The Training of Pediatric Residents in the Care of Acutely Ill and Injured Children

Jennifer L. Trainor, MD; Steven E. Krug, MD

Objectives: To describe the current educational experience of pediatric residents in pediatric emergency care, to identify areas of variability between residency programs, and to distinguish areas in need of further improvement.

Design: A 63-item survey mailed to all accredited pediatric residency training program directors in the United States and Puerto Rico.

Setting and Participants: Pediatric residency programs and their directors.

Main Outcome Measures: Primary training settings, required and elective rotations related to the care of the acutely ill and injured child, supervision of care, procedural and technical training, and didactic curriculum in pediatric emergency medicine (PEM).

Results: One hundred fifty-three (72%) of 213 residency programs responded. One hundred nine (71%) were based at general or university hospitals, the remaining 44 (29%) were based at freestanding children’s hospitals. Residents most commonly saw patients in pediatric emergency departments (54%), followed by acute care clinics (21%), general emergency departments (21%), and urgent care clinics (5%). The mean number of weeks of PEM training required was 11, but varied widely from 0 to 36 weeks. Forty programs (27%) required their residents to spend 4 or fewer weeks rotating in an emergency department setting. The best predictor of the number of weeks spent in emergency medicine was residency program size, with small programs requiring fewer weeks (7 weeks for small [1-8 postgraduate year 1 residents] vs 13 for medium [9-17 postgraduate year 1 residents] vs 15 for large [≥18 postgraduate year 1 residents]). Pediatric surgery (18%), orthopedic (8%), anesthesia (6%), and toxicology (4%) rotations were rarely required. Ninety-two percent of the programs had 24-hour on-site attending physician coverage of the emergency department. Supervising physicians varied widely in their training and included PEM attendings and fellows, general emergency medicine attendings, and general pediatric attendings. Small programs were less likely to have PEM coverage (57% at small vs 95% at large) and more likely to have general emergency medicine coverage (79% at small vs 29% at large). Reported opportunities to perform procedures were uniformly high and did not differ by program size or affiliated fellowship. Residency program directors were uniformly confident in their residents’ training in medical resuscitation, critical care, emergency care, airway management, and minor trauma. Thirty-seven percent of all respondents were not confident in their residents’ training in major trauma. Most programs reported that they had a didactic PEM curriculum (77%), although the number of hours devoted to the lectures varied substantially.

Conclusions: Wide variability exists in the amount of time devoted to emergency medicine within pediatric residency training curricula and in the training background of attendings used to supervise patient care and resident education. Nevertheless, pediatric residency training programs directors feel confident in their residents training in most topics related to PEM. Residents’ training in major trauma resuscitation was the most frequently cited deficiency.


PEDiatric EMERGENCY medicine (PEM) is a relatively young subspecialty of pediatrics. As PEM has evolved, so too have the methods of teaching residents to care for acutely ill and injured children. Once the province of the general emergency medicine (GEM) physician or general pediatrician, the acutely ill and injured child is increasingly being cared for in a pediatric emergency department (ED) by specialists with advanced training and experience in PEM.

Pediatric emergency medicine as a field encompasses everything from the rapid assessment and management of acute injuries and other surgical emergencies, to the care of the poisoned child, to the management of common general pediatric and primary care issues. It is also a proce-
MATERIALS AND METHODS

A survey tool, initially developed by the National Emergency Medical Services for Children Resource Alliance to assess PEM training in GEM residency programs, was modified to assess training in pediatric residency programs. In December 1996 a pilot version of this survey was distributed to 9 pediatric residency program directors throughout the country. The final version of the survey was modified to incorporate feedback from the pilot version. The 4-page, 63-item survey consisted of the following 7 major sections: general description of residency program, required and elective rotations, PEM training, supervision of emergency care, procedural and technical skill training, and curriculum. Question types included yes/no (36), fill in the blank (15), rank (8), open ended (3), and multiple choice (1). Fill-in-the-blank items were limited to questions regarding the number of hours or weeks residents spent in various activities and patient volumes seen in the ED. Respondents were asked to provide their best estimate if actual numbers were unknown. Program directors were instructed that a suitable physician designee could fill out the survey on their behalf.

Program directors were asked via yes/no question if “all residents uniformly have the opportunity to perform the following activities/procedures”: lumbar puncture, arterial puncture, chest tube placement, splinting, wound repair, conscious sedation, bag-valve mask ventilation, rapid sequence intubation, peripheral venous line insertion, central venous line insertion, intravenous line insertion, participant in medical resuscitations, and participant in trauma resuscitations. The survey did not specify that these procedures were done in the ED; they could have been performed anywhere in the hospital.

In addition, respondents were asked to rate their confidence in their residents’ training in skills related to the management of acutely ill or injured patients in the following 6 major areas: pediatric emergency care, minor trauma, major trauma, airway management, medical resuscitation, and pediatric critical care. Possible responses included very confident, confident, not confident, and definitely not confident. Because there were so few definitely not confident responses, these were included in the not confident category for analysis.

Program directors were asked to identify supervising physicians in their ED and faculty members responsible for didactic education in PEM in 2 separate areas of the survey. Possible responses included PEM attendings, PEM fellows, general pediatricians, and PEM attendings. Board certification and eligibility were not specified in the questionnaire, although they were assumed.

Possible locales where residents might see PEM patients included general EDs, pediatric EDs, urgent care or fast track areas, or acute care clinics. We incorporated all of these settings to address residency programs with small or nonexistent pediatric EDs whose sick patients went to an ambulatory clinic instead.

Prior to data analysis, programs were categorized by size according to the number of postgraduate year 1 (PGY-1) residents per year in training as either small (1-8 PGY-1 residents), medium (9-17 PGY-1 residents), or large (>18 PGY-1 residents). We could not find any prior published standards for program size; these designations were made by consensus to facilitate data analysis.

Surveys were mailed along with self-addressed stamped envelopes to program directors of all accredited pediatric residency programs in the United States and Puerto Rico in January 1997. The names and addresses of all programs were obtained from the 1996-1997 Graduate Medical Education Directory published by the American Medical Association. Nonresponding programs were sent an additional copy of the survey along with a self-addressed stamped envelope 3 months later. At the May 1997 meeting of the Pediatric Academic Societies, additional surveys were distributed to residency program directors at their section meeting. Programs not returning surveys by August 1997 were considered nonresponders. In cases where more than one survey was received from a given institution, only the initial submission was used for data analysis. The respondents were assured that their responses to the survey would remain confidential. Only the primary investigator (J.L.T.) was aware of programs by name. Even with this assurance, some respondents chose not to identify themselves.

Data were entered and analyzed using SPSS for Windows, Version 6.1.4 (SPSS Inc, Chicago, Ill). Statistical analyses were performed on nominal data using the chi-squared test and on continuous variables using the t test. Additional analyses were performed using 1-way analysis of variance with Tukey’s Honestly Significant Difference multiple comparisons test. Results of statistical tests were considered significant for P<.05.

February 1997, issued new requirements for pediatric residency education in the care of acutely ill and injured children. The Residency Review Committee now requires 4 months of acute illness experience, with at least 3 of the 4 months in emergency medicine. At least 1 of those months must be in an ED accepting emergency medical services ambulance traffic.

Little has been published regarding pediatric resident experience in PEM. Most recently, Del Beccaro and Shugerman1 reported on the spectrum of illness and the number of patients seen in a single busy pediatric ED. In the late 1980s, Isaacman and Davis2 described practice patterns in EDs associated with pediatric training programs, but did not directly discuss resident education. Fein et al3 surveyed a sample of chief residents regarding the teaching practices in the ED itself, but did not evaluate other components of


©2000 American Medical Association. All rights reserved.
the residency program contributing to knowledge of the care of acutely ill and injured children. Our study attempts to describe comprehensively the current educational experience of residents in all areas related to the care of ill and injured children, to identify areas of variability between programs, and to distinguish areas in need of further improvement.

RESULTS

One hundred fifty-three (72%) of 213 residency programs responded. Seventy-eight percent of the surveys were completed by residency program directors, 8% were completed by PEM physicians, 8% were completed by chief residents, and 3% by either the chairman or director of ambulatory pediatrics. Three percent of the respondents did not identify themselves by title or name. Responding programs represented 48 states and the territory of Puerto Rico. The 2 states not represented each contain a single pediatric emergency medicine residency program. On average, nonresponding programs had fewer PGY-1 residents per year than responding programs (10 PGY-1 residents vs 13 PGY-1 residents, \( P < .05 \)). Small residency programs (1-8 PGY-1 residents per year) were underrepresented accounting for 35% of the responding programs vs 51% of the nonresponding programs. No differences were noted in the response rates of medium-sized programs (9-17 PGY-1 residents per year). Large residency programs (≥18 PGY-1 residents per year) were more likely to respond, accounting for 25% of the responding programs vs 13% in the nonresponding programs. The remainder of the results will focus on programs that responded to the survey.

GENERAL RESIDENCY PROGRAM CHARACTERISTICS

One hundred nine (71%) of 153 programs were based at general or university hospitals. The remaining 44 (29%) were based at freestanding children’s hospitals. The mean number of residents per year at the PGY-1 level was 13, with a range of 4 to 41 residents. Fifty-six percent of programs had affiliated emergency medicine residency programs and almost one third had a postgraduate training program in PEM. Residents at 34% of the residency programs rotated to other sites for some or all of their acute illness or emergency care training. These sites most commonly consisted of community hospitals (48%), followed by children’s hospitals (33%), general hospitals (31%), freestanding acute care clinics (23%), and other university hospitals (21%). Residents most commonly saw emergency patients in pediatric EDs (53%), followed by acute care clinics (21%), general EDs (21%), and urgent care clinics (5%).

Programs with PEM fellowships were more likely to see patients primarily in the pediatric ED (96% vs 56%, \( P < .001 \)). Programs without such fellowships were more likely to see patients primarily in a general ED (70% vs 32%, \( P < .001 \)). For all programs combined, the mean yearly outpatient acute illness census was 29,050 patients, but the range varied widely (1500-85,000). Some programs reported only ED patient volumes while others included walk-in clinic patient encounters as well. Twenty percent of the respondents did not quantify their patient volume. Larger-sized residency program correlated with a greater acute illness census and more weeks spent in PEM rotations (Table).

REQUIRED AND ELECTIVE ROTATIONS

Ninety-seven percent of the programs required clinical training in PEM. The mean number of weeks required during residency was 11, with a median of 9 weeks, and a total range of 0 to 36 weeks. Four residency programs (3%) identified PEM as a nonrequired elective rotation. At all 4 programs, residents cared for ill patients in an acute care walk-in clinic. Three additional programs (2%) had only 1 or 2 required weeks of emergency medicine experience, and 33 more (22%) required only 4 weeks. Residents in training programs with no access to PEM faculty spent significantly less time in emergency medicine rotations (6 vs 12 weeks, \( P < .001 \)). The best predictor of number of weeks spent in emergency medicine was residency program size, with small programs requiring fewer weeks (Table). Programs requiring less ED time generally had more acute care clinic hours. Thus, when the total number of weeks of emergency medicine, urgent care, and acute care were combined, the mean number of weeks did not differ significantly between residency programs. (Figure 1) Ninety-nine percent of the programs required rotations in pediatric critical care, with a mean and median of 8 weeks’
experience (range, 2-24 weeks). Twenty-four percent of the programs required a pediatric transport rotation, with another 33% offering it as an elective (Figure 2A).

Twenty-three percent of the training programs required a child maltreatment rotation, averaging 2 weeks per resident, and an additional 44% offered it as an elective. Rotations in general pediatric surgery, orthopedic surgery, pediatric anesthesia, and toxicology were rarely required (Figure 2B). Twenty-eight percent of the programs did not offer an elective in pediatric anesthesia, and 53% had no available toxicology rotation. Larger residency programs were significantly more likely to offer toxicology rotations to their residents (66% large vs 48% medium vs 32% small, P = .006). Programs affiliated with PEM fellowships were also more likely to offer toxicology (66% vs 39%, P < .002) and anesthesia (83% vs 67%, P < .05) rotations.

SUPERVISION OF EMERGENCY CARE

Ninety-two percent of the residency training programs had 24-hour on-site attending physician coverage of the ED. Of those programs that did not have such coverage, a mean of 15 hours daily was supervised on site. The credentials of supervising physicians varied widely and included PEM attendings (77%) and fellows (27%), GEM attendings (60%), and general pediatric attendings (48%). Many programs used more than 1 type of physician to supervise care. Trainees at 23% of the programs had no access to supervision by PEM faculty. Small programs were significantly less likely to have PEM faculty and more likely to have GEM attending coverage (Table 1). Programs that did not use PEM attendings for supervision were also more likely to provide supervision with general pediatric attendings (71% vs 29%, P = .002) and GEM attendings (89% vs 11%, P < .001).

PROCEDURAL AND TECHNICAL TRAINING

Residency program directors were asked whether residents uniformly had the opportunity to perform a variety of procedures and activities. Reports of procedural performance were universally high with greater than 95% of the programs identifying all residents as having the opportunity to perform lumbar puncture, peripheral line insertion, arterial puncture, bag-valve mask ventilation, and wound repair, as well as active participation in medical resuscitations. In addition, 88% of the programs reported that all residents had the opportunity to perform conscious sedation, 85% to splint fractures, and 83% to insert intravenous lines. The lowest percentages reported were chest tube placement (76%), central venous line insertion (76%), and rapid sequence intubation (74%). Residents did not routinely have the opportunity to participate in trauma resuscitations at 26% of the programs. There were no significant differences between procedures performed when analyzed by the presence of a PEM fellowship program, residency program size, or number of weeks spent in emergency medicine. Eighty-four percent of the programs had some method of tracking performance of procedures, most involving log sheets or resident databases. Programs where residents spent more time in emergency medicine were significantly less likely to formally track performance of procedures (95% in programs requiring ≤ 4 weeks in the ED vs 65% in those requiring > 20 weeks in the ED, P = .006).

CONFIDENCE IN TRAINING

Respondents were asked to rank confidence in their residents’ training in the following 6 major areas: pediatric emergency care, minor trauma, major trauma, airway management, medical resuscitation, and critical care. Confidence ratings were high, with more than 90% of the directors reporting that they were very confident or confident in all areas except major trauma. In the area of major trauma, only 14% of the program directors were very confident, with another 46% replying confident. Thirty-seven percent of all respondents were not confident in their residents’ training in major trauma (Figure 3). No significant differences were reported in confidence in training when analyzed by program size or number of weeks spent in emergency medicine (Table 1). The presence of a PEM fellowship program was associated with significantly greater reported confidence in training in both major trauma (74% vs 56%, P = .04) and minor trauma (100% vs 92%, P = .05).

CURRICULUM

Seventy-seven percent of the programs reported that they had a formal PEM curriculum. The number of didactic
hours per trainee varied substantially ranging from 6 to 156 hours, with a mean of 36 hours per program and a median of 24 hours per program. In addition, 98% of programs required Pediatric Advanced Life Support certification, 14% required Advanced Pediatric Life Support certification, 90% required Neonatal Resuscitation Program certification, and 9% mandated Advanced Trauma Life Support certification. Mock codes and morbidity and mortality conferences were used as PEM teaching tools by 84% and 85% of the programs, respectively. Fifty-two percent of the programs also had technical skill inservices, most using mannequins and nonliving animal models. Few programs reported the use of live animals.

Large programs, programs with affiliated fellowships, and programs with more weeks of emergency medicine were also significantly more likely to use mock codes for teaching. In addition, programs with affiliated PEM fellowship programs were more likely to have a formal PEM curriculum (92% vs 70%, \( P = .004 \)).

**TARGETED AREAS IN NEED OF IMPROVEMENT**

Residency program directors were asked via open-ended questions to comment on any aspect within their training program in need of improvement. Eighty-three residency program directors (54%) of the total group responded. The following summarizes this subset of responses. Major trauma was the area cited most frequently, with 44% of those answering identifying this as an area of weakness. Twenty-five percent of the respondents replied that their residents needed more training in orthopedic examination, splinting, and fracture management. Twenty-one percent believed their residents should have additional experience in the management of minor trauma. Other notable areas were minor surgical procedures such as suturing and wound repair (15%) and toxicological management (11%). Pediatric transport (8%), triage skills, both telephone and in-person (5%), and evaluation of physical and sexual abuse (8%) were also identified as areas of weakness. Several residency program directors (6%) believed that the presence of more PEM-trained personnel would be an asset to their residents’ training and education.

Overall, pediatric residency training program directors are confident in the adequacy of their residents’ training in topics related to pediatric emergency care. Most residency programs require at least 8 weeks of emergency medicine clinical training and most offer a variety of elective experiences to complement the required ED training. The vast majority of programs have 24-hour in-house coverage of the ED.

On-site supervision in the ED by attending physicians increased substantially from previous published reports. In 1988, Isaacman\(^5\) reported that only 65% of the residency programs with PEM fellowships had 24-hour attending or fellow coverage. More than 90% of the programs we surveyed had 24-hour on-site attending physician coverage of the ED. In 1986, Baker\(^6\) noted that only 10% of the EDs affiliated with pediatric training programs had pediatric attending coverage around the clock. At that time, 33% of the programs had no attending pediatric faculty at all in the ED. Only 6% of the programs we surveyed did not have any pediatric coverage of their ED. In addition, 77% of programs we surveyed had some coverage by PEM attendings or fellows.

However, this survey uncovered marked variation in the number of weeks pediatric residents spend in emergency medicine rotations and in the training background of the attendings that supervise them. Depending on his or her training program, a pediatric resident could work between 0 and 36 weeks in an ED. Most striking is that in 27% of the programs, residents spent 4 or fewer weeks in an ED during their 3 years of training. Notably, the number of weeks of training increased significantly with larger program size and with the presence of a PEM fellowship program.

Del Becarro and Shugerman\(^1\) reported their experience in a tertiary pediatric ED of a 200-bed children’s hospital in 1998. Despite the fact that residents spent an average of 15 weeks over 3 years of residency in an ED seeing more than 23,000 visits per year, they documented significant training weaknesses. In 3 years of training, a pediatric resident saw an average of 467 patients. Even with this volume, 11% never managed a case of child abuse, 16% never took care of a case of toxic ingestion, 21% never saw a child with acute appendicitis, and 74% never witnessed a case of anaphylaxis. One third never diagnosed a case of intussusception and almost half never managed a child with Henoch-Schönlein purpura. Fifty-two percent of the residents had never performed an intubation in the ED during their residency. This was the experience in a large residency program with a moderate volume, high-acuity pediatric ED. The experience of the residents in a small residency program whose residents see fewer patients and spend fewer weeks in ED rotations is likely to be significantly more limited.

One way to accommodate for this is to augment ED time with subspecialty exposure in related areas. However, we found that training in areas related to the care of the acutely ill and injured child including transport, anesthesia, child abuse, toxicology, orthopedics, and pediatric surgery were rarely required and often unavailable as electives. It may be that the traditional rotations in the surgical subspecialty areas were geared toward managing inpatients, and thus not particularly enlightening regarding management of outpa-
While it may be impossible to define a critical clinical threshold for procedures, many programs may leave a training gap at such programs. This study had several limitations, some inherent to the survey format as a research tool, others to the particular content of our survey. Recall bias and reporting bias are acknowledged limitations to the survey method. We attempted to direct the survey to residency program directors to receive the most accurate information about required and elective rotations both in emergency medicine, and other rotations conducted outside the ED that affect the care of the acutely ill and injured child. Our response rate, although high, was not 100%. Response bias, however, may actually have made our results appear more optimistic because a disproportionate number of small programs did not respond to the survey. These are the programs we identified as least likely to have a formal emergency medicine curriculum and rotations.

Our reliance on residency program directors’ (or their designees’) self-report is most problematic for subjective responses. While one would hope reported information would be accurate for clear-cut questions such as who provides care in the ED, questions regarding resident performance of procedures and confidence in training are more subjective. Unless the respondent actually worked in the ED or reviewed resident procedure logs for relevant items personally, it would be difficult to know with certainty if all residents actually perform these procedures. In addition, the fact that the survey was handled confidentially, but not anonymously, may have biased some respondents to artificially inflate their responses. Despite the lack of anonymity in the survey, however, many programs identified themselves as out of compliance with the Residency Review Committee recommendations.

CONCLUSIONS

Despite the Residency Review Committee’s recommendations that pediatric residents need at least 8 weeks of experience in the care of acutely ill and injured children during the course of their residency, this survey found that as of 1997 three percent of programs did not require any emergency medicine experience for their residents. An additional 22% of programs required only the minimum experience of 4 weeks in an ED, with the remainder of the experience in an ambulatory walk-in clinic where patient acuity may be much lower and the spectrum of injury and/or illness very different. Complementary subspecialty experiences in orthopedics, pediatric surgery, anesthesia, toxicology, child abuse, and transport were often unavailable or unused. Major trauma was identified as a training weakness at both small and large programs.

Residents at small programs, which had the lowest ED patient volumes, were also more likely to spend fewer weeks in ED rotations than their colleagues at larger residency programs. The relative infrequency of critical illness in children and limited opportunities to perform invasive or high-risk procedures may leave a training gap at such programs. While it may be impossible to define a critical clinical threshold for an optimal residency training experience, program directors should consider whether their trainees are exposed to a sufficient volume and acuity mix of patients in emergency or acute care settings. Smaller programs might consider forming training alliances with larger or high-volume regional facilities to augment their residents’ education in pediatric emergency care.

Although residency program directors report that residents universally have opportunities to perform a wide range of procedures during their residency and are confident in their training, actual resident experience may differ substantially. Further study is warranted to determine if residents are performing these procedures and to determine what level of confidence they have in their own training. How residency training in the care of acutely ill and injured children prepares trainees for practice after residency is a separate but perhaps more important question.

Accepted for publication May 22, 2000.

This investigation was supported in part by the Department of Health and Human Services Administration, Maternal and Child Health Bureau, Washington, DC, and the National Emergency Medical Services for Children Resource Alliance, Torrance, Calif.

Presented as a scientific poster at the annual meeting of the American Academy of Pediatrics, Boston, Mass, October 31, 1997.

We gratefully acknowledge the assistance of Nancy Ryan in the production and distribution of the surveys, Genie Roosevelt, MD, MPH, for her statistical assistance, and Daniel Isaacman, MD, for his critical review of the manuscript.

Corresponding author and reprints: Jennifer L. Traiger, MD, Division of Pediatric Emergency Medicine, Children’s Memorial Hospital, Box 62, 2300 Children’s Plaza, Chicago, IL 60614.

REFERENCES


Educational Interventions

Purpose: This section is intended to share information concerning educational efforts in the broad field of pediatrics. We welcome studies on the following topics: undergraduate and graduate education in medicine and allied health occupations; continuing education of health professionals; education of patients and families; and health education for the general public, the community, and organizations that contribute to the promotion and improvement of the health of children and adolescents.