Where Are the Sick Kids?

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There are concerns that emergency medicine residents are not sufficiently exposed to critically ill children during their pediatric emergency medicine rotations. In 2007, the Institute of Medicine Committee on the Future of Emergency Care in the United States Health System expressed concern about a lack of substantial training in pediatrics among emergency physicians. They observed that although emergency physicians may be competent in caring for the pediatric population, this competency seems to be gained through experience over time rather than through formal training. In a national survey of 65 emergency medicine programs in 1999, graduating residents logged an average of 107 adult medical resuscitations compared with an average of 19 pediatric ones. Similarly, the average number of adult trauma resuscitations was 74 per graduating resident compared with only 13 for pediatric patients. The authors of this early investigation into the extent of procedural exposure among emergency medicine residents observed the need for alternative methods of gaining exposure to these and other fundamental emergency procedures. Unfortunately, the majority of existing literature exploring these questions has innate limitations owing to study design, power, and recency and thus limited generalizability when considered individually; nevertheless, the pooled information sheds light onto a potential gap in emergency medicine postgraduate training.

In a national assessment of 24 million annual pediatric-aged emergency department (ED) visits in the United States, it was reported that 83% of the physicians providing care were general emergency physicians. When a subgroup analysis of the EDs that treat more than 10,000 pediatric patients a year was examined, the percentage of general emergency physicians rendering care was 45%. Although the busier pediatric EDs do have a greater proportion of pediatric emergency physicians taking care of the children, this accounts for only a fraction of the total number of children seeking emergency care. The majority of children in the United States are receiving emergency care in general hospitals instead of pediatric-specific facilities, and emergency medicine residency graduates must be comfortable and competent in caring for these children after graduation.

A thorough review of pertinent medical literature revealed no current evidence comparing the clinical outcomes of pediatric patients treated by general EDs and pediatric EDs; however, data exist in regard to differences in the medical problems the patients present with and the procedures they undergo. In a retrospective study of the National Hospital Ambulatory Medical Care Survey between 1995 and 2002, general EDs treated more injured children, whereas pediatric EDs treated more with medical problems. The number of critical procedures and resuscitations, such as intubation or cardiopulmonary resuscitation (CPR), may be as common in general EDs as in pediatric ones. A separate cross-sectional study using data from the 2008 Nationwide Emergency Department Sample and the Healthcare Cost and Utilization Project compared the emergency care of medically complex children, defined by having 1 or more complex chronic medical conditions, in pediatric and general EDs. The majority (79%) of pediatric medically complex children received their care at a general ED. Analysis of available data about ED visits by children demonstrates that, whether otherwise healthy or medically complex, they will be cared for by general emergency physicians in general EDs.

Exposure to critically ill children and the procedures necessary to care for them is naturally accompanied by various levels of competence and confidence among emergency medicine residents. Multiple small prospective studies have attempted to elucidate the effects of various educational interventions on residents’ competence and confidence. Surcouf et al. used an in situ simulation program in which pediatric residents were tasked with managing an unannounced neonatal resuscitation in their hospital. After the simulation education, there were significant increases in both the residents’ confidence and competence based on pre- and postself-assessments, as well
as through an independent skills observational assessment. Similarly, in a separate study with pediatric residents undergoing an educational curriculum using mock code scenarios, residents reported a significant increase in their comfort with and ability to run a pediatric code one year after the intervention. These residents also reported a significant decrease in anxiety after the educational intervention. Although actual competence was not ascertained, increased confidence and perception of knowledge may encourage more active participation in critical patient care when the occasion arises.

The available data underscore the need for comprehensive and effective pediatric emergency medicine education during residency. Incorporation of a simulation-based pediatric emergency medicine curriculum to supplement residents’ clinical rotations may provide residents with additional exposure, competence, and confidence in caring for high-triage severity pediatric patients.

**SIMULATION-BASED MEDICAL EDUCATION AND ITS USE IN PEDIATRIC EMERGENCY MEDICINE**

Currently, medical education uses constructivism as one of the main educational theories. A main tenet of constructivism is the notion that the learner increases his or her knowledge by the cognitive and physical experiences he or she is involved in. This apprenticeship model relies on the fact that the learner needs to be exposed to such experiences; in this instance, critical pediatric cases and procedures. Problematically, in pediatric emergency medicine education, these high-triage severity cases and procedures are significantly less common than in adult emergency medicine, making the apprenticeship model inherently difficult to use as an effective educational tool.

Simulation-based medical education is “any educational activity that utilizes simulation aides to replicate clinical scenarios.” Using simulation within medical education allows learners to gain experience in managing clinical scenarios and procedures without putting patient safety at risk. This is especially useful in emergency medicine, in which critical skills such as advanced airway management and other high-risk, low-frequency procedures need to be practiced and mastered. Simulator equipment can be either low fidelity or high fidelity, ranging from simple static mannequins with little realism to mannequins that are capable of talking, blinking, and responding to interventions. Other variants are the use of lifelike body parts, also known as “task trainers,” to practice specific procedural skills such as lumbar puncture or venous cannulation. A 2011 meta-analysis comparing the effectiveness of traditional versus simulation-based medical education with regard to a variety of medical procedural skills demonstrated the relative superiority of simulation-based medical education.

Another systematic review observed that simulation-based medical education facilitates learning through providing feedback, repetitive practice, and curriculum integration, among others. Simulation as a supplement to current educational curriculums has been used in neonatal resuscitation, pediatric advanced life support (PALS), airway management, CPR, and others.

In a prospective, randomized study of emergency medicine residents, those who participated in an educational session that incorporated simulation had increased knowledge and performance of the critical actions in a simulated neonatal resuscitation compared with their counterparts who underwent the existing, standard emergency medicine curriculum. With regard to pediatric airway management, high-fidelity simulation has shown a trend toward improvement in achieving critical actions and a statistically significant improvement on a global competency score after simulation training.

Research on simulation-related clinical outcomes is limited; however, Andrea et al demonstrated that after implementation of a simulation-based mock code program, pediatric cardiac arrest survival increased significantly, up to 50% within their hospital, exceeding the national average. Although there has been an increase in the use of simulation in emergency medicine residencies from 2003 to 2008, only 43% of the programs were using more than 10 hours of simulation annually, roughly less than 1 hour per month. This presents an opportunity for emergency medicine residencies to increase their use of simulation-based pediatric medical education to supplement current curricula.

**INCREASING THE FREQUENCY OF PEDIATRIC SIMULATION-BASED EDUCATION**

Hermann Ebbinghaus first described the notion of the spacing effect in memory and learning in the late 1800s. His idea of having repetitive iterations of verbal, nonverbal, and motor skills spaced over time demonstrated superior memory retention during a massed learning structure with consecutive iterations. The presence of benefits similar to those of the spaced format has been explored within the simulation literature recently.

Patocka et al demonstrated that weekly 75-minute sessions for 4 weeks (eg, spaced format) were comparable to a 1-time 5-hour (eg, massed) format with regard to the learner’s knowledge and performance in pediatric simulated resuscitations. There was a trend toward better retention of skills and greater efficiency in completing
the critical procedures in the spaced format compared with the massed one. In a small sample of physicians and nurses, mere observation of spaced simulation cases during 2-week periods resulted in increases in their knowledge and confidence in managing pediatric critical illness.

PALS is perhaps the most well-known pediatric resuscitation course available, yet there is concern that the 2-year retraining period may be too long, leading to decreased retention of the skills learned. In a prospective, randomized, single-blind study of 40 participants, a “reconstructed PALS” training course was compared with the standard PALS recertification. The reconstructed PALS training course consisted of the same content as a traditional PALS recertification; however, it was spaced into six 30-minute monthly in situ simulations during a 6-month period. According to a previously validated clinical performance tool, the group that underwent the reconstructed PALS course showed a statistically significant improvement in performance of the resuscitation clinical skills compared with participants who underwent the standard PALS recertification. The evidence supporting a spaced simulation format implies that integrating pediatric simulation-based medical education into emergency medicine residency curriculums may benefit from a focus on smaller segments of time, spaced throughout each academic year.

FUTURE DIRECTIONS

As emergency medicine residents undergo training, they are eager and hopeful to encounter every possible illness, procedure, and complication during those 3 to 4 years. Despite whether residents plan to work in a general ED or pursue a fellowship in pediatric emergency medicine after completion of their residency, they must be comfortable and competent in managing critically ill children. The seldom occurrence of a pediatric resuscitation makes it difficult for all emergency medicine residents to be exposed to many resuscitations throughout residency; however, this makes for an ideal situation for simulation-based learning. Despite the demonstrated benefits of simulation in pediatric emergency medical education, simulation-based research quality is highly variable. Development of high-quality simulation-based research with measurable clinical outcomes is essential. As with any venture, buy-in from administration and faculty with regard to the development and implementation of a comprehensive pediatric simulation-based medical education curriculum is essential. The lack of a clear benefit to high-fidelity simulation compared with low-fidelity simulation, paired with the greater cost-effectiveness of low-fidelity simulators, makes implementation of low-fidelity simulation likely financially feasible. Emergency medicine residencies should continue to challenge themselves in expanding their current pediatric curriculum by considering the aspects discussed here (Table). This will not only result in the betterment of residents’ competency but also the betterment of future pediatric patients requiring our critical expertise.

Table. Key actions emergency medicine residency programs can take to enhance pediatric emergency education.

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<th>Recommendation</th>
<th>Example</th>
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<td>Integrate educational time dedicated to pediatric SBME into residency curriculum</td>
<td>Facilitate one 20-min simulation case biweekly during a morning report or educational conference session</td>
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<td>Highlight high-risk/low-frequency skills</td>
<td>Choose cases involving critical decisionmaking and procedural skills, such as the following: Neonatal sepsis resuscitation and placement of an IO, Pediatric bradycardia and initiation of PALS, Pediatric head trauma requiring intubation, Pediatric anaphylaxis stabilization, critical medication dosing, airway protection if necessary</td>
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<td>Incorporate a variety of SBME modalities</td>
<td>Alternate planned versus “unannounced” simulations, in situ simulations, and task trainers when available</td>
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<td>Use current space for SBME</td>
<td>Designate an ED bed in a closed area (ie, a fast-track bed during off hours) to run SBME cases</td>
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<td>Delegate and distribute tasks</td>
<td>Reserve time in a dedicated procedure or simulation laboratory, if available</td>
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<td>Provide feedback to the team leader and team members</td>
<td>Task senior residents with conducting the case while junior residents actively participate</td>
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<td>Pilot spaced format in place of a massed format</td>
<td>Dedicate 10 min at the end of each simulation for debriefing, feedback, and questions</td>
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<td>Contribute to the current medical literature</td>
<td>Pilot a reconstructed PALS course at your institution, with weekly content reinforced during a span of months</td>
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<td>Consider investigating the effect of implementing or enhancing pediatric SBME in your institution</td>
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SBME, Simulation-based medical education; IO, intraosseous line.

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REFERENCES