at the Corporation from 1990-1994. During that period he also served as Acting Commissioner of Health for the New York City Department of Health and Acting Executive Director for Kings County Hospital Center. Dr. Chu also has extensive experience in crafting public policy. He served as legislative assistant for health for Senator Bill Bradley as a 1989-90 Robert Wood Johnson Health Policy Fellow. Earlier in Dr. Chu's career, he served as Acting Director of the Kings County Hospital Adult Emergency Department. His area of interests includes health care access and insurance, graduate medical education policy, primary care and public health issues. He has served on numerous advisory and not-for-profit boards which focused on health care policy issues. Dr. Chu received a Master in Public Health from the Mailman School at Columbia University and his Doctorate of Medicine at New York University School of Medicine.

A. Brent Eastman, M.D., joined Scripps in 1984 as Director of Trauma Services at Scripps Memorial Hospital La Jolla, and was appointed Chief Medical Officer in 1998. He continues to serve in the role of Director of Trauma.

Dr. Eastman received his medical degree from the University of California, San Francisco, where he also did his general surgical residency and served as Chief Surgical Resident. He spent one year abroad in surgical training in England at Norfolk and Norwich Hospitals.

Dr. Eastman served as Chairman of the Committee on Trauma for the American College of Surgeons from 1990-1994. This organization sets the standards for the trauma care in the United States and abroad. The position has led to his involvement nationally and internationally in the development of trauma systems in the United States, Canada, England, Ireland, Australia, Brazil, Argentina, Mexico, and South Africa. Dr. Eastman has authored or co-authored more than 25 publications and chapters principally relating to trauma. He has held numerous appointments and chairmanships over the last two decades, including Chairman, Trauma Systems Committee for the U.S. Department of Health and Human Services; Board of Directors, American Association for the Surgery of Trauma; and Chairman, Grant Review Committee, Center for Injury and Prevention and Control at the U.S. Centers for Disease Control and Prevention.

Mary E. Fallat, M.D., F.A.C.S., is currently a Professor of Surgery in the Department of Surgery, Division of Pediatric Surgery at the University of Louisville. From 1988 to 2005, she served as the Trauma Chief at Kosair Children's Hospital in Louisville, Kentucky, a 225-bed free-standing regional referral center and the only children's hospital in the State of Kentucky. She has continuously been involved in the Emergency Medical Services for Children (EMSC) program in the State of Kentucky since 1992, and is the Project Director for the EMSC Partnership Grant to Kentucky.

In addition to her positions at the University of Louisville and Kosair Children's Hospital, Dr. Fallat completed a six-year term as the Chair of the Kentucky Committee on Trauma of the American College of Surgeons and has been appointed the Chair of the Emergency Services-Prehospital Subcommittee of the National Committee on Trauma, where she is a member of the Executive Committee. She has been a member of the governor-appointed Kentucky Board of Emergency Medical Services (KBEMS) since 2000, in addition to serving as the Chair of the EMSC Subcommittee of KBEMS. On behalf of KBEMS, she has also written two successfully funded federal trauma-EMS grants for the State of Kentucky, and is the Project Director for these grants.

Dr. Fallat is a member of many other organizations including the American Academy of Pediatrics, the American Pediatric Surgical Association, the British Association of Paediatric Surgeons, and the Kentucky Pediatric Society. She has been a contributor to the Pediatric Advanced Life Support (PALS) program of the American Heart Association, having served as a member of the national pediatric subcommittee for several years. Recently, she has also contributed as a co-author to the Advanced Pediatric Life Support (APLS) course offered by the American College of Emergency Physicians. Dr. Fallat has written several other trauma-related chapters as contributions to textbooks and has several relevant trauma publications in peer reviewed journals.

George L. Foltin, M.D., F.A.A.P., F.A.C.E.P., began his involvement with the Emergency Medical Services for Children (EMSC) Program of the Health Resources and Services Administration in 1985. He is board certified in pediatrics, emergency medicine, and pediatric

emergency medicine. Dr. Foltin served on the Medical Oversight Committee for the EMT-Basic National Standard Curriculum project and was a subject expert for the Project to Revise EMT-Intermediate and Paramedic National Standard Curriculum. He is a former board member of the National Association of EMS Physicians and served on the Committee on Pediatric Emergency Medicine of the American Academy of Pediatrics. Currently Dr. Foltin co-chairs the Statewide AAP Committee on Pediatric Emergency Medicine and sits on the Regional Medical Advisory Committee of New York City. He has published extensively in the field of Emergency Medical Services for Children, has been the Principal Investigator of several federal grants, and serves as a consultant to the New York City and State Departments of Health, as well as to federal programs such as the Maternal and Child Health Bureau (MCHB), the Agency for Healthcare Research and Outcome (AHRQ), and the National Highway Traffic Safety Administration (NHTSA).

Shirley Gamble, M.B.A., served as the Senior Advisor to The Robert Wood Johnson Foundation's Urgent Matters initiative, which is working to help hospitals eliminate emergency department crowding and help communities understand the challenges facing the health care safety net. Ms. Gamble has over 20 years experience in the health care industry serving as an executive with Incarnate Word Health Services, Texas Health Plans HMO, and Tampa General Hospital. As Partner of Phase 2 Consulting, a health care management and economic consulting firm, Ms. Gamble led performance improvement and strategic planning engagements for major hospital systems, managed care entities, and university faculty practice plans. She currently is the Chief Operating Officer for the United Way Capital Area in Austin, Texas. She has an M.B.A. and B.A. from the University of Texas at Austin.

Darrell J. Gaskin, Ph.D., M.S., Darrell J. Gaskin is Associate Professor of Health Policy and Management at The Johns Hopkins Bloomberg School of Public Health and Deputy Director of the Morgan-Hopkins Center for Health Disparities Solutions. Dr. Gaskin's research interests focuses on healthcare disparities and access to care for vulnerable populations. His primary aim is to promote policies and practices that eliminate disparities in health care utilization and barriers to care for low income and minority groups. Dr. Gaskin's most recent project studies disparities in the quality of hospital care. He seeks to identify characteristics of hospitals that provide high quality care to low income and minority patients. Dr. Gaskin has studied race and ethnic differences in preventable hospital stays and usual source of care, the effects of residential segregation on health care utilization, and disparities in prescription drug spending for Medicare seniors. Dr. Gaskin has studied several issues concerning safety net hospitals. He has examined the effects of managed care and price competition of safety net hospitals' provision of care to Medicaid and the uninsured patients. Dr. Gaskin was awarded the Academy Health 2002 Article-of-the-Year Award for his *Health Services Research* article entitled, "Are Urban Safety-Net Hospitals Losing Low-Risk Medicaid Maternity Patients?"

Dr. Gaskin is active in professional organizations. He is a member of Academy Health, the American Economic Association, the National Economics Association (NEA), the International Health Economics Association, the American Society of Health Economists, and the American Public Health Association (APHA). Dr. Gaskin has served as a member of the Board of Directors of the NEA. He has been a member of the Governing Council of APHA and is currently Solicited Program Chair and Section Councilor for the Medical Care Section of APHA.

He has chaired the disparities program committee for Academy Health. He is a member of the Board of Directors for the Maryland Citizen's Health Initiative. He earned his Ph.D. in health economics at The Johns Hopkins University a master's degree in economics from the Massachusetts Institute of Technology and a bachelor's degree in economics from Brandeis University.

Robert C. Gates, M.P.A., began his career in the County of Los Angeles Chief Administrative Office, where he was the principal budget analyst for the public health, hospital, and mental health departments. He left Los Angeles to become Chief Operating Officer for the University of California, Irvine, Medical Center in Orange County. While in Orange County he was instrumental in creating their paramedic system.

Mr. Gates then returned to Los Angeles County and spent 6 years as the Chief Deputy Director of the Department of Health Services, guiding the creation of the Los Angeles County Trauma Center system. Mr. Gates was then appointed Director of Health Services for Los Angeles County and served in that capacity for over 11 years. Mr. Gates is currently serving as Medical Services for Indigents Project Director for the Orange County Health Care Agency.

Marianne Gausche-Hill, M.D., F.A.C.E.P., F.A.A.P., serves as professor of Clinical medicine at the David Geffen School of Medicine at the University of California, Los Angeles (UCLA). She is the Director of Emergency Medical Services (EMS) and EMS Fellowship and Director of Pediatric Emergency Medicine Fellowship at Harbor-UCLA Medical Center. Dr. Gausche-Hill also serves as Director of Pediatric Emergency Medicine at the Little Company of Mary Hospital in Torrance, CA. Board certified in both emergency medicine and pediatric emergency medicine, she earned her medical degree and completed her residency at UCLA. Dr. Gausche-Hill is the first emergency physician in the United States to have completed a pediatric emergency fellowship and passed the sub-Board examination.

Dr. Gausche-Hill has done extensive research on prehospital pediatric care, authoring *Pediatric Advanced Life Support: pearls of Wisdom* in 2001 and *Pediatric Airway Management for the Prehospital Professional* early in 2004. Her research and methodology that tracked the results of use of wind-pipe tube method versus the traditional bag-and-pump method as oxygen treatment for pediatric emergencies were published in the Journal of the American Medical Association (JAMA) and in Annals of Emergency Medicine. In May 1999, her work earned the prestigious "Best Clinical Science presentation" from the Society for Academic Emergency medicine (SAEM).

John D. Halamka, M.D., M.S., is Chief Information Officer of the CareGroup Health System, Chief Information Officer and Associate Dean for Educational Technology at Harvard Medical School, Chairman of the New England Health Electronic Data Interchange Network (NEHEN), Acting CEO of MA-Share, Chief Information Officer of the Harvard Clinical Research Institute and a practicing Emergency Physician.

As Chief Information Officer at CareGroup, he is responsible for all clinical, financial, administrative and academic information technology serving 3000 doctors, 12000 employees and one million patients. As Chief Information Officer and Associate Dean for Educational

Technology at Harvard Medical School, he oversees all educational, research and administrative computing for 18000 faculty and 3000 students. As Chairman of NEHEN he oversees the administrative data exchange in Massachusetts. As CEO of MA-Share he oversees the clinical data exchange efforts in Massachusetts. Chair of HITSP he coordinates the process of electronic standards harmonization among all the stakeholders nationwide.

Mary M. Jagim, R.N., B.S.N., C.E.N., FAEN, is an experienced emergency/trauma nurse with extensive leadership background in program development and implementation, emergency department management and nursing workforce issues, Emergency Preparedness, government affairs, and community based injury prevention. She is currently the Internal Consultant for Emergency Preparedness and Pandemic Planning for MeritCare Health System in Fargo, North Dakota. Well versed in current issues affecting emergency/trauma nursing and emergency care, Jagim has served on the Emergency Nurses Association Board of Directors and as national President in 2001. Jagim currently serves chair of the Emergency Nurses Association Foundation, is a member of the faculty for Key Concepts in Emergency Department Management and is a Fellow in the Academy of Emergency Nursing. Jagim also served on the Centers for Disease Control and Prevention (CDC) National Strategies for Advancing Child Pedestrian Safety Panel to Prevent Pedestrian Injuries and currently is Co-Chair for Advocates for Highway and Auto Safety. Jagim received her B.S.N. from the University of North Dakota in 1984.

Arthur L. Kellermann, M.D., M.P.H., is Professor and Chairman of the Department of Emergency Medicine at the Emory University School of Medicine, and Director of the Center for Injury Control at the Rollins School of Public Health of Emory University. His primary research focus is injury prevention and injury control. He has also conducted landmark research on prehospital cardiac care, use of diagnostic technology in emergency departments, and health care for the poor. His papers have been published in many of the nation's leading medical journals. He is a recipient of the Hal Jayne Academic Excellence Award from the Society for Academic Emergency Medicine, the Excellence in Science award from the Injury Control and Emergency Health Services Section of the American Public Health Association and the Scholar/Teacher Award from Emory University. A member of the Institute of Medicine (IOM), Dr. Kellermann served as Co-Chair of the IOM's Committee on the Consequences of Uninsurance from 2001-2004.

William N. Kelley, M.D., currently serves as Professor of Medicine, Biochemistry and Biophysics at the University of Pennsylvania School of Medicine. Previously, he served as Chief Executive Officer of the University of Pennsylvania Medical Center and Health System and Dean of the School of Medicine from 1989 to February 2000. At the University of Pennsylvania, Dr. Kelley led the development of one of the first academic, fully integrated, delivery systems in the nation. He also built and implemented the largest Health and Disease Management program in the country, with over 500 physicians and staff and 60 separate clinical sites engaged in implementing the program. Dr. Kelley also holds a patent in a frequently used gene transfer technique that has allowed for numerous advances in the application of gene therapy.

Dr. Kelley received his M.D. from Emory University School of Medicine and completed his residency in Internal Medicine at Parkland Memorial Hospital in Dallas. After a fellowship with

the National Institutes of Health and a teaching fellowship at Harvard Medical School, he began his academic career as an assistant professor of Medicine at Duke University School of Medicine, moving on to head Duke's Division of Rheumatic and Genetic Diseases, before becoming chair of Internal Medicine at the University of Michigan Medical School.

Jane F. Knapp, M.D., F.A.A.P., F.A.C.E.P., a native of Kansas City, Missouri, is professor of pediatrics at the Children's Mercy Hospital University of Missouri-Kansas City School of Medicine. She graduated from the University of Missouri-Columbia School of Medicine in 1978 and completed a residency in pediatrics and fellowship in pediatric emergency medicine at Children's Mercy Hospital. Dr. Knapp was one of the first two physicians to complete a two year fellowship in pediatric emergency medicine in the United States. Following her fellowship, Dr. Knapp served as the Director of Emergency Services at Children's Mercy Hospital for 17 years. In 2005, Dr. Knapp became the Vice Chair of Graduate Medical Education for the Department of Pediatrics at Children's Mercy Hospital

Dr. Knapp is a recognized national leader and expert in the emergency care of children. Her past national, state, and local responsibilities include Chair of the Section of Emergency Medicine of the American Academy of Pediatrics, Chair of the Committee on Pediatric Emergency Medicine of the American Academy of Pediatrics, member and Chair of the Pediatric Emergency Medicine Sub-board of the American Board of Pediatrics, Chair of the Missouri Injury Control Advisory Committee, member of the Missouri Task Force on Fatal Child Abuse, and President of the Medical Staff of the Children's Mercy Hospital.

In 1996, she was awarded the Missouri Health Care Communicator of the year award. Dr. Knapp was also the year 2000 recipient of the Citation of Merit, the highest award given by the University of Missouri-Columbia School of Medicine Alumni Association. In January 2001, Dr. Knapp was recognized through a City Council Resolution by the Mayor and City Council of Kansas City for her devotion to the children of Kansas City. She is also the 2002 recipient of the AAP Pediatric Emergency Medicine Distinguished Service Award. In 2005, Dr Knapp was named as one of Kansas City's top doctors by Ingram's Magazine.

Peter M. Layde, M.D., M.Sc., is Professor and Interim Director of the Health Policy Institute at the Medical College of Wisconsin. Dr. Layde has been an epidemiologist for over 25 years and an active injury control researcher for over 20 years. He has published extensively on agricultural injuries and methods for injury epidemiology, including early work on use of case-control studies for homicide and on the epidemiological representativeness of trauma center-based studies. He has been an ad-hoc reviewer for the injury Grant Review Committee for over 10 years and served as a member of that committee from 1997-2000. Dr. Layde serves as Co-Director of the Injury Research Center at the Medical College of Wisconsin and as Director of its Research Development and Support Core. He is also Principal Investigator on the Risk Factors for Medical Injury research project.

Eugene Litvak, Ph.D., is a co-founder and director of the *Program for the Management of Variability in Health Care Delivery* at the Boston University Health Policy Institute. He is also a Professor at the Boston University School of Management. He received his doctorate in Operations Research from the Moscow Institute of Physics and Technology in 1977. Prior to

joining Boston University he was a faculty member at the Harvard Center for Risk Analysis in the Department of Health Policy & Management at the Harvard School of Public Health (HSPH). He still teaches there course “Operations Management in Service Delivery Organizations” at HSPH as an Adjunct Professor of Operations Management. Dr. Litvak arrived in the U.S. in 1988, and joined HSPH in 1990. Prior to that time he was a chief of the Operations Management Group at the Computing Center in Kiev, Ukraine. His research interests include operations management in health care delivery organizations, cost-effective medical decision-making, screening for HIV and other infectious diseases, and operations research. Professor Litvak is an author of more than 60 publications in these areas. He was the leading author of the new cost-effective protocols in screening for HIV and hepatitis, which reduce the cost of screening by a factor of 5 to 10 while simultaneously reducing errors by a factor of 20 to 40. These protocols have been positively evaluated by FDA, NIH and CDC, and currently are the subject of a large-scale international trial supported by the U.S. Agency for International Development. Dr. Litvak serves as a Principal Investigator from the U.S. for this trial. Since 1995 he leads the development and practical applications of innovative variability methodology for cost reduction and quality improvement in health care delivery systems. Professor Litvak was the Principal Investigator in the “Emergency Room Diversion Study” supported by the grant from the Massachusetts Department of Public Health. He is also Principal Investigator in many research and hospital operations improvement studies. Dr. Litvak frequently presents as an invited lecturer at the multiple national and international meetings. He also serves as a consultant on operations improvement to several major hospitals and is a faculty of the Institute for Health Care Improvement.

Thomas R. Loyacono, M.P.A., NREMT-P, is the Chief Operations Officer at the Emergency Medical Services (EMS) Department in Baton Rouge, Louisiana. A Nationally Registered Emergency Medical Technician-Paramedic with 32 years of experience in prehospital EMS, his experience includes more than 20 years as a patient care provider and 15 years in EMS management.

Mr. Loyacono completed his EMS education at the University of South Alabama in 1978, his undergraduate degree Summa Cum Laude from the University of Alabama in 1992, and his Master of Public Administration degree from Southern University in 1998. He has extensive training in emergency management, and has been recognized as a Certified Emergency Manager by the International Association of Emergency Managers.

Mr. Loyacono’s professional affiliation includes chairing the National Association of Emergency Medical Technicians’ Pediatrics Committee, membership on the Louisiana Governor’s Emergency Medical Services for Children Advisory Council, and membership on the Board of Directors of the National Registry of Emergency Medical Technicians. Through these affiliations, he is active on numerous local, state, and national EMS committees and panels.

Milap C. Nahata, M.S., Pharm.D., is the Professor of Pharmacy and Chairman of the Division of Pharmacy Practice and Administration at the Ohio State University College of Pharmacy. He is also a professor of pediatrics and internal medicine at the Ohio State University College of Medicine and Children’s Hospital of Columbus. Dr. Nahata earned his master of science and doctor of pharmacy degrees from the Duquesne University School of Pharmacy. He has served

as president of the American College of Clinical Pharmacy and the American Association of Colleges of Pharmacy.

Dr. Nahata is nationally and internationally recognized for his clinical practice and research endeavors in pediatric pharmacotherapy. His research specialties include the efficacy and safety of various drug therapies in pediatric patients, pharmacokinetics/pharmacodynamics of drugs in pediatric patients, and health outcomes and quality of life studies in children and adolescents on pharmacotherapy. His research also focuses on the development of stable and palatable dosage forms of drugs for pediatric patients and has studied the dosage forms of nearly 50 orally and intravenously administered drugs in children. He has published 2 books and over 450 refereed articles in 50 journals. He is Editor-in-Chief of *The Annals of Pharmacotherapy*, and on the editorial boards of four journals. Dr. Nahata received the Pharmacist of the Year Award from the Ohio Society of Health-System Pharmacists, Distinguished Educator Award from the American Association of Colleges of Pharmacy, and the Award for Achievement for Sustained Contributions to the Literature of Health-System Pharmacy from the American Society of Health-System Pharmacists. He is an elected fellow of six national societies and has received five national research awards.

Richard A. Orr, M.D., serves as Professor at the University of Pittsburgh School of Medicine, Associate Director of the Cardiac Intensive Care Unit at the Children's Hospital of Pittsburgh, and Medical Director of the Children's Hospital Transport Team of Pittsburgh, Pennsylvania. Dr. Orr has devoted much of his career to interfacility transportation problems of infants and children in need of tertiary care. He is a member of many professional organizations and societies and has authored numerous articles regarding the safe and effective air and surface transport of the critically ill and injured pediatric patient. Dr. Orr is also a noted lecturer to the air and ground transport community, both nationally and internationally.

Dr. Orr is editor of *Pediatric Transport Medicine*, a unique 700 page book published in 1995. He is the 2001 recipient of the Air Medical Physician Association (AMPA) Distinguished Physician Award and a founding member of the AMPA.

Jerry L. Overton, M.A., serves as the Executive Director, Richmond Ambulance Authority (RAA), Richmond, Virginia, and has overall responsibility for the Richmond Emergency Medical Services system. His duties extend to planning and administering the high performance system design, negotiating and implementing performance based contracts, maximizing fee for service revenues, development of advanced patient care protocols, and employing innovative equipment and treatment modalities. Mr. Overton was previously the Executive Director of the Kansas City, Missouri, EMS system. In addition, he has provided technical assistance to EMS systems throughout the United States and to Europe, Russia, Asia, Australia, and Canada. He designed an implementation plan for an Emergency Medical Transport program in Central Bosnia – Hercegovina. Mr. Overton is a faculty member of the Emergency Medical Department of the Medical College of Virginia, Virginia Commonwealth University, and the National EMS Medical Directors Course, National Association of EMS Physicians. He is the Past President of the American Ambulance Association and is on the Board of Directors of the North American Association of Public Utility Models.

John E. Prescott, M.D., is Dean of the West Virginia University (WVU) School of Medicine, and received both his B.S. and M.D. degrees at Georgetown University. He completed his residency training in Emergency Medicine at Brooke Army Medical Center, San Antonio and was then assigned to Fort Bragg, NC, where he was actively engaged in providing both operational and hospital emergency care in a variety of challenging situations. In 1990 he joined WVU and soon assumed leadership of the Section of Emergency Medicine. During that same year, Dr. Prescott founded and became the first Director of WVU's Center for Rural Emergency Medicine. In 1993 he became the first Chair of WVU's newly established Department of Emergency Medicine. As past recipient of major CDC and private foundation grants, Dr. Prescott's research and scholarly interests include: rural emergency care; injury control and prevention; medical response to disasters and terrorism; and academic and administrative medicine.

In 1999, Dr. Prescott became WVU's Associate Dean for the Clinical Enterprise and President/CEO of UHA, WVU's physician practice plan. In 2003 he was named Senior Associate Dean and was appointed Dean of the WVU School of Medicine in 2004. He has been a Fellow of the American College of Emergency Physicians since 1987 and is the recipient of WVU's Presidential Heroism Award.

Nels D. Sanddal, M.S., REMT-B, is the President of Critical Illness and Trauma Foundation in Bozeman, Montana and is currently on detachment as the Director of the Rural Emergency Medical Services and Trauma Technical Assistance Center (REMSTTAC). Nels has been involved in EMS since the 1970s and has held many state, regional, and national positions in organizations furthering EMS causes, including president of the Intermountain Regional EMS for Children Coordinating Council and core faculty for the Development of Trauma Systems Training Programs for the U.S. Department of Transportation. Nels is a Nationally Registered Emergency Medical Technician-Basic, volunteers with a local fire department, and has been involved with the CIT Foundation since its inception in 1986. He holds a M.S. in psychology and is currently pursuing a Ph.D. in health services.

C. William Schwab, M.D., F.A.C.S., is Professor of Surgery and Chief of the Division of Traumatology and Surgical Critical Care at the University of Pennsylvania. Dr. Schwab's surgical practice reflects expertise in trauma systems, caring for the severely injured patient and incorporating the most advanced techniques into trauma surgery. He is the Director of the Firearm & Injury Center at Penn (FICAP) and holds several grants supporting work on reducing firearm and non-firearm injuries and other repercussions. He has served as a trauma systems consultant to the CDC, New York State and several state health departments. He has established trauma centers and hospital-based aeromedical programs in Virginia, New Jersey and Pennsylvania. He currently directs a network of three regional trauma centers throughout southeastern Pennsylvania. He has been the president of EAST, Vice Chairman of the American College of Surgeons Committee on Trauma and currently serves as the President of the American Association for the Surgery of Trauma.

Mark D. Smith, M.D., M.B.A., has led the California HealthCare Foundation in developing research and initiatives aimed at improving California's health care financing and delivery systems since its formation in 1996. Prior to joining the California Healthcare Foundation, he

was Executive Vice President at the Henry J. Kaiser Family Foundation and served as Associate Director of the AIDS Service and Assistant Professor of Medicine and Health Policy and Management at Johns Hopkins University. Dr. Smith is a member of the Institute of Medicine and is on the board of the National Business Group on Health. Previously, he served on the Performance Measurement Committee of the National Committee for Quality Assurance and the editorial board of the *Annals of Internal Medicine*. A board certified internist, Dr. Smith is a member of the clinical faculty at the University of California, San Francisco, and an attending physician at the AIDS clinic at San Francisco General Hospital.

Donna Ojanen Thomas, R.N., M.S.N., earned her M.S.N. in Parent-Child Nursing from the University of Utah. She currently serves as Emergency Department Director and Rapid Treatment Unit Director at Primary Children's Medical Center in Salt Lake City, Utah. She previously served as Clinical Specialist, responsible for education and orientation of all emergency department employees.

A member of the Emergency Nurses Association (ENA) and one of the original authors of the Emergency Nursing Pediatric Course, Thomas received the ENA Lifetime Achievement Award in 2002. She has also published extensively in *RN Journal* and *Journal of Emergency Nursing*. Thomas was co-editor of *Core Curriculum for Pediatric Emergency Nursing*, which won the 2002 American Journal of Nursing Book of the Year Award.

Appendix C
 Recommendations and Responsible Entities
 from the *Future of Emergency Care Series*

HOSPITAL-BASED EMERGENCY CARE: AT THE BREAKING POINT

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
Chapter 2: The Evolving Role of Hospital-Based Emergency Care											
2.1 Congress should establish dedicated funding, separate from DSH payments, to reimburse hospitals that provide significant amounts of uncompensated emergency and trauma care for the financial losses incurred by providing those services.											
<ul style="list-style-type: none"> • Congress should initially appropriate \$50 million for the purpose, to be administered by the Centers for Medicare and Medicaid Services. • CMS should establish a working group to determine the allocation of these funds, which should be targeted to providers and localities at greatest risk; the working group should then determine funding needs for subsequent years 	X	X									
Chapter 3: Building a 21st-Century Emergency Care System											
3.1 The Department of Health and Human Services and the National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with		X	X							X	

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	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
multidisciplinary expertise to develop an evidence-based categorization system for EMS, EDs, and trauma centers based on adult and pediatric service capabilities.											
3.2 The National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop evidence-based model prehospital care protocols for the treatment, triage, and transport of patients.			X							X	
3.3 The Department of Health and Human Services should convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency care system performance.		X									
3.4 The Department of Health and Human Services should adopt regulatory changes to the Emergency Medical Treatment and Active Labor Act (EMTALA) and the Health Insurance Portability and Accountability Act (HIPAA) so that the original goals of the laws are preserved but integrated systems may further develop.		X									
3.5 Congress should establish a demonstration program, administered by the Health Resources and Services Administration, to promote regionalized, coordinated, and accountable emergency care systems throughout the country, and appropriate \$88 million over 5 years to this program.	X	X									
3.6 Congress should establish a lead agency for emergency and trauma care within 2 years of the publication of this report. The lead agency should be housed in the Department of Health and Human Services, and should have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and	X	X									

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
trauma care, and medical-related disaster preparedness. Congress should establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency and trauma care.											
Chapter 4: Improving the Efficiency of Hospital-Based Emergency Care											
4.1 Hospital chief executive officers should adopt enterprise-wide operations management and related strategies to improve the quality and efficiency of emergency care.							X				
4.2 The Centers for Medicare and Medicaid Services should remove the current restrictions on the medical conditions that are eligible for separate clinical decision unit (CDU) payment.		X									
4.3 Training in operations management and related approaches should be promoted by professional associations; accrediting organizations, such as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the National Committee for Quality Assurance (NCQA); and educational institutions that provide training in clinical, health care management, and public health disciplines.										X	X
4.4 The Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) should reinstate strong standards that sharply reduce and ultimately eliminate ED crowding, boarding, and diversion.											X
4.5 Hospitals should end the practices of boarding patients in the ED and ambulance diversion, except in the most extreme cases, such as a community mass casualty event. The Centers for Medicare and Medicaid Services should convene a working group that includes experts in emergency care, inpatient critical care, hospital operations management, nursing and other relevant disciplines to develop		X					X				

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
boarding and diversion standards, as well as guidelines, measures, and incentives for implementation, monitoring, and enforcement of these standards.											
Chapter 5: Technology and Communication											
5.1 Hospitals should adopt robust information and communications systems to improve the safety and quality of emergency care and enhance hospital efficiency.							X				
Chapter 6: The Emergency Care Workforce											
6.1 Hospitals, physician organizations, and public health agencies should collaborate to regionalize critical specialty care on-call services.							X			X	X
6.2 Congress should appoint a commission to examine the factors responsible for the declining availability of providers in high-risk emergency and trauma care specialties, including the role played by medical malpractice liability in specific, and to recommend targeted state and federal actions to mitigate the adverse impact of the responsible factors and ensure quality of care.	X										
6.3 The American Board of Medical Specialties and its constituent Boards should extend eligibility for certification in critical care medicine to all acute care and primary care physicians who complete an accredited critical care fellowship program.										X	X
6.4 The Department of Health and Human Services, the Department of Transportation, and the Department of Homeland Security should jointly undertake a detailed assessment of emergency and trauma workforce capacity, trends, and future needs, and develop strategies to meet these needs in the future.		X	X	X							
6.5 The Department of Health and Human Services, in partnership with professional organizations, should develop national standards for core competencies applicable to physicians, nurses, and other key		X								X	

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
emergency and trauma professionals, using a national, evidence-based, multidisciplinary process.						X	X				
6.6 States should link rural hospitals with academic health centers to enhance opportunities for professional consultation, telemedicine, patient referral and transport, and continuing professional education.						X					
Chapter 7: Disaster Preparedness											
7.1 The Department of Homeland Security, the Department of Health and Human Services, the Department of Transportation, and the states should collaborate with the Veterans Health Administration to integrate the VHA into civilian disaster planning and management.		X	X								X
7.2 All institutions responsible for the training, continuing education, and credentialing and certification of professionals involved in emergency care (including medicine, nursing, EMS, allied health, public health, and hospital administration) incorporate disaster preparedness training into their curricula and competency criteria.						X				X	X
7.3 Congress should significantly increase total disaster preparedness funding in FY 2007 for hospital emergency preparedness in the following areas:											
<ul style="list-style-type: none"> • strengthening and sustaining trauma care systems; • enhancing ED, trauma center, and inpatient surge capacity; • improving EMS response to explosives • designing evidence-based training programs; • enhancing the availability of decontamination showers, standby ICU capacity; negative pressure rooms, and appropriate personal protective equipment; • conducting international collaborative research on the civilian consequences of conventional weapons (CW) terrorism. 	X										
Chapter 8: Enhancing the Emergency and Trauma Care Research Base											
8.1 Academic medical centers should support emergency and trauma							X				

EMERGENCY MEDICAL SERVICES AT THE CROSSROADS

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
Chapter 3: Building a 21st-Century Emergency Care System											
3.1 The Department of Health and Human Services and National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop an evidence-based categorization system for EMS, EDs, and trauma centers based on adult and pediatric service capabilities.		X	X							X	
3.2 The National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop evidence-based, model prehospital care protocols for the treatment, triage, and transport of patients.			X							X	
3.3 The Department of Health and Human Services should convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency care system performance.		X									
3.4 Congress should establish a demonstration program, administered by Health Resources and Services Administration, to promote regionalized, coordinated, and accountable emergency care systems throughout the country, and appropriate \$88 million over 5 years to this program.	X	X									
3.5 Congress should establish a lead agency for emergency and trauma care within 2 years of the publication of this report. This lead agency should be housed in the Department of Health and Human Services, and should have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both	X	X									

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. Congress should establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency and trauma care.											
3.6 The Department of Health and Human Services should adopt rule changes to the Emergency Medical Treatment and Active Labor Act (EMTALA) and the Health Insurance Portability and Accountability Act (HIPAA) so that the original goals of the laws are preserved but integrated systems may further develop.		X									
3.7 CMS should convene an ad hoc work group with expertise in emergency care, trauma, and EMS systems to evaluate the reimbursement of EMS and make recommendations regarding inclusion of readiness costs and permitting payment without transport.		X									
Chapter 4: Supporting a High Quality EMS Workforce											
4.1 State governments should adopt a common scope of practice for EMS personnel, with state licensing reciprocity.						X					
4.2 States should require national accreditation of paramedic education programs.						X					
4.3 States should accept national certification as a prerequisite for state licensure and local credentialing of EMS providers.						X					
4.4 The American Board of Emergency Medicine should create a subspecialty certification in EMS.										X	
Chapter 5: Advancing System Infrastructure											
5.1 States should assume regulatory oversight of the medical aspects of air medical services, including communications, dispatch, and transport protocols.						X					

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
5.2 Hospitals, trauma centers, EMS agencies, public safety departments, emergency management offices, and public health agencies should develop integrated and interoperable communications and data systems.							X	X			X
5.3 The Department of Health and Human Services should fully involve prehospital EMS leadership in discussions about the design, deployment, and financing of the National Health Information Infrastructure (NHII).		X									
Chapter 6: Preparing for Disasters											
6.1 The Department of Health and Human Services, the Department of Transportation, the Department of Homeland Security, and the states should elevate emergency and trauma care to a position of parity with other public safety entities in disaster planning and operations.		X	X	X		X					
6.2 Congress should substantially increase funding for EMS-related disaster preparedness through dedicated funding streams.	X										
6.3 Professional training, continuing education, and credentialing and certification programs of all the relevant EMS professional categories, should incorporate disaster preparedness training into their curricula, and require the maintenance of competency in these skills.			X			X				X	X
Chapter 7: Optimizing Prehospital Care through Research											
7.1 Federal agencies that fund emergency and trauma care research should target additional funding at prehospital EMS research, with an emphasis on systems and outcomes research.		X	X	X	X						X
7.2 Congress should modify Federalwide Assurance Program (FWA) regulations to allow the acquisition of limited, linked, patient outcome data without the existence of an FWA.	X										
7.3 The Secretary of Department of Health and Human Services should conduct a study to examine the gaps and opportunities in emergency and trauma care research, and recommend a strategy for the optimal organization and funding of the research effort. This study should	X	X	X	X	X						

<p>include consideration of: training of new investigators; development of multi-center research networks, involvement of emergency medical services researchers in the grant review and research advisory processes; and improved research coordination through a dedicated center or institute. Congress and federal agencies involved in emergency care research (including Department of Transportation, Department of Health and Human Services, Department of Homeland Security, and Department of Defense) should implement the study's recommendations.</p>	<p>Congress</p>
	<p>DHHS</p>
	<p>DOT</p>
	<p>DHS</p>
	<p>DOD</p>
	<p>States</p>
	<p>Hospitals</p>
	<p>EMS Agencies</p>
	<p>Private Industry</p>
	<p>Professional Organizations</p>
	<p>Other</p>

EMERGENCY CARE FOR CHILDREN: GROWING PAINS

	Congress	DHHS	DOT	DHS	DOD	Hospitals	EMS Agencies	Private Industry	Professional Societies	Other
Chapter 3: Building a 21st-Century Emergency Care System										
3.1 The Department of Health and Human Services and National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop an evidence-based categorization system for EMS, EDs, and trauma centers based on adult and pediatric service capabilities.		X	X						X	
3.2 The National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop evidence-based model prehospital care protocols for the treatment, triage, and transport of patients, including children			X						X	
3.3 The Department of Health and Human Services should convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency care system performance, including performance of pediatric emergency care.		X								
3.4 Congress should establish a demonstration program, administered by the Health Resources and Services Administration, to promote regionalized, coordinated, and accountable emergency care systems throughout the country, and appropriate \$88 million over 5 years to this program.	X	X								
3.5 The Department of Health and Human Services should adopt rule changes to the Emergency Medical Treatment and Active Labor Act and the Health Insurance Portability and Accountability Act so that the original goals of the laws are preserved but integrated systems may further develop.		X								
3.6 Congress should establish a lead agency for emergency and trauma care within 2 years of the publication of this report. The lead agency	X	X								

	Congress	DHHS	DOT	DHS	DOD	Hospitals	EMS Agencies	Private Industry	Professional Societies	Other
<p>should be housed in the Department of Health and Human Services, and should have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. Congress should establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency and trauma care.</p> <p>3.7 Congress should appropriate \$37.5 million each year for the next five years to the EMS-C Program.</p>	X									
Chapter 4: Arming the Emergency Care Workforce with Knowledge and Skills										
4.1 Every pediatric and emergency care-related health professional credentialing and certification body should define pediatric emergency care competencies and require practitioners to receive the appropriate level of initial and continuing education necessary to achieve and maintain those competencies.									X	
4.2 The Department of Health and Human Services should collaborate with professional organizations to convene a panel of individuals with multidisciplinary expertise to develop, evaluate, and update pediatric emergency care clinical practice guidelines and standards of care.		X							X	
4.3 EMS agencies should appoint a pediatric emergency coordinator and hospitals should appoint two pediatric emergency coordinators—one a physician—to provide pediatric leadership for the organization.						X	X			
Chapter 5: Improving the Quality of Pediatric Emergency Care										
5.1 The Department of Health and Human Services should fund studies on the efficacy, safety, and health outcomes of medications used for infants, children, and adolescents in emergency care settings in order to		X								

	Congress	DHHS	DOT	DHS	DOD	Hospitals	EMS Agencies	Private Industry	Professional Societies	Other
improve patient safety.										
5.2 The Department of Health and Human Services and the National Highway Traffic Safety Administration should fund the development of medication dosage guidelines, formulations, labeling, and administration techniques for the emergency care setting to maximize effectiveness and safety for infants, children and adolescents. EMS agencies and hospitals should implement these guidelines, formulations, and techniques into practice.		X	X			X	X			
5.3 Hospitals and EMS systems should implement evidence-based approaches to reduce errors in emergency and trauma care for children.						X	X			
5.4 Federal agencies and private industry should fund research on pediatric-specific technologies and equipment used by emergency and trauma care personnel.		X	X	X				X		
5.5 EMS agencies and hospitals should integrate family-centered care into emergency care practice.						X	X			
Chapter 6: Improving Emergency Preparedness and Response for Children Involved in Disasters										
6.1 Federal agencies (the Department of Health and Human Services, the National Highway Traffic Safety Administration, and the Department of Homeland Security) in partnership with state and regional planning bodies and emergency care provider organizations should convene a panel with multidisciplinary expertise to develop strategies for addressing pediatric needs in the event of a disaster. This effort should encompass the following: 1) Development of strategies to minimize parent-child separation and improved methods for reuniting separated children with their families. 2) Development of strategies to improve the level of pediatric expertise on Disaster Medical Assistance Teams and other organized disaster response teams. 3) Development of disaster plans that address pediatric surge capacity for both injured and non-injured children.		X	X	X						

	Congress	DHHS	DOT	DHS	DOD	Hospitals	EMS Agencies	Private Industry	Professional Societies	Other
<p>4) Development of and improved access to specific medical and mental health therapies, as well as social services, for children in the event of a disaster.</p> <p>5) Development of policies that ensure that disaster drills include a pediatric mass casualty incident at least once every 2 years.</p>										
Chapter 7: Building the Evidence Base for Pediatric Emergency Care										
<p>7.1 The Secretary of DHSS should conduct a study to examine the gaps and opportunities in emergency care research, including pediatric emergency care, and recommend a strategy for the optimal organization and funding of the research effort. This study should include consideration of training of new investigators, development of multicenter research networks, involvement of emergency and trauma care researchers in the grant review and research advisory processes, and improved research coordination through a dedicated center or institute. Congress and federal agencies involved in emergency and trauma care research (including the Department of Transportation, Department of Health and Human Services, Department of Homeland Security, and Department of Defense) should implement the study's recommendations.</p>		X	X	X	X					
<p>7.2 Administrators of statewide and national trauma registries should include standard pediatric-specific data elements and provide the data to the NTDB. Additionally, the American College of Surgeons should establish a multidisciplinary pediatric specialty committee to continuously evaluate pediatric-specific data elements for the NTDB and identify areas for pediatric research.</p>										X

Appendix D

List of Commissioned Papers

1. The Role of the Emergency Department in the Health Care Delivery System

Consultant: Eva Stahl, Brandeis University

2. Patient Safety and Quality of Care in Emergency Services

Consultant: Jim Adams, Northwestern University

3. Patient Flow in Hospital-Based Emergency Services

Consultant: Brad Prenny, Boston University, Health Policy Institute

4. Models of Organization, Delivery, and Planning for EMS and Trauma Systems

Consultant: Tasmeen Singh, Children's National Medical Center

5. Information Technology in Emergency Care

Consultant: Larry Nathanson, Harvard Medical School

6. Emergency Care in Rural America

Consultant: Janet Williams, University of Rochester

7. The Emergency Care Workforce

Consultant: Jean Moore, SUNY School of Public Health

8. The Financing of EMS and Hospital-Based Emergency Services

Consultants: Richard Lindrooth, Medical University of South Carolina
David Gray, Oregon Health and Sciences University
John McConnell, Oregon Health and Sciences University

9. The Impact New Medical Technologies on Emergency Care

Consultant: Sg2

10. Mental Health and Substance Abuse in the Emergent Care Setting

Consultant: Linda Degutis, DrPH, Yale University

11. Emergency Care Research Funding

Consultant: Roger Lewis, Harbor-UCLA Medical Center

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Appendix E

List of Presentations to the Committee

February 2–4, 2004

Overview of Emergency Care in the U.S. Health System

- Overview of the Emergency Care System
Arthur L. Kellermann (Emory University School of Medicine)
- Emergency Care Supply and Utilization
Charlotte S. Yeh (Centers for Medicare and Medicaid Services)
- Rural Issues in Emergency Care
John E. Prescott (West Virginia University)

Major Emergency Care Issue Areas

- Patient Flow and Emergency Department Crowding
Brent R. Asplin (University of Minnesota)
- Evolution of the Emergency Department (circa 2004): A Systems Perspective
Eric B. Larson (Group Health Cooperative)
- Mental Health and Substance Abuse Issues
Michael H. Allen (University of Colorado Health Sciences Center)
- Workforce Education and Training
Glenn C. Hamilton (Wright State University School of Medicine)
- Information Technology in Emergency Care
Larry A. Nathanson (Beth Israel Deaconess Medical Center)

Pre-Hospital Care, Public Health, and Emergency Preparedness

- Emergency Care and Public Health
Daniel A. Pollock (Centers for Disease Control and Prevention)
- Overview of the Issues Facing Pre-Hospital EMS
Robert R. Bass (Maryland Institute for Emergency Medical Services Systems)
- Emergency Preparedness
Joseph F. Waeckerle (University of Missouri Baptist Medical Center)

Research Agenda

- Overview of Research in Emergency Care
E. John Gallagher (Montefiore Medical Center)
- Research Needs for the Future
Robin M. Weinick (Agency for Healthcare Research and Quality)

June 9–11, 2004

Overview of the Emergency Medical Services for Children

- The EMS-C Program History and Current Challenges
Jane Ball (The EMSC National Resource Center)
- The 1993 IOM Report: Promise and Progress
Megan McHugh (IOM Staff)

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Issues in Pediatric Emergency Care

- Pediatric Equipment and Care Management
Marianne Gausche-Hill (Harbor-UCLA Medical Center)
- Special Problems in Pediatric Medication
Milap Nahata (Ohio State University Schools of Pharmacy and Medicine)
- Training and Skills Maintenance
Cynthia Wright-Johnson (Maryland Institute for EMS Systems)
- Emergency Research and Data Issues
David Jaffe (Washington University in St. Louis)

Pediatric Disaster Preparedness

- *George Foltin (New York University Bellevue Hospital Center)*

Organization & Delivery of Emergency Medical Services

- System-Wide EMS & Trauma Planning and Coordination
Stephen Hise (National Association of State EMS Directors)
- Fire Perspective on EMS
John Sinclair (International Association of Fire Chiefs)
- Trauma Systems
Alasdair Conn (Massachusetts General Hospital)
- Critical Care Transport
Richard Orr (Children's Hospital of Pittsburgh)

History and Organization of EMS in the U.S.

- EMS System Overview and History
Robert Bass (Maryland Institute for Emergency Medical Services Systems)
- Overview of Local EMS Systems
Mike Williams (Abaris Group)
- Issues Facing Rural Emergency Medical Services
Fergus Laughridge (Emergency Medical Services, Nevada State Health Division)

Prehospital EMS Issue Areas

- EMS Financing and Reimbursement
Jerry Overton (Richmond Ambulance Authority)
- EMS Quality Improvement and Patient Safety
Robert A. Swor (William Beaumont Hospital)
- Overview of the EMS Agenda for the Future
Ted Delbridge (University of Pittsburgh)
- EMS Data Needs
Greg Mears (University of North Carolina-Chapel Hill)
- Overview of Current EMS Research
Ron Maio (University of Michigan)

Agency Reaction Panel

- Health Resources and Services Administration, Maternal and Child Health Bureau
Dave Heppel (Division of Child, Adolescent, and Family Health) and/or Dan Kavanaugh (EMSC Program)
- National Highway Traffic Safety Administration
Drew Dawson (EMS Division)
- Agency for Healthcare Research and Quality
Robin Weinick (Safety Nets and Low Income Populations and Intramural Research)

- Centers for Disease Control and Prevention, National Center for Injury Prevention and Control
Rick Hunt (Division of Injury and Disability Outcomes and Programs)
- Health Resources and Services Administration, Office of Rural Health Policy
Evan Mayfield (U.S. Public Health Service and Public Health Analyst)

June 24–25, 2004

Workforce Issues in the Emergency Department

- Issues Facing the Emergency Care Nursing Workforce
Mary Jagim (MeritCare Hospital)
Carl Ray (Bon Secours DePaul Medical Center)
Kathy Robinson (Pennsylvania Department of Health)

Current Initiatives in Patient Flow

- Patient Flow Initiative Implemented at University of Utah
Jadie Barrie (University of Utah)
Pamela Proctor (University of Utah)
- Program for Management of Variability in Health Care Delivery
Eugene Litvak (Boston University Health Policy Institute)

Luncheon Speaker—Medical Technology in Emergency Medicine

- *Michael Sachs (Sg2)*

September 20–21, 2004

Prehospital EMS Issue Areas

- International EMS Systems
Jerry Overton (Richmond Ambulance Authority)
- Current Status of Federal Emergency Care Legislation and Funding
Mark Mioduski (Cornerstone Government Affairs)
- Overview of EMS Workforce Issues
John Becknell (Consultant)
- EMS System Design and Coordination
Bob Davis (USA Today)

Reimbursement and Funding of Pediatric Emergency Care Services

- Reimbursement Issues in Pediatric Emergency Care
Steven E. Krug (Northwestern University/Children's Memorial Hospital)
- Current Status of Federal Emergency Care Legislation and Funding
Mark Mioduski (Cornerstone Government Affairs)

Issues Facing Pediatric Emergency Care

- Funding of Children's Hospitals
Peter Holbrook (Children's National Medical Center)
- Survey on Pediatric Preparedness
Marianne Gausche-Hill (Harbor-UCLA Medical Center)

October 4–5, 2004

No open sessions held.

March 2–4, 2005

Public Health Perspectives

- Overview of EMS & Trauma System Issues
William Koenig (Emergency Medical Services Agency, LA County)
- The Hospital Perspective
Doug Bagley (Riverside County Regional Medical Center)
- The Safety Net and Community Providers Perspective
John Gressman (San Francisco Community Clinics Consortium)
- Mental Health & Substance Abuse
Barry Chaitin (University of California—Irvine)
- The Patient Perspective
Sandy Schuhmann-Atkins (University of California—Irvine)

On-Call Coverage Issues

- Survey of On-Call Coverage in California
Mark Langdorf (University of California—Irvine)
- Specialty Physician Perspective—Orthopaedics
Nick Halikis (Little Company of Mary Hospital)
- Specialty Physician Perspective—Neurosurgery
John Kusske (University of California—Irvine)

Issues in Rural Emergency Care

- The Family Practice Perspective
Arlene Brown (Southern New Mexico Family Medicine Residency and Family Practice Associates of Ruidoso, PC)
- Telemedicine in Rural Emergency Care
Jim Marcin (University of California—Davis)