PERSPECTIVE

Development of Emergency Medical Services

Before the advent of civilian ambulance services, the sick and injured were transported by any means available, including passerby motorists, wagons, farm machinery, delivery carts, buses, and taxicabs. Figure 190-1 depicts the early Larrey ambulance used during the Napoleonic Wars, the Rucker wagon used during the American Civil War, and a modern ambulance used today. In 1865, the Commercial Hospital in Cincinnati established the first hospital-based ambulance service. Four years later, the first city service began at New York’s Bellevue Hospital.1

In 1965, the President's Commission on Highway Safety recommended a National Accident Response Program to decrease death and injury from highway accidents.2 Results from a second national survey by the National Academy of Sciences–National Research Council were used to draft a white paper entitled Accidental Death and Disability: The Neglected Disease of Modern Society.3 Published in 1966, this document described the hazardous conditions of emergency care provision at all levels and outlined the necessary building blocks for future maturation of emergency medical services (EMS). These national efforts were the impetus for congressional legislation that directed the U.S. Department of Transportation (DOT)–National Highway Traffic Safety Administration (NHTSA) to develop a program for improving emergency medical care.

During the mid-1960s, out-of-hospital cardiac care included field defibrillation programs in Belfast, Northern Ireland, and cardiac arrest research in several U.S. cities.4,5 In 1969, the first National Conference on EMS convened, resulting in the development of a curriculum, certification process, and national registry for the emergency medical technician–ambulance (EMT-A). By 1972, the U.S. Department of Labor recognized the EMT as an occupational specialty.6 Interested physicians and nurses later provided advanced educational courses and practical experiences for the EMTs, and thus began the paramedic providers.7,8

Additional programs prompted Congressional passage of the EMS Systems Act of 1973 (P.L. 93-154), which authorized funding that dramatically improved the development of comprehensive regional EMS delivery systems. Efforts to improve pediatric emergency care occurred in 1984 when Congress adopted the Emergency Medical Services for Children (EMS-C) initiative through the Health Services, Preventive Health Services, and Home Community Based Services Act of 1984 (P.L. 98-555).9 An Institute of Medicine (IOM) study, released in 1994, promoted the integration of EMS-C not just into existing EMS systems but into comprehensive systems of care provision, including injury prevention, primary and definitive care, and rehabilitation services.10

In 1996, the NHTSA published Emergency Medical Services Agenda for the Future, which broadly outlined the principles required for future EMS development.11 All components of an EMS system, both operational and clinical, were identified and discussed. This document has been used by many individuals and organizations as valuable reference material for planning, administration, and forecasting of the future of EMS delivery. More than 40 years since publishing the 1966 white paper, the IOM released a report on the status of emergency care entitled The Future of Emergency Care in United States Health System. The report focused on three separate yet related topics: (1) emergency care: at the breaking point, (2) emergency medical services at the crossroads, and (3) emergency care for children: growing pains.12-14

A major focus included the need to strengthen the integration of EMS into the entire health care system because lack of such coordination often results in patients being diverted from overcrowded or inappropriate or distant facilities. The recommendation was to ensure that the delivery of emergency medical and trauma care is organized into a coordinated, regional system such that patients receive care at the most appropriate facility on the basis of their injury or illness. Additional recommendations targeting EMS improvement included national accreditation for paramedic educational programs, adoption of a national certification system for individual state licensure, and recognition of common levels of EMS certification across the United States.

The concern for inadequate funding for EMS systems operations and disaster response was also addressed. Recommendations included development by Congress of regionally funded, multiyear demonstration projects that encourage states to identify and to test strategies for creation of seamless systems of care, workforce strengthening, evidence-based practices, and disaster preparedness. It was further recommended that an advisory committee be created to work with the Centers for Medicare and Medicaid Services to improve reimbursement and policies related to reimbursement.

Finally, a small yet significant proportion of EMS transports involve the pediatric population; thus it is often difficult for prehospital providers to maintain the knowledge and skills necessary to care for critically ill or injured children. Many plans, including disaster preparedness, often neglect children. As such, the IOM report recommended several items, the most important of which is that the care of children be integrated into the overall EMS system and not separated from that of adults, with pediatric emergency care competencies being defined and training enhanced to maintain those competencies. Because it is difficult to ascertain whether systems have targeted the pediatric population, the IOM
Emergency Medical Service Systems

Multiple EMS system designs exist, all predicated on the type of community served. Whereas this is a local decision, all states incorporate an administrative office that governs or oversees the provision of EMS activities. Typically the role is not to direct any individual service but to assist in planning, licensing services, and establishing or enforcing the scope and standards for practice. Other functions may include training, examining, certifying, and recertifying providers; record keeping; data collection; and auditing or investigating programs. A description of systems for the 200 most populous cities in the United States is periodically published in the Journal of Emergency Medical Services. For simplicity, the following categorization of systems is used: private and public agencies; basic life support (BLS) and advanced life support (ALS) services; and single-tiered, multitiered, and first responder systems.

Private and Public Agencies

Where local government has not assumed primary responsibility for EMS services, communities may depend on private providers. Financial responsibility varies but usually depends on federal reimbursement (Medicare or Medicaid) and user fees. A local government subsidy may or may not supplement the operation. If multiple providers are serving one jurisdiction, calls may be allocated by rotation or specified zone coverage. Dispatching varies by the system but may be by the provider or by a central agency. Medical direction is often provided by a contracted physician or physician oversight board.

Hospital-based EMS systems are few in number and may be managed by a single hospital or hospital corporation. Not all hospital-based EMS programs are considered private, in that the hospital may be a division under local or state government or operating under a public authority. As in private models, financial responsibility is usually in the form of user fees, with or without additional subsidy. Dispatching may be provided by a local public safety agency that may also be responsible for police and fire communications. An emergency physician from a sponsor or base hospital typically provides medical direction for these systems.

A public utility model is a hybrid between private and public design that allows local government to contract with a private or public provider. The successful bidder for service becomes a contracted entity that agrees to provide the specified services (ALS, BLS, or both) to the catchment area and, depending on the arrangement, may bill the patient directly or receive uniform reimbursement. Depending on local structure and interagency agreement, dispatching may be performed by an existing public safety organization or by the parent company. Medical direction is usually a specified individual subject to contractual terms.

When government officials were faced with planning and establishment of EMS systems during the early maturation periods, many decided that the fire department was the logical choice to incorporate EMS. Fire stations were strategically located throughout the community, and personnel were already used to providing emergency response. Firefighters could be cross-trained as a firefighter-paramedic or dedicated to either fire or EMS function with the opportunity for transfer. Public EMS systems that were not incorporated into fire departments evolved into their own separate entity, referred to as a municipal third-service system. Such agencies are operated by local municipalities and are endorsed and supported by local government. Many cities have been successful in combining police, fire, and EMS under a global public safety agency, with all department heads or chiefs reporting to one manager or administrator. Financially, public EMS systems may be supported by a tax base, which may or may not be supplemented by user fees. Regardless of design, medical oversight for a

Further recommended that a pediatric coordinator be included in all EMS systems to advocate for ensuring that equipment, medications, training, and protocols are appropriate for children.

Each of the three IOM reports supported the development by the federal government of national standards for emergency care performance indicators and evaluation and protocols for triage, treatment, and transport of patients. To accomplish this objective, a lead federal agency should be identified. Debate exists as to whether EMS at a national level should remain under the NHTSA or reside in other applicable agencies. Regardless, the parent organization should ensure that research is supported to improve the knowledge base and evidence for the practice of out-of-hospital medical care.
municipal EMS system may be provided by a physician appointed and contracted by a local hospital, an advisory council, or a medical oversight board.

**Basic Life Support and Advanced Life Support Service**

BLS describes the provision of emergency care without the use of advanced therapeutic interventions. Skills include airway management (oral and nasal airways, bag-mask ventilation), cardiopulmonary resuscitation (CPR), hemorrhage control, fracture and spine immobilization, and childbirth assistance. Defibrillation with an automated external defibrillator (AED) is often included by many BLS systems. Services are provided by certified or medical first responders or emergency medical technicians (EMTs) certified at the basic level (EMT-B).

BLS systems may be associated with poor survival rates from out-of-hospital cardiac arrest, especially those not incorporating AED technology. Alternatively, there is debate on the effectiveness of ALS for medical and traumatic emergencies. Despite this evidence, few urban communities across the United States operate solely at the BLS level. Many rural and some suburban EMS services rely on volunteers who may not wish to become advanced-level providers. Because these services may have low call volumes, it becomes more difficult for personnel to maintain advanced skills and a proficient knowledge base. Also, such communities may not have access to medical supervision or hospital sponsorship for ALS care.

Systems categorized as ALS offer a more comprehensive level of service by highly educated providers, usually certified at the intermediate or paramedic level (EMT-I or EMT-P, respectively) or equivalent levels, depending on individual state certifications. Provider skills include advanced airway interventions, intravenous line placement, medication administration, cardiac monitoring and manual defibrillation, and certain invasive procedures. Most EMS systems in urban cities operate at the ALS level of care.

The number of EMT-Ps in any jurisdiction has come under scrutiny, in that cities with more paramedics per capita tend to have lower survival rates. Although this may seem implausible, one explanation might be that the number of patient encounters per paramedic decreases and the sharpness of skills degrades when that community is saturated with paramedics.

**Single-Tiered, Multitiered, and First Responder Systems**

In a single-tiered system, every response regardless of the call type receives the same level of personnel expertise and equipment allocation (all BLS or ALS). Multiple-tiered systems use a combination of ALS and BLS levels, depending on the nature of the call. Differences in cost and effectiveness between a mixed ALS-BLS service and an all-ALS service have been debated. A single-tiered ALS response may prove to be cost-effective in specific locales, ensures the capability of providing a consistent advanced level of care to all patients regardless of illness or injury severity, and obviates the potential for undertriage or overtriage by 9-1-1 telecommunicators. Alternatively, a multitiered system may meet the needs of individual communities or agency infrastructure. This design often meets with employee satisfaction and has the potential to preserve ALS resources for higher priority calls in that BLS transport of nonurgent patients allows ALS ambulances to be available for potential critical responses.

Regardless of single- or multiple-tier design, EMS systems usually include first responder services as part of their structure. The first responder, usually a police officer or firefighter, is the nontransport BLS or ALS provider who responds to the scene of an emergency to provide initial care before definitive medical care and transportation assets arrive. The first responder quickly assesses the situation and patients, determines whether additional resources are required, initiates patient care, and provides advance information to responding personnel.

The design of an EMS system is targeted toward providing quality patient care in the briefest time after unexpected injury or illness. A desirable and cost-effective design might include BLS nontransport first responders with short response times (average 2-4 minutes), having the capability of providing early defibrillation and airway support, coupled with ensuing ALS care and transport services.

**Levels of Provider and Scope of Practice**

At the federal level, the NHTSA is responsible for development of the education standards and scope of practice for the different certification levels. The National EMS Education Agenda and the National EMS Scope of Practice Model now define the curriculum, education content, and core competencies for each level of provider. Individual state legislation is responsible for provider levels recognized, initial and continuing medical education requirements at each level, testing, and time intervals for course completion and recertification. The following sections outline the new suggested levels of provider and incorporated skills. Suggested hours of training are listed in Table 190-1.

**Emergency Medical Responder**

The emergency medical responder, formerly referred to as first responder, is typically the first to arrive on the scene of an incident. Initial scene and patient assessment along with limited lifesaving interventions is the primary function. Along with CPR and basic airway management skills, the emergency medical responder should be able to control hemorrhage and initiate spinal immobilization.

The four elements referred to as the chain of survival by the American Heart Association, which decrease mortality from out-of-hospital cardiac arrest, are early access to care, CPR, defibrillation, and advanced airway management and medications. Because early defibrillation may improve the odds of survival of out-of-hospital cardiac arrest, the use of an AED should be a mandatory procedure for the emergency medical responder.

**Emergency Medical Technician**

The EMT, formerly referred to as the EMT-Basic, is the minimum level required to staff a BLS ambulance and is commonly used for nonemergency and convalescent transport services. In addition to the skills of the first responder, the EMT is also involved with triage, more detailed patient assessment, and transportation. Like first responders, EMTs should have the capability of providing early defibrillation.

In 1995, the NHTSA released the revised EMT curriculum to include 46 lessons, each with cognitive, effective, and psychomotor objectives. Many states expanded the course to include more skills, such as AED use, epinephrine autoinjections, albuterol administration by hand-held nebulizer or metered-dose inhaler, and use of adjunctive airway devices such as the extraglototic airway.

**Advanced Emergency Medical Technician**

The advanced emergency medical technician (AEMT), formerly referred to as the EMT-Intermediate, was established to allow a more comprehensive approach to care when paramedic services are unavailable or unobtainable. Many states recognize the AEMT certification, but others designate alternative but comparable
Accreditation of Allied Health Education Programs.

Standards document recommends that all paramedic education advanced from 1-year certificate curriculums to 2-year associate career options, many paramedic educational programs have and to administer limited medications. AEMT to establish an intravenous line, to manually defibrillate, AEMT varies across the United States. Most systems allow the use of various medications and practices included that allow programs to incorporate an expanded scope of practice. With the expansion of EMS technology and management career options, many paramedic educational programs have advanced from 1-year certificate curriculums to 2-year associate or 4-year baccalaureate degrees. The National EMS Education Standards document recommends that all paramedic education programs be accredited in the future by the Commission on Accreditation of Allied Health Education Programs.

Emergency Medical Technician–Paramedic

The EMT-P is the most advanced provider. Paramedics have the capability to address most prehospital emergencies. The scope of practice includes a wide variety of therapeutics and procedures including cardiac rhythm recognition, expanded pharmacologic treatments, and advanced airway interventions. Other important invasive procedures include needle decompression of a tension pneumothorax, needle or surgical cricothyrotomy, and transthoracic cardiac pacing.

The initial training course for the EMT-P includes didactic, clinical, and field education. All course content focuses on technical and professional competencies. Additional modules are included that allow programs to incorporate an expanded scope of practice. With the expansion of EMS technology and management career options, many paramedic educational programs have advanced from 1-year certificate curriculums to 2-year associate or 4-year baccalaureate degrees. The National EMS Education Standards document recommends that all paramedic education programs be accredited in the future by the Commission on Accreditation of Allied Health Education Programs.

Material Resources

Before the mid-1960s, few if any regulations governed system design, operations, and equipment. As EMS development progressed, guidelines for emergency vehicle specifications were adopted by the DOT and equipment lists were proposed. Today, collaborative efforts from multiple professional medical colleges and organizations continue to publish documents that recommend design, equipment, and medications for ambulances.

Medications

During the 1980s, many believed that prehospital drug administration was unjustified and simply delayed hospital transport. Moreover, although there was a profound paucity of outcomes-based research into the use of various medications and practices.

<table>
<thead>
<tr>
<th>PROVIDER LEVEL</th>
<th>DOT RECOMMENDED HOURS OF TRAINING</th>
<th>SKILL SET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency medical responder</td>
<td>Initial: 48-60 didactic and laboratory hours</td>
<td>Initial scene and patient assessment and stabilization, Basic airway skills, CPR, Control hemorrhage, Spinal immobilization</td>
</tr>
<tr>
<td>EMT</td>
<td>Initial: 150-190 hours that include didactic, laboratory, clinical, and field experience</td>
<td>First responder skills plus: Triage and detailed patient assessment, AED, May assist in some systems: use of epinephrine autoinjectors for anaphylaxis; albuterol for wheezing</td>
</tr>
<tr>
<td>Advanced EMT</td>
<td>Initial: 150-250 hours that include didactic, laboratory, clinical, and field experience</td>
<td>EMT-Basic skills plus: Endotracheal intubation, Manual defibrillation, Intravenous line placement, Limited pharmacologic treatments, May assist in some systems: laryngeal mask airway</td>
</tr>
<tr>
<td>EMT-Paramedic</td>
<td>Initial: Typical range of 1000-1300 hours as suggested by the Commission on Accreditation of Allied Health Education Programs</td>
<td>EMT-Intermediate skills plus: Cardiac rhythm recognition, Expanded pharmacologic treatments, Needle decompression of a tension pneumothorax, Needle or surgical cricothyrotomy, Transthoracic cardiac pacing</td>
</tr>
</tbody>
</table>

AED, automated external defibrillator; CPR, cardiopulmonary resuscitation; DOT, Department of Transportation; EMT, emergency medical technician.
in the prehospital environment, this has been improved in recent years.\textsuperscript{31} There is significant evidence for early defibrillation and certain advanced cardiac life support medications, which are carried by most ALS services.\textsuperscript{24,32} The wide variety of alternative medications is less uniform. This includes respiratory and anaphylaxis medications, preparations for altered mental status, analgesics, and antiemetics. Medications are traditionally administered in the field by the parenteral route, but the intranasal route is becoming popular for certain preparations. The beneficial aspects are that absorption is rapid with an onset of action similar to that of parenteral administration. Medications that are commonly administered intranasally are naloxone for narcotic overdose, midazolam for pediatric seizure, and fentanyl for pain control.\textsuperscript{33,34}

**Emergency Medical Dispatch**

Dispatching encompasses multiple elements that assist patients in receiving expeditious medical care.\textsuperscript{36} There are several recognized programs with varying sensitivities and specificities that assist call-takers in identifying a patient’s acuity level on the basis of the caller’s information.\textsuperscript{37,38}

The emergency medical dispatcher (EMD) is responsible for ascertaining the primary medical condition and severity. Communication centers that model their dispatch response protocols on priority use a finite list of common chief complaints, each having associated predetermined questions. Answers to these questions ultimately dictate a predefined response mode. Depending on the response assigned and system configuration, an ambulance (BLS or ALS) and possibly a first responder resource is dispatched to respond in an emergency or nonemergency mode. When critical conditions are identified, the EMD may proceed to give specific prearrival instructions to assist the caller in providing critical interventions before EMS arrival. These include procedures such as opening and clearing an airway, performing CPR, controlling hemorrhage, and assisting with childbirth. Such assistance dramatically narrows the response time interval for receiving emergency medical care.

**Systems Status Management**

Depending on system size, population served, and resources available, systems status management has proved beneficial for many services. On the basis of historical data, high-performance or peak-demand periods of the day coupled to service areas or call location can be identified so that coverage plans or posting assignments may be instituted. Such mechanisms place ambulances at predetermined locations where potential calls are likely to occur. Response vehicles may be equipped with an automatic vehicle locator that functions as a telemetry unit or a global positioning satellite system that provides a site interface with the computer-aided dispatch system. This site information is helpful in the staging or redeployment of vehicles during periods of high call volume or when resources are limited.

**Field Communications**

At the scene or during transport, EMTs usually have the capability of communicating with hospital staff. A consultative patient report may be given to receive medication or intervention orders or simply for arrival notification. Additional information resources may include cardiac telemetry or transmission of a 12-lead electrocardiogram. EMS providers should also have the capability of communicating with all allied public safety agencies for mutual aid purposes, mass casualty situations, or disaster responses. If air medical services are available, EMS and fire personnel must have the capability of communicating with the helicopter pilot and crew members. Scene personnel must relay landing zone information and potential hazards to the pilot and should provide a preliminary patient report to the medical crew.

**Oversight**

**Federal**

Various federal agencies participate in the oversight of EMS development and refinement. Specifically, the lead agency in the federal government is the EMS Division of NHTSA under the DOT. In 2007, the National EMS Advisory Council was formed to provide
advice and recommendations from consumers, advocates, and stakeholders regarding EMS to the NHTSA. Additional federal support comes from EMS-C under the Maternal and Child Health Bureau, Department of Health and Human Services. In an effort to better coordinate federal agencies involved with state, local, tribal, or regional EMS, Congress formed the Federal Interagency Committee on EMS in 2005. The purpose of this organization is to simplify the processes and efforts by which federal agencies support EMS by identifying state and local EMS needs and recommending the addition, expansion, or improvement of programs. Although it is not regulatory, the National Association of EMS Physicians is an international organization of physicians and pre-hospital professionals interested in promoting research, innovation, and excellence in prehospital care delivery.

State

Each state incorporates a governmental agency that oversees EMS. Duties typically include enforcement, regulation, and implementation of EMS rules adopted by the state and possibly a medical board, licensing services, and certifying providers. The NASEM-SO assists in developing policy, providing insight, and ensuring leadership and resources for EMS development at the state, regional, and local levels.

Local

EMS Medical Director

An EMS medical director is a physician with specialized interest and knowledge of patient care activities unique to the out-of-hospital environment. Medical oversight must extend from the communications center through all components of field care. Typically, a contractual arrangement for services provides the physician with administrative authority to implement patient care protocols, to interact with all aspects of the system, and to remove a provider from practice if medical care or behavior is substandard. Published guidelines describing the activities and performance of an EMS medical director have been prepared by the American College of Emergency Physicians, National Association of EMS Physicians, NHTSA, and Health Resources and Services Administration.

Medical direction consists of off-line (indirect) and on-line (direct) control. Off-line medical control includes protocol development, personnel education, prospective and retrospective patient care review, and other quality improvement processes. Direct medical control concerns real-time interaction between a physician or designee and the field provider.

Indirect Medical Control

Medical accountability for patient care activities is the basis for indirect medical control and functions either before a patient is encountered (prospective) or after hospital transport has occurred (retrospective). Patient care guidelines and protocol development for EMTs and EMDs, continuing medical education, medical-legal policies, and quality and performance improvement processes are important elements.

Perhaps the most important duty of the medical director is to develop patient care protocols. Protocols serve as pre-established practice guidelines that define the standard of care for most illnesses or injuries encountered in the out-of-hospital setting. Operational issues, such as hospital designation and destination policies, termination of resuscitation, and patient transport refusal, may be included. Depending on state regulations, protocols may include standing orders for particular clinical situations in which EMTs may perform certain procedures or administer medications for predefined patient conditions before communication with hospital personnel. Protocol development should be driven by system resources and patient needs and should include guidelines for triage and care of specific populations of patients, including trauma patients, newborns, and children.

Regardless of local communication protocols, out-of-hospital providers should always be able to discuss a case with a physician for clarification or guidance when clinical questions or controversial situations arise. Furthermore, hospital notification is important when critical patients are being transported.

Medical directors should be familiar with and actively involved in local or regional educational programs for initial and continuing education courses for all levels of EMT certification. Course curriculum development and administration, evaluation, and revision processes should be understood. Systems that incorporate their own educational programs allow modifications that reflect intrinsic needs of the system and the providers.

Field personnel and telecommunicators should be given regularly scheduled courses that improve competency in knowledge and skills. Instructional formats and resources to accomplish educational objectives may include didactic classroom lectures, skill laboratories, direct field observation, and distance learning models for self-paced opportunities. Standardized core content is important for maintenance of consistency and quality of care.

Once patient care protocols are developed and implemented, there must be mechanisms, such as retrospective patient care report review or direct field observation, for evaluation of individual and system performance and patient outcome. Deviations from specific protocols may reflect problems with individual EMTs, medical control personnel, or the protocol itself, each requiring education and re-evaluation. Deficiencies, both operational and clinical, should be identified for appropriate remediation to occur, which may be in the form of counseling, educational instruction, or revisions of system design or patient care protocols.

Competency, knowledge retention, and skill performance are measurable parameters. Time standards (e.g., out-of-chute time [time from ambulance notification to deployment], response time, and scene time) are equally important measures.

Direct Medical Control

Direct medical control is the concurrent direction of EMTs providing patient care. This may be in the form of radio or telephone communications or by direct scene observation and may be considered centralized or decentralized. In a centralized system, a selected hospital is designated the lead facility (base station hospital, resource hospital, or sponsor hospital) and is responsible for providing all direct medical control orders and notification regardless of the receiving facility. In a decentralized system, each hospital functions as a base station, providing direction to EMTs transporting patients to its facility.

Personnel responsible for direct medical control must be knowledgeable about the entire EMS system, receiving facilities, protocols, medication formulary and equipment, administrative and operational issues, and medical-legal implications for certain presenting situations. Systems whose protocols include standing orders may require direct communication only for specific reasons. Thus, whereas these medical and administrative protocols may guide EMTs through most circumstances, medical control consultation may assist with medical-legal issues, situational problems at the scene, patient nontransport, or a multitude of potential ethical dilemmas that may be encountered. Nevertheless, direct medical control is usually invaluable for notification of a receiving facility for treatment room and staff preparation when critical or potentially critical patients are being transported.

Agencies and organizations involved in EMS development and oversight are listed in Table 190-2.
Emergency Medical Services Resource and Contact Information

<table>
<thead>
<tr>
<th>RESOURCE</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advocates for EMS</td>
<td><a href="http://www.advocatesforems.org">www.advocatesforems.org</a></td>
</tr>
<tr>
<td>American Ambulance Association</td>
<td><a href="http://www.the-aaa.org">www.the-aaa.org</a></td>
</tr>
<tr>
<td>American College of Emergency Physicians</td>
<td><a href="http://www.acep.org">www.acep.org</a></td>
</tr>
<tr>
<td>Centers for Disease Control and Prevention</td>
<td><a href="http://www.cdc.gov">www.cdc.gov</a></td>
</tr>
<tr>
<td>Commission on Accreditation of Ambulance Services</td>
<td><a href="http://www.caas.org">www.caas.org</a></td>
</tr>
<tr>
<td>EMS Division, NHTSA</td>
<td><a href="http://www.nhtsa.dot.gov/people/injury/ems">www.nhtsa.dot.gov/people/injury/ems</a></td>
</tr>
<tr>
<td>Maternal and Child Health Bureau, EMS-C</td>
<td><a href="http://www.ems-c.org">www.ems-c.org</a></td>
</tr>
<tr>
<td>National Association of EMS Educators</td>
<td><a href="http://www.naemse.org">www.naemse.org</a></td>
</tr>
<tr>
<td>National Association of EMS Physicians</td>
<td><a href="http://www.naemsp.org">www.naemsp.org</a></td>
</tr>
<tr>
<td>National Association of EMTs</td>
<td><a href="http://www.naemt.org">www.naemt.org</a></td>
</tr>
<tr>
<td>National Association of State EMS Officials</td>
<td><a href="http://www.ems-c.org">www.ems-c.org</a></td>
</tr>
<tr>
<td>National Registry of EMTs</td>
<td><a href="http://www.nrems.org">www.nrems.org</a></td>
</tr>
</tbody>
</table>

EMS, emergency medical services; EMT, emergency medical technician; NHTSA, National Highway Traffic Safety Administration.

OUT-OF-HOSPITAL MEDICAL CARE AND CONTROVERSIES IN MANAGEMENT

Airway Support and Respiratory Emergencies

Interventions

Respiratory complaints account for a significant number of EMS responses. Basic measures to control and support a patient’s airway include manual maneuvers (e.g., chin lift or jaw thrust), oral and nasopharyngeal devices, and bag-mask ventilation. At a more advanced level, interventions may include use of extraglottic-type airway devices (e.g., Combitube, laryngeal mask airway, or laryngeal tracheal airway), which have been shown to enable faster placement and to provide improved minute ventilation. Studies have shown that basic-level EMTs were able to successfully place laryngeal mask airways in simulated arrest models and also demonstrated an improved minute ventilation with these devices compared with bag-valve mask ventilations. 47,48 Similar studies have demonstrated that laryngeal mask airways are more successful than endotracheal intubation for paramedics because they provide a faster technique, require fewer attempts for successful insertion, and improve ventilation. 49

Commonly used by air medical services, drug-assisted intubation (DAI) and rapid sequence intubation (RSI) procedures are well established in ground transport services, despite a lack of supporting evidence. Although many services routinely perform intubation, several studies have challenged the effectiveness of out-of-hospital intubation, particularly in view of an alarming incidence of esophageal intubation in some systems and poor outcomes with the use of RSI for head-injured patients. 50-53 One prospective, randomized study of pediatric out-of-hospital airway management concluded that in the urban setting, bag-mask ventilation may be superior to intubation in certain groups of patients. 54 Although controversy exists and the debate will continue, most would agree that to have a successful airway management program, the educational and quality management component must be meaningful and should be as comprehensive and compulsive as possible. 55 For programs using DAI or RSI procedures, the experiential component should include operating room time and simulator sessions. Ideally, training would also occur in an emergency department setting where patients requiring emergent intubation would potentially have the full complement of confounding variables (e.g., combative status, full stomachs, blood and vomit in the airway). Such training may be difficult or impossible to achieve, particularly ongoing maintenance of skills sessions, especially in rural communities. Unless EMS systems perform a large number of intubations, with at least several intubations per provider per year, use of an extraglottic device for tracheal intubation should be strongly considered. 56

Traditionally used in the hospital, continuous positive airway pressure (CPAP) is intensifying in the out-of-hospital setting. The effectiveness of out-of-hospital use of CPAP has been demonstrated; however, patient outcome studies have been limited. 57,58 Out-of-hospital use would require strict protocols that outline such variables as indications and contraindications, clinical applications, mental status assessment, hemodynamic status, and mechanisms for transfer of the patient at the hospital.

Medications

Most advanced programs have adopted the use of clinically proven medications for bronchospasm, chronic obstructive pulmonary disease, and anaphylaxis, but no studies have demonstrated benefit to administration of these medications in the out-of-hospital environment. Whereas some studies might be considered unethical (e.g., an out-of-hospital study of epinephrine for anaphylaxis), others (e.g., out-of-hospital use of beta2-agonists or steroids for asthma, or loop diuretics for pulmonary edema) could easily be performed, with the results far from certain. Pending further studies, most systems have adopted the position that these medications do not harm patients in the out-of-hospital setting, may be helpful, and may provide comfort and clinical improvement for most patients experiencing varying degrees of respiratory distress. The overhead for training and maintenance of knowledge related to these additional, probably unnecessary medications is rarely considered.

Cardiovascular Emergencies

Interventions

Early research demonstrated the effectiveness of early defibrillation for termination of ventricular fibrillation and improvement of survival rates from sudden cardiac death. 59 Advances in technology have improved such that defibrillators, traditionally used by paramedics, are now used by a variety of public safety responders and bystanders. Public access defibrillation programs are continuing to be implemented throughout the country, with devices being placed in high-volume, populous, and secluded areas such as airports and airplanes, casinos, churches, office buildings, and other locations identified as high risk for resuscitation. 60 The acquisition and transmission of out-of-hospital 12-lead electrocardiograms is becoming more prevalent as well. Although it is expensive to implement, several studies have revealed minimal delays in scene time while the electrocardiogram is obtained and a shorter time to intervention (thrombolytic administration or catheterization laboratory admission) by use of this technology. 61,62

A factor now recognized to improve survival from cardiac arrest is uninterrupted or minimally interrupted chest compressions.
Each interruption of compressions (e.g., while intubating, checking for pulses, analyzing rhythms) decreases coronary perfusion pressure, which in turn decreases cellular respiration. This same tenant may be used for prearrival telephone CPR instructions in that more bystanders may be willing to perform continuous chest compressions if artificial ventilations were discarded.

Although the statistics for cardiac arrest survival across the United States are dismal, those who do survive may suffer some degree of hypoxic encephalopathy. Recent evidence suggests that with cooling of patients who achieve a spontaneous return of circulation after cardiac arrest, especially with ventricular fibrillation as the initial rhythm, higher survival rates and level of neurologic functioning are achieved. The explanation may be due to several mechanisms, including a decrease in neuronal cell oxygen consumption, cell membrane protection, slowing of degenerative reactions resulting from reperfusion, and limiting of acidosis. International guidelines now call for the institution of hypothermia for patients who are resuscitated from cardiac arrest, and many out-of-hospital systems have implemented protocols that may include administration of chilled saline, sedation, or neuromuscular blockers in coordination with receiving hospital emergency departments.

Medications

Traditional cardiac medications recommended by advanced cardiac life support are used by most ALS systems. Recent investigations involving amiodarone as an out-of-hospital agent to terminate refractory ventricular fibrillation have resulted in higher survival rates to hospital arrival; however, improvement in survival to discharge is still not significant. Whether amiodarone should replace lidocaine for out-of-hospital ventricular fibrillation requires further investigation, although many systems have already made this expensive change. The use of out-of-hospital fibrinolytic agents for acute ST elevation myocardial infarction has not gained wide acceptance and may be a useful intervention only for systems having prolonged transport times or if hospitals may not have catheterization or intervention facilities available. Future recommendation for out-of-hospital use of these agents remains speculative.

Traumatic Emergencies

Interventions

Interventions for specific medical emergencies, such as cardiac arrest (i.e., defibrillation, intubation, intravenous line, and medication administration), may be effectively performed while on the scene or before hospital transport. Alternatively, it is widely accepted that most interventions for traumatic injuries should be performed en route to the hospital, and all efforts should be extended to reduce on-scene time. Only two interventions should be considered for critical injuries, control of the airway to reverse hypoxemia and to prevent aspiration and stopping of uncontrolled hemorrhage. Although it is a routine part of prehospital trauma care, tracheal intubation is not known to be beneficial for severely injured patients. There are many potential drawbacks to prehospital intubation for major trauma. To be successful, paramedics should rapidly place the endotracheal tube correctly, assess and confirm the placement, and secure the tube to prevent displacement. In addition, providing the correct minute and tidal volumes is equally important. Inadvertent hyperventilatory rates may impair cardiac output and cause further tissue damage. Patients sustaining blunt head injury pose special problems that should be expeditiously addressed and resolved. Intubation is but one means of providing ventilatory assistance and airway protection, but misadventure, complications, and improper postintubation care may negate these potential benefits. Attempting to intubate head-injured patients may result in dental or soft tissue damage in those patients with clenched teeth, and intracranial pressure may be exacerbated from an intact gag reflex or from subsequent regurgitation. Studies on the use of RSI in head-injured patients reveal that patients experience significant hypoxia and bradycardia during the procedure, and outcome is actually worse. Thus the role of RSI in prehospital airway management in trauma patients is in question, just as it is for medical patients. The use of extraglottic airway devices may be a promising addition to prehospital airway management in trauma patients. Routine use of prehospital intubation is not recommended unless the system can ensure that its providers meet the standards previously outlined. Emergent hemorrhage control is also essential in reducing mortality in severe trauma. For internal bleeding, limiting of total prehospital time and transfer to definitive surgical care are paramount. Recent evidence on the battlefield has demonstrated the effectiveness of tourniquet application to extremity wounds. These devices may have application in the civilian setting, are quick and easy to apply, and do not result in the complications once thought to exist.

The issue of intravenous fluid administration has gained controversy over the years. High-volume intravenous fluid for hemodynamic instability resulting from traumatic injury has traditionally been the accepted standard in most out-of-hospital care systems. Previous data, however, support a paradigm shift to restrictive or hypotensive resuscitation for penetrating truncal injuries. Restoration of hemodynamic stability with fluid resuscitation before definitive surgical hemostasis may lead to increased morbidity. The use of prehospital intubation and high-volume crystalloid infusion bears unfortunate similarity to the widespread, unsupported adoption of the pneumatic anti-shock garment in the 70s and 80s. Despite lack of evidence of benefit and significant evidence of harm or potential harm, these practices are notoriously difficult to discontinue once adopted.

INTERFACILITY AND SPECIALIZED TRANSPORTS

Transportation between health care facilities may occur for several reasons, including patient preference, unavailable diagnostic or therapeutic resource availability at the transferring facility, and managed care requirements that patients be cared for in predesignated hospitals after stabilization. Hospital corporations engaged in networks or alliances that share resources and services depend on interhospital transport systems to convey patients to allied institutions for specialized tests or procedures. Likewise, critical patients admitted to less specialized facilities may need to be transferred to tertiary care or designated trauma centers. Where long-distance transports may be best accomplished by air medical services, regional or local transports should use ground systems. These may be provided by either local EMS resources or those owned and operated by the hospital.

Interfacility transfer of patients that is medically indicated must fall under a set of requirements referred to as the Emergency Medical Treatment and Active Labor Act. Although the EMS system providing the transport plays a key role, these guidelines primarily involve particular information and obligations that must be satisfied by the transferring and receiving facilities before transfer. An unstable patient should not be transferred to another facility at the request of a managed care organization unless the transferring hospital is incapable of providing standard care and the receiving hospital does have the capability to manage the condition and foreseeable complications. Box 190-1 lists various requirements that should be completed before a patient is transferred to another facility.
As with any EMS activity, all interfacility transports should be reviewed for appropriateness of transfer and medical care provided. In 1993, the Practice Management Committee of the American College of Emergency Physicians updated the 1990 policy statement on interfacility transfers.\(^2\)

**THE FUTURE**

Providing quality, efficient, and responsible health care to the right patient, in the right setting, at the right time will be a laudable objective for any system, but there is a need for research to demonstrate which interventions are conducive to better patient outcome. As the call volumes increase, it is imperative that systems focus on those interventions, from both the training and health care delivery perspectives, that are known to be of benefit.

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*The references for this chapter can be found online by accessing the accompanying Expert Consult website.*
References


