Emergency Medical Services and the Pediatric Patient: Are the Needs Being Met? II. Training and Equipping Emergency Medical Services Providers for Pediatric Emergencies

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ABSTRACT. Emergency medical services have been organized to meet the needs of adult patients. A study was undertaken to determine the training in pediatrics offered to paramedics and emergency medical technicians throughout the United States and the equipment carried by prehospital care provider agencies. Most training (50%) takes place at colleges and universities and the remainder at hospitals and emergency medical services agencies. Many programs (40%) have less than ten hours of didactic training in pediatrics and 41% offer ten hours or less of clinical experience. Some programs offer no training in pediatric emergency medicine. The most common deficiencies in pediatric equipment included backboards, pediatric drugs, resuscitation masks, and small intravenous catheters. More attention to training and equipping prehospital personnel for pediatric emergencies may help to improve outcomes of out-of-hospital resuscitations of infants and children. *Pediatrics* 1986;78:808–812; *prehospital care, pediatric emergency, emergency medical services, paramedic training, emergency medical technician.*

The goal of prehospital care, as first described by Pantridge and Geddes[1] in Belfast, was to provide rapid stabilization and transportation to patients who had suffered an acute myocardial infarcation. This concept of the mobile coronary care unit in the United States has been incorporated into emergency medical services (EMS) systems to provide a rapid response to a variety of emergency situations. EMS may thus be defined as a complete system capable of responding to medical and surgical emergencies with timely and adequate emergency care.

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The focus of the prehospital component of EMS in the past has been on the adult patient.[2] In some EMS systems the mortality from acute myocardial infarction has been successfully reduced by the provision of effective prehospital care.[3] Children represent approximately 10% of the paramedic calls, and their needs are not being met by some systems.[4] The death rate from trauma in the field is almost twice that of adults, and the outcome from cardiac resuscitation in the prehospital setting in children is poor.[4–7]

Few data are available about the EMS services available to children in the United States and the training of EMS personnel in pediatric emergencies. This study addressed some of these issues.

MATERIALS AND METHODS

Three survey instruments were sent to emergency medical technician (EMT)/paramedic training sites and/or provider agencies. The instruments were designed to (1) gather data on the training of EMS personnel in the prehospital care of pediatric emergencies, (2) delineate specific pediatric resuscitation equipment carried by provider agencies, and (3) define types of special regionalized systems that exist for care of critically ill children.

Training

Questionnaires were mailed to 98 EMT/paramedic training programs in the United States. These were chosen from 324 training sites listed by the *National Registry of Emergency Medical Technicians, 1982 Edition.* Sites were selected at random from each state and all regions of the country were represented in the survey. Respondents were asked to list the type of EMS personnel trained; the system served, public or private; hours of pediatric

didactic, clinical, and preceptorship training; as well as hours of field simulations and years in operation. Training programs were asked whether the curriculum included instruction in 20 specific areas of pediatric emergency medicine. These included advanced pediatric life support, pediatric trauma, hypotension, asthma, respiratory distress, croup, epiglottitis, anaphylaxis, drowning, ingestions and poisoning, neonatal resuscitation, approach to the comatose child, seizures, care of the nonbreathing child, pediatric dysrhythmias, envenomation, child abuse and neglect, sexual abuse, failure to thrive, and diarrhea and dehydration. Differences in the curriculum were analyzed by region and training site using χ^2 analysis.

All 324 programs listed in the registry were analyzed for region of the country, site of training, and type of certification required at completion of the training. Differences in the curriculum were analyzed by region and training site using χ^2 analysis.

Equipment

Data were collected on pediatric equipment carried and procedures used by EMS provider agencies. The equipment list questionnaire was designed by combining pediatric equipment carried by a number of different Los Angeles County provider agencies. Equipment and supplies on the list included blood pressure cuffs (infant, child, adult, and thigh), pediatric bag-valve-mask resuscitator, masks for the resuscitator (adult, child, infant), pediatric cervical collars, sand bags, pediatric backboard, pediatric femur splint, burn pack, pediatric laryngoscope blades and endotracheal tubes, pediatric antishock trousers, Doppler blood pressure device, No. 5 F and No. 8 F feeding tubes, sodium bicarbonate 1 mEq/mL, 10-mL syringe, atropine 1 mg/mL, naloxone for neonatal use, paper strips for blood glucose determinations, 23- and 25-gauge butterfly cannulas, and 22- and 24-gauge intravenous cannulas. The list did not necessarily reflect minimum standards and contained items that were not necessarily carried by some responding agencies.

Questionnaires were sent to 82 provider agencies obtained through the *Journal of Emergency Medical Services* Salary Survey and to 27 public and seven private paramedic provider agencies in Los Angeles County. EMS agencies were asked (1) whether they carried 27 pieces of equipment and supplies for management of pediatric emergencies, (2) whether oxygen-powered breathing devices were used to resuscitate children younger than 14 years of age, (3) was regionalized care for the critically ill child available that was separate from the trauma and neonatal transport system, and (4) whether EMS personnel are able to endotracheally intubate children. They were also asked to indicate whether the agency was public or private, urban or rural.

RESULTS

Training

The United States was divided into four regions: northeast, south, midwest, and west. The distributions of EMT/paramedic training programs as listed in the National Registry by state is shown in the Figure. Most of the training (50%) takes place at colleges and universities, some programs are hospital based (32%), and others are run by local and state EMS agencies (18%) (Table 1). The only regional differences observed in training sites was in the south where 84% of the training was at colleges and universities and none at hospitals.

Certification for EMTs and paramedics also varied by state. Some states (36%) require the National Registry Examination, 25 (50%) have state examinations, and seven (14%) allow local EMS agencies to certify trainees using their own examinations.

Of 98 training programs, 62 (63%) returned the questionnaire. The regional distribution and sites of training was similar to that reported from data extracted from the *National Registry of Emergency Medical Technicians*. The majority of programs sur-

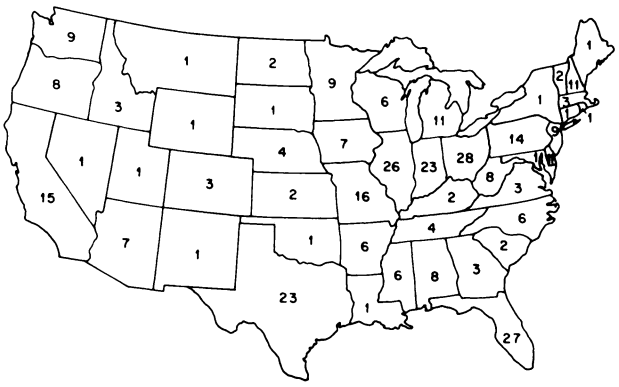

Figure. Distribution of paramedic and emergency medical technician training programs in the United States.

TABLE 1. Sites of Emergency Medical Technician/Paramedic Training by Region*

Region	Training Site			
	University	College	Hospital	Emergency Medical Services Agency
West	12 (15)	30 (37)	16 (20)	23 (28)
Midwest	13 (10)	34 (26)	72 (54)	14 (10)
East	3 (8)	7 (19)	16 (44)	10 (28)
South	6 (8)	56 (76)	(0)	12 (16)
Total	34 (11)	127 (39)	104 (32)	59 (18)

* Results are numbers (%) of agencies.

TABLE 2. Curriculum Time Devoted to Pediatric Emergencies*

Curriculum	Hours						No Response to Questionnaire
	0	1–5	6–10	11–15	16–20	20	
Didactic	3 (5)	8 (14)	13 (22)	13 (22)	11 (19)	10 (17)	4
Clinical	12 (21)	10 (17)	2 (3)	14 (24)	4 (7)	16 (28)	4
Preceptorship	32 (55)	4 (7)	5 (9)	3 (5)	2 (3)	12 (21)	6
Field simulation	28 (50)	16 (30)	9 (17)	1 (3)			8

* Results are numbers (%) of agencies offering curriculum.

veyed (79%) trained paramedics, 8% trained EMT-Is and 2% EMT-IIs, 12% trained both EMTs and paramedics. Most programs (78%) have been in operation less than 10 years and 23% less than 5 years.

The number of hours in the curriculum devoted to pediatric emergencies is shown in Table 2. Forty-one percent had ten hours or less of didactic training in pediatrics and 5% had none. The mean number of hours of didactic training for paramedics was 15 and for EMTs eight. Clinical training, ie, "bedside teaching," was not offered in 21% of the programs and 41% had ten hours or less. A preceptorship, in which trainees worked in pediatric units, was not offered in 55% of the training programs and 71% had less than ten hours. This educational experience was not offered in 75% of the EMT programs.

There was wide variation in the content of pediatric topics covered in the curriculum, with no significant regional differences. The deficient areas of pediatric education are shown in Table 3. It is remarkable that areas not covered in the curriculum included pediatric dysrhythmias (50%), hypotension (36%), drowning (26%), advanced pediatric life support (22%), and neonatal resuscitation (16%). The strong areas of pediatric training, as shown on Table 4, are epiglottitis and croup (98%), respiratory distress (99%), asthma (98%), and seizures (95%).

Equipment

The equipment questionnaires were returned by 63 of 82 (77%) provider agencies outside of California. The majority of agencies responding (80%) were public EMS providers, 13% were private, and 7% were staffed by volunteers. Most (43%) served urban EMS systems, 30% rural, and 19% urban and rural. The deficiencies in pediatric equipment carried by EMS providers are shown in Table 5. Many responding units (24%) did not have a complete set of blood pressure cuffs, 51% had no infant cuffs. Prefilled syringes with 10 mL of sodium bicarbonate (1 mEq/mL) was not carried by 49% of the agencies. Although most providers carried a bag-valve-mask resuscitator, 79% did not have a

TABLE 3. Deficient Areas of Training Programs Surveyed in Pediatric Prehospital Care

Topic	Agencies Without Topic in Curriculum (%)
Pediatric field simulations	50
Pediatric dysrhythmias	50
Envenomation	45
Pediatric hypotension	36
Approach to the comatose child	29
Drowning	26
Sexual abuse	24
Advanced pediatric life support	22
Diarrhea and dehydration	22
Neonatal resuscitation	16
Pediatric trauma	14

TABLE 4. Strong Areas of Training Programs Surveyed in Pediatric Prehospital Care

Topic	Agencies With Topic in Curriculum (%)
Epiglottitis	98
Croup	98
Respiratory distress	98
Asthma	97
Seizures	95
Ingestions and poisoning	91
Child abuse and neglect	90

TABLE 5. Deficiencies in Pediatric Equipment and Supplies Carried by Emergency Medical Services Providers

Equipment and Supplies	No. (%) of Deficient Providers
Doppler BP device	50 (98)
Feeding tubes	
5 F	55 (87)
8 F	51 (81)
Naloxone for neonatal use	45 (74)
Pediatric backboards	40 (63)
24-gauge intravenous catheters	39 (62)
BP cuffs	
Thigh size	33 (52)
Infant size	32 (51)
Dextrostix	32 (51)
Pediatric sodium bicarbonate syringe	31 (49)
Pediatric atropine syringe	34 (48)
Pediatric defibrillator paddles	27 (43)
22-gauge intravenous catheter	19 (30)

complete set of masks. Other deficiencies included small gauge catheters and backboards.

The same equipment questionnaire was sent to all Los Angeles County EMS provider agencies. Of 34 agencies 25 (74%) responded. Although Los Angeles County has a recommended pediatric equipment list, deficiencies were still noted among provider agencies as shown in Table 6. Seventy percent did not carry pediatric bicarbonate and 20% did not have pediatric bag-valve-mask resuscitator.

The Los Angeles County Fire Department reported that all of their EMS squads were in compliance with the recommended equipment list. With the fire department's permission, questionnaires were sent to each individual Los Angeles County fire units. Of 37, 22 (59%) responded. Many of the units did not carry the equipment and supplies that were on the approved list (Table 7). Two squads (9%) did not have a pediatric bag-valve resuscitator, and 27% did not have pediatric masks.

The national survey revealed that 14% of the responding EMS providers used oxygen-powered breathing devices on children and 46 providers (73%) trained their EMS personnel to endotracheally intubate children.

Seventeen prehospital care systems for children were identified. The majority of these (88%) are voluntary systems that provide direct (62%) or secondary (88%) transfer for pediatric critical care. The age groups served by these systems were: neonates only, two (12%), 0 to 14 years, three (18%), 0 to 16 years, one (6%), and all ages, ten (59%). Of the areas that have prehospital care systems for children, six (35%) were in the west, five (29%) the midwest, five (29%) the northeast, and one (6%) the south. Eighteen percent have been in operation less than 5 years, 29% 5 to 7 years, and 62% 8 to 10 years.

TABLE 6. Los Angeles County Emergency Medical Services Provider Pediatric Equipment Survey*

Equipment	No. (%) of Providers Without Equipment
Pediatric defibrillator paddles (optional)	14 (56)
Infant BP cuff	8 (32)
Child BP cuff	3 (12)
Pediatric backboard	13 (52)
Pediatric femur splint	5 (20)
Pediatric bag valve mask resuscitator	5 (20)
Child mask	4 (16)
Infant mask	4 (16)
Burn pack	3 (12)
23-gauge butterfly cannulas	1 (4)
25-gauge butterfly cannulas	5 (20)
22-gauge intracatheters	6 (30)
Sodium bicarbonate (10 mEq/10 mL)	19 (70)

* n = 25; 25/34 = 74% respondents.

TABLE 7. Los Angeles County Fire Department Paramedic Squad Equipment Survey Results Compared With Required Items*

Item	No. (%) of Squads Without Item
Pediatric defibrillator paddles (optional)	2 (9)
Infant BP cuff	2 (9)
Child BP cuff	2 (9)
Pediatric backboard	16 (73)
Pediatric femur splint	3 (14)
Pediatric bag valve mask resuscitator	2 (9)
Child mask	6 (27)
Infant mask	6 (27)
Burn pack	3 (14)
23-gauge butterfly cannulas	1 (5)
25-gauge butterfly cannulas	5 (23)
22-gauge intracatheters	7 (32)
Sodium bicarbonate (10 mEq/10 mL)	16 (73)

* n = 22; 22/37 = 59% respondents.

DISCUSSION

EMS have been organized primarily to meet the needs of the adult patient. Although pediatric patients frequently access these systems, the EMS providers may not be equipped or trained to manage pediatric emergencies.

Emergency medical technicians (EMT-Is) receive from 50 to 100 hours of training. EMT-IIs and EMT-Ps (paramedics) receive from 400 to 2,000 hours of training. Training time is generally split into one-third didactic, one-sixth to one-third clinical training, and one-third preceptorship in the field. The majority of training takes place at colleges and universities, however, some curricula are developed by local hospitals and EMS agencies. This study demonstrates that training in pediatrics often contains few hours of lecture and less of hands-on-experience in pediatric emergency departments, intensive care units, or other specialized pediatric areas.

The equipment and supplies carried by EMS providers must be determined by the need of the system. It is often limited by the space on the responding vehicle. Data from this study indicate that basic deficiencies do, however, exist in equipment and supplies necessary for adequate resuscitation of critically ill children. Oxygen-powered breathing devices that generate high inflation pressures that may lead to gastric distension and barotrauma are still used by some EMS agencies in

resuscitating children.

Although there are a number of programs to transfer critically ill children to pediatric centers, these are few and generally not part of the official EMS system.

To improve outcomes of children entering the EMS system (1) more attention should be directed toward the training of EMTs and paramedics in pediatric emergencies, (2) minimal standards for pediatric supplies and equipment for EMS response vehicles must be developed, and (3) transportation guidelines to direct children to facilities that can offer rapid and appropriate definitive care for both trauma and medical emergencies should be part of the EMS system.

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SEAT BELTS REVIEWED

In 1981, and at the tenth time of asking, the British Parliament agreed to make compulsory the wearing of seat belts by the drivers and front passengers of most motor vehicles. An argument much used by proponents of compulsion was that 1000 lives a year would be saved. This has not happened, and the reason is not lack of compliance. Seat belt wearing rates, hovering around 40% in 1982, rose to 95% when compulsion began three years ago and have remained there. However, the Department of Transport is not now claiming more than 470 lives a year saved by this measure, and there have been some unexplained and worrying increases in deaths of other road users, including rear-seat passengers. The Department's statistical assessors put the reduction in numbers killed at between 207 and 459 in a year, the serious injuries tally falling by about 7600 (10,000 was the promise back in 1981).... There will be regret that the evidence on deaths is not more one-sided and disappointment that the measure has fallen short of its promise.

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