Low-Fidelity, In-Situ Pediatric Resuscitation Simulation Improves RN Competence and Self-Efficacy

Authors: Ada Saqe-Rockoff, RN, MSN, CEN, CNS, Amanda V. Ciardiello, RN, BSN, CEN, and Finn D. Schubert, MPH, Brooklyn, NY

Contribution to Emergency Nursing Practice

- The purpose of this practice improvement project was to improve RN competence and self-efficacy in pediatric resuscitation scenarios using a low-fidelity simulation.
- The primary outcome of this practice improvement project was increased RN competence and self-efficacy for pediatric resuscitation scenarios as measured by a pre-post confidence scale and clinical performance assessment tool.
- Key implications for emergency nursing practice based on this project are that *in situ* low-fidelity simulations led by RNs can contribute to significant improvement in adherence to resuscitation guidelines and staff confidence.

Abstract

Problem: ED staff lack adequate exposure to critical pediatric patients to develop competence and confidence in resuscitation scenarios. Simulations of various designs have shown success at increasing health care staff performance and self-efficacy.

Methods: We developed a nurse-led, low-fidelity *in situ* simulation of a pediatric sepsis scenario. The primary goal was to improve staff adherence to resuscitation guidelines, as measured by the Clinical Performance Tool, a set of checklists designed to measure adherence to Pediatric Advanced Life Support algorithms by multidisciplinary teams during simulations. The secondary goal was to improve staff confidence, measured by the Confidence Scale, a 5-item Likert-type scale that can measure any psychomotor skill.

Results: A total of 43 RNs participated in 12 simulations over a period of 3 months. Mean Clinical Performance score improved by 74%, from 5.3 to 9.2 ($P < 0.001$). Mean confidence score for RNs improved by 56%, from 2.48 (standard deviation [SD] 0.83) to 3.88 (SD 0.66) ($P < 0.001$). Several systems issues were identified and addressed by multidisciplinary teams, such as increasing respiratory therapist response to the emergency department and updating of the Broselow cart.

Discussion: *In situ* low-fidelity simulations led by RNs contributed to significant improvement in adherence to resuscitation guidelines and in staff confidence. The simulation design had minimal impact on staffing and budget and enabled identification and correction of systems issues.

Key words: Pediatric resuscitation; Low-fidelity simulation; *In situ* simulation; Nurse-led simulation; Emergency department

In many settings, health care providers do not have enough exposure to critically ill pediatric patients to develop confidence and competence to care for these patients. A national survey of 65 emergency medicine programs revealed that, on average, a graduating ED physician participates in only 19 pediatric resuscitations, compared with 107 adult resuscitations.[1] Because of the low frequency of these events, nursing staff also has low exposure to critically ill pediatric patients. Without repeated experiences of similar patient scenarios, procedures, and equipment use, it is difficult for staff to build the competence and confidence needed to care for critically ill pediatric patients in a timely manner.[2]

Ada Saqe-Rockoff is a Clinical Nurse Specialist at NYU Langone Hospital–Brooklyn, Brooklyn, NY.

Amanda V. Ciardiello is a Nurse Educator at NYU Langone Hospital–Brooklyn, Brooklyn, NY.

Finn D. Schubert is in the Clinical Research Department, NYU Langone Hospital–Brooklyn, Brooklyn, NY.

For correspondence, write: Finn D. Schubert, MPH, NYU Langone Hospital–Brooklyn, 150 55th Street, Brooklyn, NY 11220; E-mail: finn.schubert@nyumc.org.

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Simulations are one approach to helping staff build competence and confidence in various patient scenarios and have been shown to lead to improvements in clinical performance, staff confidence, teamwork, and hospital preparedness.[3-5] Decreased rates of medication errors, decreased morbidity and mortality, and improved survival in patients post-cardiac arrest have also been shown after implementation of simulation-based education.[6-9] *In situ* simulations have been used as an investigative methodology by bringing the scenario into the clinical environment and assessing the teams and real-world equipment and identifying systems issues.[5] Participants of both *in situ* and in-center simulations overwhelmingly preferred *in situ* for realism and effectiveness.[10]

Simulators of low, medium, and high fidelity are available. High-fidelity simulators (HFS) use computer-based mannequins, cadavers, or animal tissue and can cost up to $200,000 for a single mannequin, computers, and initial training.[11] Low-fidelity simulators (LFS) include mannequins that do not have any automated or programmable responses to treatments or simulate body functions such as heart or lung sounds.[12] Nearly all studies that compared HFS with LFS, in terms of gains in performance and transfer to real patients, show no significant advantage of HFS over LFS.[13-16]

In education and work environments, learning outcomes are often measured with tests or through records of training hours. Unfortunately, multiple choice testing can only measure the most basic steps of learning, knowledge, and comprehension.[17] Competence of the learner is more accurately assessed through their ability to apply and analyze knowledge.[17] Simulation enables the learner to progress from knowledge and comprehension to application and analysis.[17] Simulations can also motivate adults to learn by enhancing self-efficacy through hands-on practice, increased competency, and autonomy.[18] Previous studies comparing simulation to traditional instruction have shown significantly higher performance gains, self-efficacy scores, and transfer to real patients.[13,19]

Experienced pediatric transport nurses in our institution identified knowledge gaps and highlighted the need for additional pediatric education for the ED staff members. Staff nurses also said that they did not feel comfortable caring for this patient group; some had never seen an actual pediatric resuscitation. This is a review and evaluation of our emergency department's practice improvement project to provide the staff with the educational experience they need, while incurring minimal burden on staffing, budget, and patient care.

Methods

Our facility is a 450-bed teaching hospital with approximately 13,000 annual pediatric visits to the emergency department. We set out to design a nurse-driven, *in situ* low-fidelity pediatric simulation to increase staff exposure to critical pediatric scenarios. We chose a septic shock scenario because of its prevalence and the opportunity for significant improvement in rates of mortality with increased adherence to guidelines.[20] We used a pediatric Advanced Life Support (ALS) (Simulaids, Saugerties, NY) trainer that accommodates procedures such as intravenous (IV) and intraosseous (IO) insertion, bag valve mask ventilation, oral or nasal intubation, 4-lead monitoring, brachial pulse check, and external chest compressions.[21]

Designing of the simulation program followed Kolbs Experiential Learning Cycle.[22] An initial simulation scenario provided a concrete experience in which the staff could identify learning gaps. The first scenario was followed by debriefing and the reflective observation period, which allows for learners to reflect on the scenario and their performance. In this stage, the learner identifies gaps and prepares to learn. During abstract conceptualization, the learner uses the experience and reflection to facilitate bridging the new knowledge to future experiences. A second simulation allows for active thought experimentation, in which participants are able to try out the new information immediately.[17,22]

The Clinical Performance Tool (CPT), a specific measurement instrument, which has been previously validated and used in several studies,[3,23-25] was selected to measure the nurses' performance objectively. The CPT was designed to measure adherence to Pediatric Advanced Life Support (PALS) algorithms by multidisciplinary teams during simulations.[23] It uses 4 checklists that outline necessary clinical tasks to be performed during common pediatric resuscitation scenarios such as shock, respiratory failure, supraventricular tachycardia (SVT), and asystole.[24] The tool contains tasks that are objective and straightforward to rate; each task is either done within the time frame or not. One point is given if a task is completed during the simulation (SIM), and a second point is given if the task is completed within a 60-second time frame. Thus, the CPT can be analyzed either on a total point basis or dichotomized to examine completed/not completed regardless of time frame. Inter-rater reliability for the CPT is high, and we chose to not re-establish that as part of our project (Table 1).[23,24] The simulation was developed as an educational experience for the RNs, and the CPT was scored based on their performance. When a doctor or respiratory therapist (RT) was called in later into the scenario, their input was used for system improvements only.

TABLE 1
Shock clinical performance tool

Task	0 points	1 point	2 points
Pulse check	Not done	>30s	<30s
Perfusion assessment	Not done	>60s	<60s
NIBP	Not done	>60s	<60s
IV/IO access	Not done	Peripheral IV (x1)	Peripheral IV (x2) or IO
IVF bolus	Not done	Done without clinical assessment of circulation >60s	2 simultaneous IV boluses or bolus via IV push
Dextrose check	Not done	>60s	<60s

NIBP, non-invasive blood pressure; *IV*, intravenous; *IO*, intraosseous, *IVF*, intravenous fluid.
The shock clinical performance tool was developed by Levy et al.[24]

Self-efficacy is defined as one's belief in his or her own ability to complete a task.[25] Effective people are better prepared to handle diverse conditions and meet new challenges. Simulations have been shown to improve health care workers' self-efficacy.[19] The Confidence Scale (C-Scale) was developed to measure improvement in self-efficacy, as the 2 terms have been used interchangeably.[26] The 5-statement, Likert-type scale can measure any psychomotor skill. Participants are instructed to select a response to each item, ranging from 1 (lowest confidence) to 5 (highest confidence). It has been validated and used to measure improvement in self-efficacy in studies involving nursing students and experienced nurses.[26-28]

Our pediatric simulation program was developed as a collaborative effort among the clinical nurse specialist (CNS), ED nurse educator, pediatric RNs, and the ED pediatric director. The simulations were designed to last 45 to 60 minutes. Two scenarios were scripted and allowed to run until all tasks were performed, or up to 15 minutes. A debrief and hands-on period occurred after scenario 1. On a day designated by the CNS based on scheduling availability, the charge nurse was asked to assign 3 to 4 nurses to participate in the simulation. Simulations were conducted on weekly or biweekly bases during the day shift and at 6 am to accommodate the night staff. The nurses were assigned based on their availability by the charge nurse, simulating staff allocation in the event of a real resuscitation. The only exclusion criterion was that all staff could not participate in the simulation more than once. Participation by the staff was voluntary. This was a performance improvement project that did not meet the definition of human subjects research and thus did not require internal review board review.

RNs assigned to a simulation were instructed shortly before the start of the scenario to report to a room in the critical area of the emergency department. The CNS met them there with the low-fidelity mannequin. The RNs were asked to recall their last pediatric resuscitation and complete a C-Scale based on the experience. Nurses who had not yet participated in pediatric resuscitations were asked to answer questions based on how they think they would perform if they were called on to help in a pediatric resuscitation. After completing the C-Scale, the RNs were informed that they were assigned to respond to the simulated critical pediatric scenario. They were instructed to treat this as a real-life scenario, locating and using all the equipment, resources, and staff as they would with an actual patient. The CNS presented the first simulation scenario of a pediatric patient in septic shock, and the RNs proceeded with patient evaluation and interventions. Nine of the 12 simulations were conducted without a provider. The RNs said they would contact pediatricians, located in the pediatric emergency department, and have them respond to the acute area where critical adult and pediatric patients are located. For all the simulations, the RNs, who are all PALS trained, were expected to place the patient on the cardiac monitor, obtain full set of vital signs and blood glucose, check for a manual pulse, and verbalize anticipated orders to place 2 peripheral IV lines, administer a rapid fluid bolus of 20 mL/kg, and initiate vasopressors when shock was unresponsive to fluid resuscitation. The scenario ended when the RNs completed all the clinical steps, or at 15 minutes. RTs practiced placing the mannequins on noninvasive and invasive ventilatory support. The physician completed the steps of intubation and IO insertion with a focus of ensuring that all supplies and equipment were easily located and functioning properly.

The first simulation was followed by a debriefing and hands-on skills practice of approximately 20 minutes. The team and the CNS reviewed the scenario and clinical steps

necessary for the resuscitation. RNs reviewed age-specific vital signs and the definition of hypotension by age. Appropriate fluid resuscitation with weight-based formula and administration via push-pull method was reviewed. The team practiced locating the pediatric drug reference book, which is kept with each Broselow cart (Armstrong Medical Industries, Lincolnshire, IL). RNs practiced drawing up weight-specific PALS drugs and initiation of vasopressors. The team also located pediatric and neonatal resuscitation supplies in the emergency department and in the Broselow cart (Armstrong Medical Industries, Lincolnshire, IL), such as different size blood pressure cuffs, IO drill, and Glidescope (Verathon, Seattle, WA) with appropriate size blades.

After completing the debriefing and hands-on portion of the exercise, the RNs were asked to participate in another scenario. The patients' ages and chief complaints were different, but an assessment revealed that the patients were in shock, and the clinical steps expected were the same. The RNs' performances for each scenario were scored by the CNS with the CPT. At the completion of the program, the RNs were asked to reflect on the experience and re-evaluate their confidence levels with the C-Scale.

Each simulation group was scored on the team's overall clinical performance for the first and second simulation. Each participant completed a C-Scale pre- and postsimulation. The C-Scales were anonymous, listing only date and time of participation; however, the pre- and postsimulation C-Scales could be linked without identifiers because they were completed on the same sheet of paper, which the participant retained after completing the presimulation portion and handed in only after completing the post-portion on the reverse side. The C-Scale and CPT data were entered in REDCap (REDcap Consortium, Vanderbilt University, Nashville, TN), a secure data-collection portal.[29] Scores for the C-Scale were computed as a summative score, with a range of 1 to 5. Statistical analysis included descriptive statistics as well as use of the Wilcoxon test to assess changes from presimulation to postsimulation. Reported *P* values are from the Wilcoxon test: however, mean and standard deviations are reported to aid reader understanding. Statistical analysis was conducted in SPSS 25 (IBM Corp, Armonk, NY).

Results

Between August 1, 2017, and October 30, 2017, 12 low-fidelity *in situ* pediatric sepsis simulations were conducted. A total of 43 RNs participated. Five simulations occurred at 6 am with the night staff. Seven simulations occurred between 9 am and 11:30 am, accommodating the day and mid-day nursing shifts. Teams were composed of 3 to 4 nurses. One group had 5 nurses. Respiratory therapy and a provider participated in 3 simulations. Presimulation mean confidence score for the RNs was 2.5 (SD 0.8). Postsimulation intervention, the mean confidence score increased to 3.9 (SD 0.6) ($P < 0.001$). Mean difference for each confidence scale item pre- and postintervention was 1.4 (95% CI, 1.2-1.6) (Table 2). Detailed results of paired sample t-tests by confidence scale item are presented in Supplementary Table 1. Three RTs completed confidence scales. For RTs, presimulation mean confidence score was 4.1 (SD 0.8), and postsimulation mean score was 4.8 (SD 0.3, data not shown). The providers did not complete C-Scales (Table 2).

The total possible score for the CPT is 12, if the team completes all 6 interventions within the predetermined time. Mean CPT score was 5.3 (SD 0.9) for the first simulation scenario. Mean CPT score increased to 9.2 (SD 0.6) after the second simulation scenario. The most problematic areas included pulse check and perfusion assessment, initially completed (regardless of time frame) only 18% and 55% of the time, respectively (data not shown). These 2 areas also had the most improvement in the second simulation scenario, rising to 91% and 100%, respectively (data not shown). Obtaining a blood-pressure reading and IV access had 100% completion rates at both pre- and postsimulation; however, initial ratings are lower because the RNs did not mention the need for a second IV access and did not perform a blood-pressure check consistently within 60 seconds (therefore earning a score of 1 point for these criteria instead of 2 points.) After the first simulation and debriefing, the teams had 100% compliance with early blood-pressure assessment and establishment of 2 peripheral IV-line access on a patient with signs of shock. Dextrose check (glucose assessment) was also inconsistently performed in the initial simulation and was performed consistently in the second scenario but was not consistently within the appropriate 60-second time frame (Table 3).

Discussion

The CPT is a straightforward tool with scoring for a few basic tasks, which can be administered easily by a trained staff member conducting the simulations. The simulations revealed several knowledge gaps, which were addressed in the debriefing period. RNs had difficulty recognizing pediatric hypotension or recalling the PALS formula for

TABLE 2
Confidence scale scores among nurses at pre- and postsimulation

Confidence scale item	Presimulation		Postsimulation		Mean difference	95% CI		Wilcoxon P value
	Mean	SD	Mean	SD				
I am certain that my performance is correct.	2.5	0.8	3.9	0.7	1.4	1.2	1.6	<0.001
I feel that I perform the task without hesitation.	2.4	0.9	3.8	0.6	1.4	1.2	1.6	<0.001
My performance would convince the observer that I'm competent.	2.5	0.9	3.9	0.7	1.4	1.2	1.6	<0.001
I feel sure of myself as I perform the task.	2.5	0.9	3.9	0.7	1.4	1.2	1.6	<0.001
I feel satisfied with my performance.	2.4	0.8	3.9	0.7	1.4	1.2	1.6	<0.001
Overall mean	2.5	0.8	3.9	0.6	1.4	1.2	1.6	<0.001

CI, confidence interval; *SD,* standard deviation.

minimum systolic blood pressure. There was also a pattern of incorrect fluid-volume resuscitation and a tendency to delay the recommended rapid-fluid resuscitation by placing IV fluids on an IV pump to be delivered over an hour. Manual pulse checks were infrequently done, with high reliance on readings from monitoring devices. Blood-glucose assessments were also inconsistent among the teams. In the second scenario, only 1 intervention was omitted by 1 of the teams. Despite this, 100% compliance was not achieved because CPT takes into account time frame of interventions. The second simulation scenario was of an older, more stable child with recognition of septic shock and implementation of interventions not always meeting the CPT timeframes. Timing of the simulation did not have a significant effect on staff performance. Staff members participating in the last hour of their shifts performed slightly better, with an average CPT score of 5.8 versus 5.2 for initial simulation and 9.4 versus 9.14 for the second simulation.

Conducting the simulations *in situ* allowed the team to identify several system issues that were brought to interdisciplinary teams to rectify such as staff having knowledge of and locating the pediatric resuscitation reference book. The simulations allowed the staff to test their knowledge, acquire new information, and practice a variety of skills in a safe environment without any harm or delay to patients.

During an early simulation, and from previous anecdotal reports from nursing staff, it became evident that ED respiratory therapy also lacked exposure and efficiency with critically ill pediatric patients. Some nurses and RTs were not aware that noninvasive ventilatory support, such as bubble continuous positive airway pressure (CPAP), was available for neonates and pediatric patients in the emergency department. In collaboration with the respiratory

TABLE 3
Mean simulation scores at pre- and postsimulation

Simulation item	Simulation 1		Simulation 2		Wilcoxon P value
	Mean	SD	Mean	SD	
Pulse check	0.2	0.4	1.2	0.6	0.005
Perfusion assessment	0.5	0.5	1.3	0.4	0.011
NIBP	1.7	0.4	2.0	0.0	0.083
IV/IO access	1.3	0.4	2.0	0.0	0.005
IVF bolus	1.0	0.4	1.9	0.3	0.004
Dextrose check*	0.6	0.5	1.0	0.0	0.046
Total score (max of 12)	5.3	0.9	9.2	0.6	0.004

IO, intraosseous; *IV,* intravenous; *IVF,* intravenous fluid; *NIBP,* noninvasive blood pressure.
* This value is missing for one team.

therapy department, several process improvements were achieved. These improvements included reorganizing all pediatric respiratory supplies in 1 location and a new process in which the neonatal intensive care unit RT responds with the ED RT when called to the emergency department for a pediatric patient.

In situ simulations enabled identification of several supply concerns. The emergency department did not have a supply of neonatal nasal cannulas or face masks. These supplies were ordered and a par level, a predetermined amount of supplies, was set for the emergency department. The pediatric IV cart located in the acute care area lacked supplies during a simulation, and it was discovered that it was not on any of the assignments for regular restocking. The Broselow cart was noted to have supplies that were incompatible with new equipment, the wrong size, or had necessary resuscitation items missing. The emergency department reviewed the current par list of the cart and aligned it with items from the Broselow tape. Recommendation was made to replace some of the prepackaged modules with supplies compatible with hospital equipment. The par changes were presented and approved by a multidisciplinary meeting with representatives from all hospital units that have Broselow carts.

In situ simulations also eliminate the need for expensive dedicated simulation space. All the supplies used for the simulations are kept in a duffle bag and brought to any available room for the simulation. Staff travel time to the simulation site is also minimal, allowing for more time to be dedicated to the simulation, or to have the staff return more quickly to their clinical areas. A concern with *in situ* simulations is distractions. Support from management and the staff is critical to allow assigned staff to complete the simulation. The entire ED team has to acknowledge the need for improvement in pediatric resuscitation and allocate staffing and resources accordingly.

LIMITATIONS

This was a single-site practice improvement project. It did not include randomization of participants. We did not measure retention of knowledge over time or transference to actual patient care. Limitations related to the CPT include lack of weight applied to any particular intervention and not taking into account any potentially harmful interventions. Possibility for expectation bias exists for participant responses to the C-Scale. Several staff members rated their confidence lower postintervention, perhaps after realizing that their exposure to critical pediatric patients was limited.

In addition, our sample size of 12 simulations with 43 RNs participating was relatively small, so these results should be considered preliminary and may be used to inform future research in this area with larger samples. It should be noted that we did not adjust P values for multiple comparisons in this study, which can increase the risk of Type 1 error (finding a false positive result), so P values for individual comparisons between each survey item should be interpreted with this awareness.[30,31] However, despite the small sample size, our results appear to be consistently indicative of a positive effect of this approach; our primary results showed a statistically significant difference of 1.4 points (95% CI, 1.2 to 1.6) on the confidence scale and a statistically significant increase from 5.3 (SD 0.9) to 9.2 (SD 0.6, $P = 0.004$) on the simulation scale. These findings may be confirmed and further explored in larger studies on the topic.

Implications for Emergency Nursing

ED nurses are challenged to face every imaginable patient scenario. Some critical scenarios occur in low frequency and do not allow enough opportunity for staff to develop competence or confidence. Nurse-led simulations allow a safe environment for staff to practice recognition and interventions for high-risk, low-volume scenarios. Progress through performance improvement projects can be quantified through use of validated tools. Future simulation projects should assess different repetition times for optimal skill retention: for example, 3, 6, or 12 months.

Conclusions

Simulations have been widely used by physicians and in higher education settings with great success in improving learning and patient outcomes. Our results suggest that pediatric simulations can be used to improve nursing staff confidence and adherence to resuscitation guidelines. The low-fidelity *in situ* simulation placed minimal burden on staffing and budget and enabled identification of system issues within the department. Use of previously published scoring tools allowed us to measure improvements quantitatively.

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REFERENCES

1. McGovern T, D'Amore K. Where are the sick kids? *Ann Emerg Med*. 2017;70(1):80-83. https://doi.org/10.1016/j.annemergmed.2016.08.432.
2. Ojha R, Liu A, Rai D, Nanan R. Review of simulation in pediatrics: the evolution of a revolution. *Front Pediatr*. 2015;3:106. doi: 10.3389/fped.2015.00106.
3. Gilfoyle E, Koot DA, Annear JC, et al. Improved clinical performance and teamwork of pediatric interprofessional resuscitation teams with a simulation-based educational intervention. *Pediatr Crit Care Med*. 2017;18(2):e62-e69. doi: 10.1097/PCC.0000000000001025.
4. Whitfill T, Gawel M, Auerbach M. A Simulation-based quality improvement initiative improves pediatric readiness in community hospitals. *Pediatr Emerg Care*. 2018;34:431-435. doi: 10.1097/PEC.0000000000001233.
5. Abulebda K, Lutfi R, Whitfill T, et al. A Collaborative in situ simulation-based pediatric readiness improvement program for community emergency departments. *Acad Emerg Med*. 2018;25:177-185. doi: 10.1111/acem.13329.
6. Ford DG, Seybert AL, Smithburger PL, Kobulinsky LR, Samosky JT, Kane-Gill SL. Impact of simulation-based learning on medication error rates in critically ill patients. *Intens Care Med*. 2010;36(9):1526-1531. doi: 10.1007/s00134-010-1860-2.
7. Theilen U, Leonard P, Jones P, et al. Regular in situ simulation training of paediatric medical emergency team improves hospital response to deteriorating patients. *Resuscitation*. 2013;84(2):218-222. https://doi.org/10.1016/j.resuscitation.2012.06.027.
8. Andreatta P, Saxton E, Thompson M, Annich G. Simulation-based mock codes significantly correlate with improved pediatric patient cardiopulmonary arrest survival rates. *Pediatr Crit Care Med*. 2011;12(1):33-38. doi: 10.1097/PCC.0b013e3181e89270.
9. Knight LJ, Gabhart JM, Earnest KS, Leong KM, Anglemyer A, Franzon D. Improving code team performance and survival outcomes. *Crit Care Med*. 2014;42(2):243-251. doi: 10.1097/CCM.0b013e3182a6439d.
10. Couto TB, Kerrey BT, Taylor RG, FitzGerald M, Geis GL. Teamwork skills in actual, in situ, and in-center pediatric emergencies. *Simul Healthc*. 2015;10(2):76-84. doi: 10.1097/SIH.0000000000000081.
11. Al-Elq A. Simulation-based medical teaching and learning. *J Fam Community Med*. 2010;17(1):35. https://doi.org/10.1111/j.1742-6723.2008.01137.x.
12. Lee KHK, Grantham H, Boyd R. Comparison of high- and low-fidelity mannequins for clinical performance assessment. *Emerg Med Australas*. 2008;20(6):508-514. https://doi.org/10.1111/j.1742-6723.2008.01137.x.
13. Norman G, Dore K, Grierson L. The minimal relationship between simulation fidelity and transfer of learning. *Med Educ*. 2012;46(7):636-647. https://doi.org/10.1111/j.1365-2923.2012.04243.x.
14. Nimbalkar A, Patel D, Kungwani A, Phatak A, Vasa R, Nimbalkar S. Randomized control trial of high fidelity vs low fidelity simulation for training undergraduate students in neonatal resuscitation. *BMC Res Notes*. 2015;8:636.
15. Curran V, Fleet L, White S, et al. A randomized controlled study of manikin simulator fidelity on neonatal resuscitation program learning outcomes. *Adv Health Sci Educ*. 2014;20(1):205-218. doi: 10.1007/s10459-014-9522-8.
16. Connell CJ, Endacott R, Jackman JA, Kiprillis NR, Sparkes LM, Cooper SJ. The effectiveness of education in the recognition and management of deteriorating patients: a systematic review. *Nurse Educ Today*. 2016;44:133-145. https://doi.org/10.1016/j.nedt.2016.06.001.
17. Zigmont JJ, Kappus LJ, Sudikoff SN. Theoretical foundations of learning through simulation. *Semin Perinatol*. 2011;35(2):47-51. https://doi.org/10.1053/j.semperi.2011.01.002.
18. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol*. 2000;55(1):68-78. https://doi.org/10.1016/j.nedt.2015.07.021.
19. O'Leary J, Nash R, Lewis P. Standard instruction versus simulation: educating registered nurses in the early recognition of patient deterioration in paediatric critical care. *Nurse Educ Today*. 2016;36:287-292. https://doi.org/10.1016/j.nedt.2015.07.021.
20. Kessler DO, Walsh B, Whitfill T, et al. Disparities in adherence to pediatric sepsis guidelines across a spectrum of emergency departments: a multicenter, cross-sectional observational in situ simulation study. *J Emerg Med*. 2016;50(3):403-415.e403. doi: 10.1016/j.jemermed.2015.08.004.
21. Simulaids. Pediatric ALS trainer with carry bag. https://www.simulaids.com/product/101-090; 2016. Accessed December 7, 2017.
22. Kolb DA. *Experiential Learning: Experience as the Source of Learning and Development*. Upper Saddle River, NJ: Prentice Hall; 1983.
23. Donoghue A, Nishisaki A, Sutton R, Hales R, Boulet J. Reliability and validity of a scoring instrument for clinical performance during pediatric advanced life support simulation scenarios. *Resuscitation*. 2010;81(3):331-336. https://doi.org/10.1016/j.resuscitation.2009.11.011.
24. Levy A, Donoghue A, Bailey B, et al. External validation of scoring instruments for evaluating pediatric resuscitation. *Simul Healthc*. 2014;9(6):360-369. DOI: 10.1097/SIH.0000000000000052.
25. Bandura A. Perceived self-efficacy in cognitive development and functioning. *Educ Psychol*. 1993;28(2):117-148. https://doi.org/10.1207/s15326985ep2802_3.
26. Grundy SE. The confidence scale. *Nurse Educ*. 1993;18(1):6-9.
27. Visovsky C, Haas M, Faiman B, et al. Nurse self-evaluation of assessment of chemotherapy-induced peripheral neuropathy in patients with cancer. *J Adv Pract Oncol*. 2012;3(5):319-325.
28. Seldomridge EA. Faculty and student confidence in their clinical judgment. *Nurse Educ*. 1997;22(5):6-8.
29. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap): a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377-381. https://doi.org/10.1016/j.jbi.2008.08.010.
30. Rothman KJ. No adjustments are needed for multiple comparisons. *Epidemiology*. 1990;1(1):43-46.
31. Streiner DL, Norman GR. Correction for multiple testing: is there a resolution? *Chest*. 2011;140(1):16-18. https://doi.org/10.1378/chest.11-0523.

SUPPLEMENTARY TABLE 1

Results of paired samples *t*-test for confidence scale

Confidence Scale Item	Mean	Standard Deviation	Standard Error Mean	95% Confidence Interval of the Difference		t	df	Sig (2-tailed)
				Lower	Upper			
I am certain that my performance is correct.	-1.3954	0.6597	0.1006	-1.5984	-1.1923	-13.8696	42	<0.001
I feel that I perform the task without hesitation.	-1.4286	0.7034	0.1085	-1.6478	-1.2094	-13.1620	41	<0.001
My performance would convince the observer that I'm competent.	-1.3721	0.6909	0.1054	-1.5847	-1.1595	-13.0234	42	<0.001
I feel sure of myself as I perform the task.	-1.3954	0.7603	0.1159	-1.6293	-1.1614	-12.0344	42	<0.001
I feel satisfied with my performance.	-1.4186	0.6980	0.1065	-1.6334	-1.2038	-13.3264	42	<0.001