"Sim One, Do One, Teach One"
A Simulation-Based Trauma Orientation for Pediatric Residents in the Emergency Department

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Objectives: The objective of this study was to determine the effectiveness of a simulation-based curriculum in improving confidence in trauma resuscitation skills and increasing attendance during trauma resuscitations for pediatric residents during their emergency medicine rotation.

Methods: A simulation-based orientation curriculum was implemented for the 2017–2018 academic year. Participants completed a qualitative survey before and after each session to assess their comfort level with skills required in a trauma resuscitation. Responses were compared using the Wilcoxon ranked sum test. Nursing documentation was reviewed for the 2016–2017 and 2017–2018 academic years to determine the frequency of resident attendance at trauma resuscitations. Pediatric resident attendance before and after intervention were compared via χ^2 analysis.

Results: Survey responses showed a significant increase in confidence in all skills assessed, including primary and secondary survey performance, knowledge of pediatric resident role, knowledge of necessary equipment, ability to determine acuity of patient illness or injury, and ability to differentiate between modes of oxygen delivery ($P < 0.01$). There was no statistically significant change in the frequency of pediatric resident attendance at trauma bay resuscitations before and after curriculum implementation (21.2% vs 25.7%, $P = 0.09$).

Conclusions: Through the implementation of a simulation-based trauma orientation for pediatric residents, we were able to improve self-reported confidence in trauma resuscitation skills. This improvement did not result in an increased attendance at trauma resuscitations. Next steps include identifying additional barriers to pediatric resident attendance at trauma bay resuscitations.

Key Words: pediatric emergency department, medical education, simulation, trauma, cardiopulmonary resuscitation

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"See one, do one, teach one" is an age-old adage of health care training that has historically reflected the progressive levels of knowledge acquisition, which typically eases learners into new skills. In pediatrics, the "do one" aspect of this learning triad often becomes a rate-limiting step, especially when it comes to the resuscitation of critically ill patients, as pediatric medical and traumatic emergencies are less common than those in adult medicine.[1] Observational studies have shown that senior residents in the pediatric emergency department (PED) have poor performance and limited exposure to rapid cardiopulmonary assessment of critically ill patients.[2] One survey of pediatric senior residents showed that only 22% had been the first responder to an actual patient resuscitation and 44% reported they had never led a resuscitation during residency.[3] Without this adequate experience, pediatric physicians may not feel comfortable appropriately caring for these patients after residency.[4,5] A national survey of 112 pediatric program directors showed that less than two-thirds of program directors believed that all or almost all of their residents were competent to perform basic procedural skills recommended by the Residency Review Committee (such as basic and advanced life support or endotracheal intubation) by the end of their training.[6] This is concerning because all pediatricians, regardless of their subspecialty, need the ability to respond to critically ill patients but often feel unprepared.[7,8]

Simulation-based medical education is an emerging technique many institutions are using in an attempt to compensate for this lack of clinical experiences.[9] Although there have been numerous publications on the various qualitative benefits of simulation, the literature on quantitative data documenting concrete changes in real clinical practice or outcomes is varied.[9–11] Specifically, simulation interventions targeted at pediatric residents in the PED have shown increased resident confidence in managing critically ill patients, but have not attempted to show a change in their behaviors.[12]

At our institution, we were specifically interested in examining resident behaviors surrounding trauma resuscitations. There was anecdotal concern for limited pediatric resident attendance at trauma resuscitations in our PED, meaning that residents were not engaging in some of the few opportunities available to care for critically ill or injured patients. This has also been demonstrated to be a concern by medical educators nationwide. A survey of accredited pediatric residencies in the United States found that program directors cited a deficiency in training in major trauma as the most common deficiency in residents' ability to care for an acutely ill child.[13] Based on these findings, we developed and implemented a novel trauma-based simulation orientation. Our goal was to provide pediatric residents with a curriculum focused on the resuscitation of critically ill pediatric trauma patients presenting to a tertiary PED. We believe that increased exposure to trauma resuscitation would improve resident confidence and ability in managing critically ill or injured children. The overall objectives of this study were to (1) assess residents' comfort, confidence, and knowledge on various topics related to cardiopulmonary resuscitation through use of electronic preimplementation and postimplementation surveys and (2) determine if this orientation would increase pediatric resident presence and engagement in cardiopulmonary resuscitation for level 1 and level 2 trauma and medical evaluations.

METHODS

Subjects

The study was performed at an academic children's hospital PED that is an American College of Surgeons–accredited level I

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trauma center. Resident staffing in our ED is divided between pediatric residents (including child neurology and combined internal medicine–pediatric residents) and emergency medicine residents. Resident staffing in the PED for trauma resuscitations is not assigned and is reliant on individual responses to overhead pages on the arrival of a level 1 or 2 trauma to one of our trauma rooms. This role can be filled by any resident or pediatric emergency medicine (PEM) fellow.

All categorical, combined internal medicine and pediatrics, and child neurology residents at our institution were invited to participate in this study. The study occurred during their regularly scheduled PEM rotations for the 2017–2018 academic year. Categorical, combined internal medicine and pediatrics, and child neurology residents who had completed a PEM rotation in the prior academic year were used for comparison of resident attendance at pediatric trauma resuscitations. Participants provided consent before participation in the study. The study was approved by our institutional review board before commencement.

Curriculum Development and Implementation

Six scenarios were developed based on common traumatic mechanisms in the pediatric patient population, including closed head injury, blunt abdominal trauma, burns, and falls. Scenarios were reviewed by PEM physicians at our institution. Simulation sessions were conducted every 4 weeks from August 2017 to June 2018 at the start of each resident rotation. Sessions were led by a PEM attending or fellow. The session began with an orientation to the trauma bay, with emphasis on the role of a pediatric resident in a trauma resuscitation and the location of equipment. The session leader would demonstrate an appropriate primary and secondary survey. Each resident would then take turns leading a scenario in the role of a pediatric resident. During each case, they would receive report on the patient, then perform the primary and secondary surveys. They were expected to intervene when appropriate on any abnormalities identified in their assessment. A high-fidelity simulation mannequin was used (Laerdal SimJunior, New York, NY) and operated by a simulation nurse educator. After each case, there was a resident-centered debriefing led by the attending or fellow and simulation nurse educator. This debrief provided feedback on the resident's performance of primary and secondary surveys as well as discussed the appropriate patient management. A general debrief script was provided to help standardize the sessions. All simulations were performed in the trauma bays of the PED at our institution. Group size varied from 3 to 6 based on the individual residents' shift schedules.

Outcome Measures (Survey)

Participants completed an online, qualitative, anonymous survey immediately before the simulation orientation to assess their comfort with various components of pediatric trauma assessment and resuscitation. A follow-up survey regarding their comfort with trauma resuscitation skills was repeated immediately after completion of the simulation. Survey questions are available in Appendix 1, http://links.lww.com/PEC/A527. Participants were asked to rank response to questions on a scale from 0 to 100, where 0 was not comfortable at all, 50 was neutral, and 100 was very comfortable.

Outcome Measures (Chart Review)

During trauma resuscitations at our institution, the charting nurse documents provider presence in the trauma bay, including which individual is present to perform the resident role. The medical record was reviewed for all patients meeting level 1 or level 2 trauma criteria presenting during the 2016–2017 and 2017–2018 academic years to determine the number of trauma activations that occurred and if a pediatric resident was present. The resident's year of training as well as training program was also noted. We reviewed the rotation schedules for each academic year to determine how many residents completed an PEM rotation. We also reviewed the schedule to determine what percentage of shifts was covered by pediatric residents.

Statistical Analysis

Descriptive statistics of our study population were calculated to report participant demographics and compared via χ^2 analysis. Preintervention and postintervention survey responses were compared using the Wilcoxon ranked sum test. Pediatric resident attendance before and after intervention were compared via χ^2 analysis. SPSS software was used to perform statistical analysis. (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0; IBM Corp, Armonk, NY).

RESULTS

A total of 87 residents completed a PEM rotation between August 2017 and June 2018. Of the 87 residents who completed

TABLE 1. Demographic Information for Resident Populations Before and After Curriculum Intervention

	2016–2017	2017–2018 (Scheduled)	2017–2018 (Participated)	*P*
Total no.	89	87	69	
Program				0.20
Categorical	71 (79.8%)	69 (79.3%)	58 (84.1%)	
Child neurology	6 (6.7%)	6 (6.9%)	3 (4.3%)	
Medicine-pediatrics	12 (13.5%)	12 (13.8%)	8 (11.6%)	
Training year				0.24
PGY-1	32 (36.0%)	33 (37.9%)	33 (47.8%)	
PGY-2	27 (30.3%)	24 (27.6%)	16 (23.2%)	
PGY-3	24 (27.0%)	24 (27.6%)	16 (23.2%)	
PGY-4	6 (6.7%)	6 (6.9%)	4 (5.8%)	
Sex				0.16
Male	31 (34.8%)	31 (35.6%)	25 (36.2%)	
Female	58 (65.2%)	56 (64.4%)	44 (63.8%)	

PGY indicates postgraduate year.

TABLE 2. Survey Responses Before and After Curriculum Intervention

	Negative Ranks			Positive Ranks			Ties	Test Statistics	
Survey Questions	**n**	**Median**	**Interquartile Range**	**n**	**Median**	**Interquartile Range**	**n**	***z***	***P***
Primary survey	3	60	30–71	26	78	69–82	1	−4.521	<0.01
Secondary survey	1	50	26–68	28	75	66–80	1	−4.596	<0.01
Resident role	2	38	25–65	28	76	67–84	0	−4.67	<0.01
Equipment	1	28	7–54	28	67	59–75	1	−4.617	<0.01
Sick vs not sick	2	70	60–77	23	74	69–82	5	−3.931	<0.01
Types of shock	2	55	40–67	24	63	56–67	4	−4.083	<0.01
Respiratory distress vs failure	6	64	50–75	21	70	59–76	3	−3.607	<0.01
Oxygen delivery	5	61	50–75	24	70	62–76	1	−4.013	<0.01
Ventilation methods	5	64	53–81	23	71	62–80	2	−3.819	<0.01
Medications	2	45	28–65	24	64	43–70	3	−4.243	<0.01

a PEM rotation during that academic year, 69 (79.3%) attended the simulation-based orientation session before their rotation. Residents were excused if their clinical schedule conflicted with the orientation session. A summary of resident demographic characteristics both before and after the curriculum intervention is included in Table 1. There was no significant difference between the residents rotating in 2016 to 2017, the residents rotating in 2017 to 2018, and residents who participated in the simulation orientation.

Survey responses were compared from before and after the simulation-based orientation session. Of those who participated in the curriculum, 30 (43.4%) completed a postorientation survey to report their level of comfort with various components of trauma resuscitation. For all trauma components that were surveyed, a Wilcoxon ranked sum test indicated that the median postintervention ranks were significantly higher than the median preintervention ranks (Table 2). Negative ranks indicate when a resident's response was lower after intervention, positive ranks indicate when a resident's response was higher after intervention, and a tie occurred when responses were equal. Appendix 1, http://links.lww.com/PEC/xxx contains full survey questions as well as definitions of question identifiers used in Table 2.

There were 539 level 1 and 2 trauma activations during the 2016–2017 academic year and 475 during the 2017–2018 academic year (Table 3). There was no statistically significant change in the frequency of pediatric resident attendance at trauma bay resuscitations before and after curriculum implementation (21.2% for 2016–2017 academic year vs 25.7% for 2017–2018 academic year, $P = 0.09$). For comparison, on review of the rotation schedules for the 2016–2017 and 2017–2018 academic years, pediatric residents provided staffing for 59.5% of resident shifts in the PED for both years, with the other shifts being covered by emergency medicine residents.

DISCUSSION

In this evaluation of a simulation-based trauma orientation for pediatrics residents rotating through the PED, we were able to demonstrate improved confidence in trauma resuscitation skills. However, despite attendance by most pediatric residents at this simulation orientation, this improved confidence did not translate into increased attendance by pediatric residents at trauma resuscitations.

Qualitative surveys of learner confidence are frequently used in assessment of an educational curriculum. Specifically, simulation as an educational modality has been shown to result in improvements in learner confidence, although it is often difficult to assess whether those changes will result in improved clinical performance or patient outcomes. Many simulation studies are able to show improvement on retesting in simulated scenarios, although it is not guaranteed that these changes will be sustained in clinical practice.[14–17] Interestingly, there are multiple studies that show improvement in clinical practice after a simulation intervention, although these are often based on observation of a specific procedural skill, such as surgical knot tying or cardiac auscultation, as these skills are easy to identify and measure.[18–21] There have been some simulation-based studies that have shown improvement in clinical practice in regard to more complex skills, such as adherence to advanced cardiac life support protocols,[22] or that have shown improvements in patient outcomes.[23,24] Ultimately, systematic reviews of simulation studies have agreed that simulation can be an effective intervention resulting in "large effects for outcomes of knowledge, skills, and behaviors and moderate effects for patient-related outcomes."[25]

In addition to these successful simulation interventions, there have also been multiple studies that have shown increased provider confidence when specifically addressing pediatric trauma resuscitation. Interventions directed at rural emergency department teams,[26] interdisciplinary teams at a tertiary care PED,[27] and emergency medicine residents and PEM fellows[28] have shown improvement in both provider confidence and performance in a simulated trauma scenario. Our study is unique in its attempt to show a correlation between increased resident confidence in trauma resuscitation skills and improved attendance at trauma bay resuscitations as a demonstration of change in learner behavior. However, our intervention demonstrated that increased confidence does not necessarily result in increased attendance at trauma bay resuscitations.

TABLE 3. Pediatric Resident Attendance at Trauma Resuscitations Before and After Curriculum Intervention

	Academic Year		
	2016–2017 (Precurriculum)	**2017–2018 (Postcurriculum)**	***P***
Pediatric resident present?			
Yes	114	122	
No	425	353	
Total	539	475	
% Attendance	21.15	25.68	0.09

This study did not examine the reasons why resident attendance did not change, but we have several hypotheses. It is possible that pediatric residents who are not planning to pursue a career in emergency or critical care medicine may not see the value and translation of skills learned in the trauma bay. These clinical experiences are not required in that there are often other providers present (emergency medicine residents or PEM fellows) who can fill in the role of the pediatric resident if the pediatric resident does not appear in the trauma bay. Pediatric residents may feel uncomfortable in a high-pressure, high-stakes situation where they are expected to perform these skills in front of colleagues. Ultimately, further studies could work to identify and target barriers that are preventing full pediatric resident engagement in trauma resuscitations.

We consider the strengths of this study to include a high attendance rate by residents at the simulation sessions (79.3%) and the ability to observe, through review of nursing documentation, some aspect of the learner's response to the curriculum in actual clinical scenarios. We do acknowledge limitations to our study. The monthly sessions were run by different fellows and attendings. Although they were provided with a standardized format and script, there may have been differences in how scenarios were presented and how sessions were debriefed based on each individual's teaching style. We had a low response rate to our postintervention survey (43.4%), which does not affect chart review for resident attendance but does impact our interpretation of reports of increased confidence in resuscitation skills. This study is also limited because it is a retrospective chart review and is susceptible to the limitations of this study design. Lastly, review of nursing documentation for resident attendance is a simple measure. It does not provide information on how pediatric residents performed their designated skills during a trauma resuscitation. Future studies should aim at improving both learner attendance to these crucial experiences while also measuring their performance during the evaluation and management of critically ill or injured children.

CONCLUSIONS

We demonstrated that a simulation-based trauma orientation for pediatric residents before their PEM rotation resulted in increased self-reported confidence in basic trauma resuscitation skills but did not affect resident attendance at actual trauma bay resuscitations. For educators, it is an important reminder that increased confidence reported by learners may or may not affect their clinical practice. Future efforts should aim to identify barriers for pediatric resident participation in the management of critically ill or injured children and to improve resident attendance during these encounters as well as the quality of their performance during resuscitations.

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