Chapter 190

Emergency Medical Services: Overview and Ground Transport

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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, or 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 EMS maturation. 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 concept of EMS-C becoming integrated not just into existing EMS systems but into comprehensive systems of care provision, including injury prevention, primary and definitive care, and rehabilitation services.[10]

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.[11-13]

A major focus included the need to strengthen the integration of EMS into the entire healthcare system, because lack of such coordination often results in patients being diverted from overcrowded to 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 based on their injury or illness. Additional recommendations targeting EMS improvement included national accreditation for paramedic educational programs, adopting a national certification system for individual state licensure, and recognizing 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 Congress developing regionally funded, multiyear demonstration projects that encourage states to identify and test strategies for creating 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, most importantly that the care of children be integrated into the overall EMS system and not separated from adults, with pediatric emergency care competencies being defined and training enhanced to maintain those competencies. Because it is diffi-

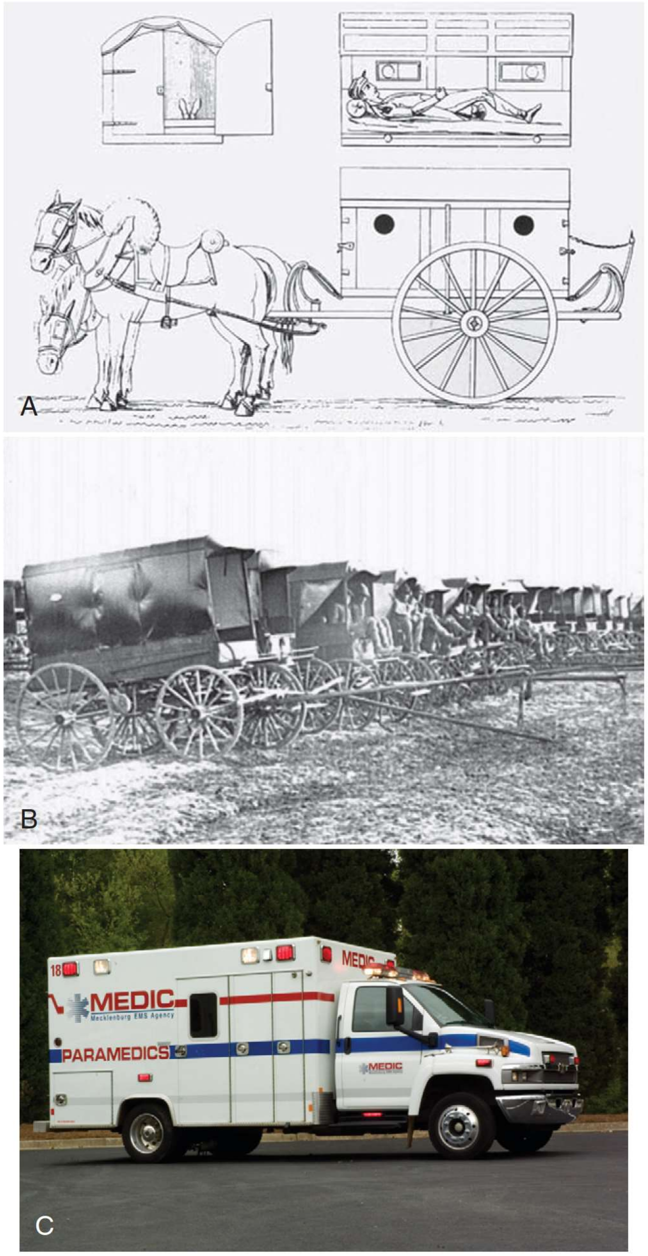

Figure 190-1. Larrey's Flying Ambulance (**A**), Letterman's Rucker Wagon (**B**), and the modern ambulance used today (**C**). (**A**, courtesy of the National Library of Medicine, History of Medicine Division; **B**, courtesy of the Library of Congress, Prints and Photographs Division, LC-88171-2585 DLC; and **C**, courtesy of Monroe Hicks, Mecklenburg EMS Agency, Charlotte, North Carolina.)

cult to ascertain whether systems have targeted the pediatric population, the IOM further recommended that a pediatric coordinator be included in all EMS systems to advocate for ensuring equipment, medications, training, and protocols are appropriate for children.

Each of the three IOM reports supported the concept of the federal government developing 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 whether EMS at a national level should remain under the NHTSA or reside in other applicable agencies (e.g., Health and Human Services, Homeland Security). Regardless, the parent organization must ensure that research is supported to improve the knowledge base and support evidence for the practice of out-of-hospital medical care.

Emergency Medical Service Systems

Multiple EMS system designs exist, all predicated on the type of community served. While 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*.[14] For simplicity, the following categorization of systems will be 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 depending on 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. Like 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 establishing 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 municipal EMS system may be provided by a physician appointed and contracted by a local hospital, an advisory council, or 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 using 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.[15,16] Alternatively, there is debate on the effectiveness of ALS for medical and traumatic emergencies.[17,18] 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.[19] 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 (IV) 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.[20] 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. Currently, there is a steady decrease in systems that provide mixed ALS-BLS care.[21,22] 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 for ALS ambulances to be available for potential critical responses.

Regardless of single- or multiple-tier design, EMS systems usually include first-responder (FR) services as part of their structure. The FR, usually a police officer or firefighter, is the nontransport BLS or ALS provider who quickly responds to the scene of an emergency to provide initial care before definitive medical care and transportation assets arrive. The FR quickly assesses the situation and patient(s), 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 period of time following unexpected injury or illness. A desirable and cost-effective design might include BLS nontransport FRs with short response times (average 2–4 min), having the capability of providing early defibrillation and airway support, coupled with ensuing ALS care and transport services.[23]

Levels of Provider and Scope of Practice

At the federal level, NHTSA is responsible for developing the National Standard Curriculum for the different certification levels. 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 DOT recommendations for the four common levels of provider with suggested hours of training and incorporated skills (Table 190-1).

First Responder

The FR is typically the first to arrive on the scene of an incident. Initial scene and patient assessment, along with limited life-saving interventions, are primary functions. Along with CPR and basic airway management skills, the FR 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 (AHA), which decrease mortality from out-of-hospital cardiac arrest, are early access to care, CPR, defibrillation, and advanced airway management and medications.[24] 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 FR.[25,26]

The DOT recommends 40 hours of didactic instruction for the standard FR course and 16 to 36 hours for refresher training. A clinical rotation is not part of the curriculum.[27]

Emergency Medical Technician—Basic

The EMT-B 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 FR, the EMT-B is also involved with triage, more detailed patient assessment, and transportation. Like FRs, EMT-Bs should have the capability of providing early defibrillation.[28]

In 1995, NHTSA released the revised EMT-B curriculum. The initial course requires approximately 110 hours of instruction and includes 46 lessons, each with cognitive, effective, and psychomotor objectives.[29] Many states have expanded the course to include more skills such as AED use, epinephrine autoinjections, albuterol administration by hand-held nebulizer or metered-dose inhaler, and IV fluid therapy. For recertification, the DOT recommends a 24-hour refresher course,

Table 190-1 EMS Provider Level Training and Skills

EMS PROVIDER LEVEL	DOT RECOMMENDED HOURS OF TRAINING	SKILL SET
First responder	Initial: 40 hr Refresher: 16–36 hr	Initial scene and patient assessment and stabilization Basic airway skills CPR Control hemorrhage Spinal immobilization
EMT—Basic	Initial: 110 hr Refresher: 24-hr refresher course, 48 hr of continuing education, and a BLS course every 2 years	First responder skills plus: Triage and detailed patient assessment AED May assist in some systems: Use of epinephrine autoinjectors for anaphylaxis; albuterol for wheezing
EMT—Intermediate	Initial: 300–400 hr and includes didactic and clinical experience	EMT—basic skills plus: Endotracheal intubation Manual defibrillation IV line placement Limited pharmacologic treatments May assist in some systems: Laryngeal mask airway
EMT—Paramedic	Initial: 1000–1200 hr Refresher: 48-hr refresher course, 24 hr of yearly continuing education, and BLS and ALS courses at the pediatric and adult levels	EMT—intermediate skills plus: Cardiac rhythm recognition Expanded pharmacologic treatments Needle decompression of a tension pneumothorax Needle or surgical cricothyrotomy Transthoracic cardiac pacing

AED, automated external defibrillator; ALS, advanced life support; BLS, basic life support; CPR, cardiopulmonary resuscitation; DOT, Department of Transportation; EMT, emergency medical technician; IV, intravenous.

48 hours of continuing education, and a BLS course every 2 years.

Emergency Medical Technician—Intermediate

The EMT-I was established to allow a more comprehensive approach to care when paramedic services were unavailable or unobtainable. Many states recognize the EMT-I certification, but others designate alternative, but comparable, levels depending on specific skills and procedures. The intermediate level is useful for rural systems because it supplies an ALS for less cost and educational time expended. The scope of practice for the EMT-I varies across the United States. Most systems allow the EMT-I to establish an IV line and to manually defibrillate. Limited administration of medications and use of adjunctive airway devices (e.g., blind insertion airway device or laryngeal mask airway) may be integrated skills.

The DOT recommends 300 to 400 hours of initial education that includes didactic classroom lectures combined with hospital and field experiences.[30]

Emergency Medical Technician—Paramedic

The EMT-P is the most advanced out-of-hospital provider. Paramedics have the capability to address most out-of-hospital 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.

A recent revision of the National Standard Curriculum for the EMT-P calls for approximately 1000 to 1200 instructional hours, including didactic, clinical, and field education. All course content focuses on technical and professional competency. Additional modules are included that allow programs to incorporate an expanded scope of practice.[31] 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. Recertification requirements include a 48-hour refresher course, 24 hours of yearly continuing education, and BLS and ALS courses at the pediatric and adult levels.

Material Resources

Prior to 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, the American College of Surgeons, the ACEP, and the EMS-C Program continue publishing documents that recommend design, equipment, and medications for ambulances.[32,33]

Medications

During the 1980s, many believed that prehospital drug administration was unjustified and simply delayed hospital transport.[34,35] Moreover, there is a profound paucity of outcomes-based research into the use of various medications in the out-of-hospital environment.[36] There is significant evidence for early defibrillation and certain advanced cardiac life support medications, which are carried by most ALS services.[37] 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 parenteral administration. Two medications that are commonly administered intranasally are naloxone for narcotic overdose and midazolam for pediatric seizure.[38,39]

Equipment

Basic ambulance equipment should include items necessary for emergency procedures (i.e., airway support, hemorrhage control, fracture and spine immobilization, childbirth), personal protection, patient movement, and basic rescue procedures. Additional patient care equipment is predicated on the level of provision outlined by the system design.

Ambulances

Three basic ambulance vehicle designs are recognized by the DOT: type I, type II, and type III. Both type I and type III ambulances incorporate a modular patient compartment mounted on a conventional truck and van chassis, respectively. The type II vehicle is a standard van. The larger medium-duty vehicle, mounted on a business-class chassis, has become popular in recent years. This configuration requires less periodic maintenance and offers extended service time. Each ambulance manufacturer promotes various interior cabinetry and all include sufficient lighting, outlets for 110-volt equipment, suction, oxygen systems, and external audible and visual warning devices. The six-pointed blue star, or "Star of Life," surrounding the staff of Aesculapius is recognized worldwide as the standard symbol for EMS.[40]

Communications

Integral to out-of-hospital care systems, EMS communications involve multiple components, all interlinked to support expedient patient care. Effective communication systems include public information and education programs regarding general access to care, technology to ensure simplified access, means of call prioritization and management of available resources, protocols for providing emergency patient care instructions prior to EMS arrival, ability to communicate with allied agency and hospital personnel, educational opportunities for telecommunicators, and quality improvement processes.

Access

Since 1973, the 9-1-1 universal emergency access telephone number has been adopted by many communities throughout the United States. Basic 9-1-1 service simply connects a caller to a central communications center or public safety answering point (PSAP). Most primary PSAPs are under the domain of law enforcement. Although many of these handle all public service (police, fire, EMS) calls, many larger cities have secondary PSAPs for fire and EMS. Enhanced 9-1-1 provides additional information by immediately displaying the caller's telephone number and address.

Emergency Medical Dispatch

Dispatching encompasses multiple elements that assist patients in receiving expeditious medical care.[41] It is estimated that 30% of EMS calls are for nonemergent conditions, with only 15 to 20% being considered critical or life-threatening.[42]

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 an FR resource is dispatched to respond in an emergency or nonemergency mode. When critical conditions are identified, the EMD may proceed in giving specific prearrival instructions to assist the caller in providing critical interventions prior to 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, the use of systems status management has proven beneficial for many services. Based on 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 global positioning satellite system that provides a site interface with the computer-aided dispatch system. This site information is helpful when staging or redeployment of vehicles is required during periods of high call volume or when resources are limited.

Field Communications

While 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. 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.

MEDICAL DIRECTION

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 ACEP, National Association of Emergency Medicine Services Physicians (NAEMSP), NHTSA, and Health Resources and Services Administration (HRSA).[43-45]

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, medicolegal policies, and quality and performance improvement processes are important elements.

Protocols

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 prior to 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 patient populations, 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 always important when critical patients are being transported.

Education

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 for modifications that reflect intrinsic needs of the system and the providers.

Field personnel and telecommunicators must 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 labs, direct field observation, or distance learning models for self-paced opportunities. Standardized core content is important for maintaining consistency and quality of care.

Quality and Performance Improvement

Once patient care protocols are developed and implemented, there must be mechanisms, such as retrospective patient care report review or direct field observation, for evaluating 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 reevaluation. Deficiencies, both operational and clinical, must 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.[46] 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.[47]

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 as 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 medicolegal implications for certain presenting situations. Systems whose protocols include standing orders may only require direct communication for specific reasons. Thus, while these medical and administrative protocols may guide EMTs through most circumstances, medical control consultation may assist with medicolegal 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 notifying a receiving facility for treatment room and staff preparation when critical or potentially critical patients are being transported.

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 use of bag-mask ventilation. At a more advanced level, interventions may include blind-insertion airway devices (e.g., Combitube or larygneal mask airway), which have been shown to enable faster placement and 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 when compared with bag-valve mask ventilations.[48,49] 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.[50,51]

Commonly used by air medical services, drug-assisted intubation (DAI) and rapid sequence intubation (RSI) procedures have recently expanded in ground transport services, despite a lack of supporting evidence. Several long-standing programs have achieved great success using RSI; however, others have not appreciated the benefits and have questioned the usefulness.[52,53] 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.[54,55] 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 patient groups.[56] Although controversy exists and the debate will continue, most would agree that in order 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.[57] 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 ED 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).

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.[58,59] Out-of-hospital use would require strict protocols that would outline such variables as indications and contraindications, clinical applications, mental status assessment, hemodynamic status, and mechanisms for transferring 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. While 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 beta$_2$-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 related to training and maintenance of knowledge related to these additional, probably unnecessary, medications is rarely considered.

Cardiovascular Emergencies

Interventions

Previous research has demonstrated the effectiveness of early defibrillation for terminating ventricular fibrillation and improving survival rates from sudden cardiac death.[60] 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 (PAD) programs are being implemented throughout the country, with devices being placed in high-volume, populous, and secluded areas such as airports and airplanes, casinos, and office buildings.[61] The effectiveness of PAD is currently being investigated.[62] The acquisition and transmission of out-of-hospital 12-lead electrocardiograms is becoming more prevalent as well. Although expensive to implement, several studies have revealed minimal delays in scene time while obtaining the ECG, and a shorter time to intervention (thrombolytic administration or catheterization lab admission) by using this technology.[63,64]

Although the statistics for cardiac arrest survival across the United States are dismal, those that do survive may suffer some degree of hypoxic encephalopathy. Recent evidence suggests that cooling patients who achieve a spontaneous return of circulation following cardiac arrest, especially with ventricular fibrillation as the initial rhythm, achieve higher survival rates and level of neurologic functioning.[65,66] The explanation may be due to several mechanisms, including a decrease in neuronal cell oxygen consumption, cell membrane protection, slowing of degradative reactions resulting from reperfusion, and limiting acidosis.[67] 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.[68] 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 only be a useful intervention for systems having prolonged transport times, or if hospitals may not have catheterization or intervention facilities available. Future recommendations 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, IV and medication administration), may be effectively performed while on the scene or prior to hospital transport. Alternatively, it is widely accepted that most interventions for traumatic injuries should be performed while en route to the hospital, and all efforts should be extended to reduce on-scene time.

The issue of IV fluid administration has gained controversy over the past several years. High-volume IV fluid for hemodynamic instability resulting from traumatic injury has traditionally been the accepted standard in most out-of-hospital care systems. Recent data, however, support a paradigm shift to restrictive or hypotensive resuscitation for penetrating truncal injuries. Restoration of hemodynamic stability with fluid resuscitation prior to definitive surgical hemostasis may lead to increased morbidity.[69] Likewise, the use of the pneumatic antishock garment has been shown to increase mortality rates in penetrating torso injuries and is no longer recommended.

Similar to medical patients, definitive airway support by endotracheal intubation may be beneficial for severely injured patients although these benefits of intubation in improving patient outcome have not been clearly delineated. To be successful, paramedics must exhibit the technical skills to rapidly place the endotracheal tube correctly, assess the placement, and move the intubated patient appropriately. In addition, providing the correct minute and tidal volumes is equally important. Overzealous personnel subconsciously delivering hyperventilatory rates may impair cardiac output and cause further tissue damage. Patients sustaining blunt head injury pose special problems that must be expeditiously addressed and resolved. Intubation provides a solid means of providing ventilatory assistance and airway protection, but the procedure and postintubation care may negate these potential benefits.

BOX 190-1 EMTALA Requirements for Patient Transfers

Complete certification (risks and benefits) of transfer
Informed consent obtained from the patient or family
Appropriate transportation (equipment and personnel) arranged
Treatment and stabilization performed
Acceptance from receiving facility ensured
Appropriate patient care data sent (fax or with patient)

EMTALA, Emergency Medical Treatment and Active Labor Act.

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. Recent 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.[48] Thus, the role of RSI in prehospital airway management in trauma patients is in question, just as it is for medical patients.

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, or managed care requirements that patients be cared for in predesignated hospitals following 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. Whereas 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 (EMTALA).[70] 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 facility prior to transfer. It is important to note that 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 must be completed prior to transferring a patient to another facility.

Depending on patient condition, specialized transport services may function at the BLS or ALS level, providing emergency or nonemergency transportation. Patient transfers considered ALS may include interhospital (either ED or intensive care unit) neonatal or high-risk infant, critical cardiac, or trauma transports. Personnel configuration depends on system design and level of care provided. Many programs use a nurse-paramedic combination. Patients requiring specialized care may need the services of specifically trained individuals, such as respiratory therapists, neonatal nurses, or other specialized critical care personnel. The presence of a physician is not mandatory but may be useful in selected cases.

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 ACEP updated the 1990 policy statement on interfacility transfers.[71]

Table 190-2 EMS Resource and Contact Information

RESOURCE	URL
Advocates for EMS	www.advocatesforems.org
American Ambulance Association	www.the-aaa.org
American College of Emergency Physicians	www.acep.org
Centers for Disease Control and Prevention	www.cdc.gov
Commission on Accreditation of Ambulance Services	www.caas.org
EMS Division, NHTSA	www.nhtsa.dot.gov/people/injury/ems
Maternal and Child Health Bureau, EMS-C	www.ems-c.org
National Association of EMS Educators	www.naemse.org
National Association of EMS Physicians	www.naemsp.org
National Association of EMTs	www.naemt.org
National Association of State EMS Officials	www.nasemsd.org
National Registry of EMTs	www.nremt.org

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

THE FUTURE

Providing quality, efficient, and responsible health care to the right patient, in the right setting, at the right time will always be laudible objectives 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. Agencies and organizations involved in EMS development and oversight are listed in Table 190-2.

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