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Simulation for Clinical Preparedness in Pediatric Emergencies

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A Pilot Study

Bette Mariani, PhD, RN, ANEF ❍ Kelly Ann Zazyczny, MSN, RN, CPN ❍
Patricia Decina, MHA, BSN, RN, CPN ❍ Lisa Waraksa, BSN, RN, CPN ❍
Patricia Snyder, BSN, RN, CPA ❍ Elizabeth Gallagher, MSN, RN, CPN ❍
Carol Hand, MHA, BSN, RNC-NIC

Positive outcomes for pediatric in-hospital cardiopulmonary arrest remain low with little change in mortality rates. Infrequently used clinical knowledge and skills decline quickly, contributing to poor quality of resuscitation. The aim of this pilot study exploring the outcomes of repeated pediatric mock code simulations with structured debriefing demonstrated statistically significant differences in participants' knowledge of pediatric emergencies, with no significant decline in resuscitation skills. This provides an evidence-based approach for professional development educators working with nurses on pediatric emergencies.

Evidence suggests that outcomes for children who sustain in-hospital cardiopulmonary arrest (CPA) are dismal (Sahu & Lata, 2010) with mortality rates of 70%–85% in nonintensive care pediatric hospital units (Auerbach, Kessler, & Foltin, 2011). Evidence supports that increased knowledge of resuscitation guidelines improves performance of resuscitation skills; however, recall of both guidelines and skills declines quickly; hence, there is no guarantee that resuscitation efforts will be carried out with skill and accuracy (Hunt, Walker, Shaffner, Miller, & Pronovost, 2008) and the use of simulation-based resuscitation training can be an effective educational approach in teaching resuscitation (Hunt, Walker, et al., 2008).

Pediatric Advanced Life Support (PALS) education is a standard approach for teaching for emergency preparedness to nurses who care for pediatric patients. Limited exposure to pediatric emergencies creates gaps in competency when nurses are faced with these situations. It is imperative for nurses to be prepared to promote optimal outcomes for all patients, including the most compromised pediatric patients. Despite PALS training, pediatric nurses and physicians infrequently perform basic or advanced life support on children, making it difficult to maintain clinical expertise in these low-volume, high-risk events during which there is little room for error. These factors, along with frequent nursing staff requests at the study site for more education on mock codes, prompted a review of the literature for evidence on best practices on preparing staff to respond quickly, effectively, and competently to low-volume, high-risk pediatric CPA. Although some literature exists about CPA, there was a paucity of evidence on the outcomes of knowledge, critical thinking, confidence in clinical decision-making, and response time when using interprofessional pediatric mock code simulation-based experiences (SBEs) for hospital staff.

The main purpose of this pilot study was to compare the skill and competency level of nurses who participated in three simulated in-hospital pediatric mock codes with structured debriefing with nurses who only participated in one simulated in-hospital pediatric mock code experience. A second purpose was to explore whether nurses had an increase in self-confidence after participating in a series of simulation-based mock codes. A third purpose was to validate the simulation scenarios and tools used in the study. There were three research questions aimed at determining if there was a difference in (a) skill competency,

Bette Mariani, PhD, RN, ANEF, is Associate Professor, Villanova University M. Louise Fitzpatrick College of Nursing, Villanova, Pennsylvania.

Kelly Ann Zazyczny, MSN, RN, CPN, is System Nurse Manager, Pediatrics and Vascular Access, Main Line Health System, Bryn Mawr Hospital, Bryn Mawr, Pennsylvania.

Patricia Decina, MHA, BSN, RN, CPN, is Staff Nurse 5, Main Line Health System, Bryn Mawr Hospital, Bryn Mawr, Pennsylvania.

Lisa Waraksa, BSN, RN, CPN, is Staff Nurse 4, Main Line Health System, Bryn Mawr Hospital, Bryn Mawr, Pennsylvania.

Patricia Snyder, BSN, RN, CPA, is Clinical Coordinator, Main Line Health System, Bryn Mawr Hospital, Bryn Mawr, Pennsylvania.

Elizabeth Gallagher, MSN, RN, CPN, is Staff Nurse 5, Main Line Health System, Bryn Mawr Hospital, Bryn Mawr, Pennsylvania.

Carol Hand, MHA, BSN, RNC-NIC, is Clinical Nurse Educator, Neonatal Intensive Care unit, Main Line Health System, Bryn Mawr Hospital, Bryn Mawr, Pennsylvania.

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ADDRESS FOR CORRESPONDENCE: Bette Mariani, Villanova University M. Louise Fitzpatrick College of Nursing, Driscoll Hall, Room 392, 800 E. Lancaster Ave, Villanova, PA 19085 (e-mail: Bette.Mariani@villanova.edu).

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(b) knowledge, and (c) level of confidence when participating in a pediatric code. The hypothesis for the study was as follows: Nurses who participated in simulation-based pediatric mock codes with structured debriefing three times per year will have higher levels of knowledge, competency, and confidence than nurses who participated in one simulation-based mock code.

REVIEW OF THE LITERATURE

SBEs are active learning strategies that allow participants to process information for the purpose of gaining situational experience and recognizing assessment–intervention patterns (Jeffries, 2012) and to embed learning, promote critical thinking and higher cognitive processes, and speed response time in healthcare settings (Billings & Halstead, 2015; Lasater, 2007, 2011; Sahu & Lata, 2010). Active engagement in simulation and innovative simulation-based teaching strategies provides an opportunity for interprofessional education connecting theory, principles of best practice, policies, assessment, psychomotor skills, communication, and critical judgment in a nonjudgmental, low stakes, carefully facilitated environment (Hunt, Walker, et al., 2008; Jeffries & Rizzolo, 2006). Bultas, Hassler, Ercole, and Rea (2014) reported that high-fidelity patient simulation served as an effective strategy in teaching pediatric staff nurses about the deteriorating pediatric patient.

According to Kolb (1984), didactic instruction does not always provide adequate learning support for these adult learners who want to implement the lessons learned and refine their skills (Kolb, 1984). Kolb's experiential learning theory (Kolb, 1984) and NLN Jeffries Simulation Theory were used as the foundation for this study (Jeffries, 2016). There is a plethora of evidence about the use of simulation to teach undergraduate nursing students; however, there is less published about the effectiveness of simulation-based education for staff nurses or interprofessional teams in hospital settings, particularly in relation to pediatric mock code training, making it imperative for nurses in professional development to generate evidence to support these SBEs.

Some studies have identified SBEs as a possible method to identify potential deficiencies and latent issues in emergency response. Stocker et al. (2012) showed that, although key tasks were performed with skill by 80% of participants, only 27% performed well on subcomponents related to airway management or proper use of a defibrillator. In addition, problems and delays in emergency response were frequently secondary to the team's ability to initiate and run the code, facility practices, lack of leadership, prioritization, poor communication, inaccessibility of equipment, lack of familiarity with supplies, and multiple expectations of nurses (Stocker et al., 2012). Another study of 34 hospital-based mock codes revealed significant delays in airway and circulation assessment and treatment and delayed response time of the code team by as much as 2 minutes. In 75% of mock codes, the team digressed from the American Heart Association pediatric basic cardiac life support (BLS) protocols, and in 100% of mock codes, a communication error was reported (Hunt, Fiedor-Hamilton, & Eppich, 2008). Another study reported that pediatricians and pediatric nurses did not demonstrate increased levels of collaboration and competency until the third scenario of working together (Messmer, 2008). Andreatta, Saxton, Thompson, and Annich (2011) found that clinical skills and knowledge decline within weeks if not applied and that the retention of learned resuscitation skills could be improved by intensive training every 3–6 months. Two-year BLS and PALS recertification fails to fully address effective team dynamics, latent and other issues, or maintaining adequate skills (Hunt, Fiedor-Hamilton, et al., 2008).

Auerbach et al. (2011) found that repetitive simulation-based pediatric mock code training can provide an effective method for participants to repeat performance and refine behaviors and skills. The Joint Commission and the International Liaison Committee on Resuscitation recommend simulation-based resuscitation training to elicit realistic behaviors and engage all personnel and resources (Lighthall, Poon, & Harrison, 2010), noting poor adherence to BLS and advanced cardiac life support guidelines and latent conditions in U.S. hospital code situations. In addition, the Institute of Medicine (Kohn, Corrigan, & Donaldson, 2000) recognized patient simulation as a means to promote safety in health care and urged the establishment of interprofessional team training.

METHOD

Sample, Setting, and Study Design

The sample population for this study was registered nurses from a mid-Atlantic five-hospital health system who had current PALS certification and cared for pediatric patients in the emergency department, the inpatient pediatric unit, the ambulatory care center, or the postanesthesia care unit. For a medium effect size and a power of 0.80, G Power analysis indicated the need for 63 participants per group; however, the feasibility of getting that number of nurses away from the unit to conduct the study was difficult to obtain; therefore, this study was conducted as a pilot study with a total sample size of 18 ($N = 18$). The setting for the study was the simulation laboratory in one of the health system hospitals for the first simulation and at a local university's simulation laboratory for the second and third simulations. This pilot study was a pretest–posttest comparative experimental design (see Figure 1).

Simulation Intervention

Simulation has rapidly become a common teaching strategy to teach and practice high-risk/low-volume events.

	Intervention Group	Control Group
Baseline	Pediatric Emergency Preparedness Knowledge Assessment (PEPKA) Pretest Self Confidence in Pediatric Codes Survey Pretest	PEPKA Pretest Self Confidence in Pediatric Codes Survey Pretest
1 month	Simulation # 1 with Structured Debriefing Pediatric Mock Code Critical Element Observer (PMCCEO)	
5 months	Simulation # 2 with Structured Debriefing PMCCEO	
9 months	Final Simulation with Structured Debriefing PMCCEO	Final Mock Code Simulation PMCCEO
11 months	PEPKA Posttests Self Confidence in Pediatric Codes Survey Posttests	PEPKA Posttests Self Confidence in Pediatric Codes Survey Posttests

FIGURE 1 Study design and data sources.

Permission was obtained to use and modify the Pediatric Scenarios and the Pediatric Mock Code Critical Element Observer (PMCCEO) checklist from the Illinois Emergency Medical Services for Children, a collaborative program between Illinois Department of Public Health and Loyola University Health System (Illinois Emergency Medical Services for Children, 2011). This pilot study research team collaborated with pediatric specialists and peers and used PALS guidelines to modify and recreate the scenarios for this study. Learning objectives, team work competencies, and a set of knowledge, attitudes, and skills were then developed.

The scenarios developed by the research team covered three pediatric conditions: pediatric infant hypovolemic shock, pediatric respiratory distress/failure, and pediatric respiratory seizure. The International Nursing Association for Clinical Simulation and Learning (2016) standards were used to guide and implement the SBEs. The high-fidelity manikins were programmed, and the scenarios were piloted and taped before use with the participants so that issues or problems with the audiovisual cues and realism related to the script or simulator responsiveness could be identified prior to implementing the study. Adjustments were made to the script until all study team members felt that the scenarios were representative of the patient experiences participants may encounter in the actual clinical setting. Prior to starting the study, Institutional Review Board (IRB) approval was obtained.

The intervention and control groups consisted of nursing staff from across the healthcare system who participated in the scenario in teams of three to four were randomly assigned to the control and intervention group by coin toss; the interprofessional roles were filled by standardized patient actors who participated as the physician, the respiratory therapist, and a family member.

The SBE started with a 5-minute prebriefing, which included an introduction to the experience and an orientation to the surroundings. Following the prebriefing, the scenario lasted about 10–15 minutes. A structured debriefing session using Debriefing for Meaningful Learning followed for 20–30 minutes (Dreifuerst, 2012, 2015). At the start of the simulation, a brief hand-off report with information specific to the scenario was provided to the primary nurse, who was then tasked with starting the scenario and engaging the rest of the participants. Each SBE was video-taped for rating.

Instruments

Pediatric Emergency Preparedness Knowledge Assessment

Knowledge regarding pediatric emergency preparedness was assessed through a researcher-designed 18-question multiple-choice Pediatric Emergency Preparedness Knowledge Assessment (PEPKA) that was administered through an Internet-based survey platform. Questions were at the knowledge and application level. Content validity was determined by a panel of pediatric nurse expert clinicians and nurse educators with expertise in test construction and pediatrics. The content validity index (CVI) was .96.

Self-Confidence in Learning

The Self-Confidence in Learning survey was a researcher-developed instrument to better understand the pediatric

nurses' level of confidence in participating in a pediatric emergency. The content validity index was determined by a panel of pediatric experts (CVI = .83).

PMCCEO Checklist

Skill competency was measured using a PMCCEO checklist developed by the researchers based on the scenarios. The research team rated participant teams using the PMCCEO during the mock code simulations and from the video recordings of the mock code simulations. Once again, a panel of pediatric nurse expert clinicians and educators determined content validity. The CVI for this instrument was .98. The PMCCEO checklist was revised with permission from a Pediatric Mock Code Toolkit (Illinois Emergency Medical Services for Children, 2011). Another purpose of this pilot study was to provide further psychometric testing for the PEPKA, the Self-Confidence in Learning survey, the PMCCEO, and the pediatric scenarios.

RESULTS

There was no statistically significant difference between the intervention (n = 8) and control (n = 10) groups on the PEPKA pretest indicating that the groups were homogenous; however, there was a statistically significant difference in the posttest scores (p = .016) with the intervention group scoring higher on the knowledge assessment than control group. Cronbach's alpha reliability for the knowledge assessment was .88 for pretest and .96 for the posttest. For the self-confidence in learning, the Cronbach's alpha values were .76 for the pretest and .95 for the posttest; however, there was no statistically significant differences in self-confidence between the groups.

Lastly, for the PMCCEO, an independent t test to compare group means between the intervention and control groups showed no significant difference between groups for the final scenario with an interrater reliability for the checklist at .85. In addition, there was no statistically significant differences within groups for the intervention group between each of the simulation scenarios.

DISCUSSION

The goal of the SBEs was to create a nonthreatening learning environment to help assess confidence, increased knowledge, and competency to enhance interprofessional skills to translate into improved individual and group performance. As reported in Boling and Hardin-Pierce (2016), these SBEs provided a realistic, safe, practice-based environment to permit learners to make mistakes and improve their skills without enduring potential consequences. Likewise, it was an optimal educational opportunity to educate teams of healthcare providers who can engage in conversations about how to manage low-volume, high-risk emergency events (Brown & Overly, 2016).

This study team aimed to improve staff's knowledge and confidence about pediatric emergency preparedness. The pre-PEPKA scores did not show any statistical significance between the intervention and control groups. However, the study results demonstrated that the intervention group's knowledge, measured by the post-PEPKA, was statistically higher than the control group. The findings of this study which demonstrated a statistically significant positive difference in knowledge scores between the intervention and control group contrasts the finding in Bultas and colleague's (2014) study, which did not demonstrate knowledge increase between their intervention and control group. This could be related to the variance in study design, as Bultas and colleagues did not use debriefing as a part of their simulation training. Cheng's (2013) study of pediatric simulation with scripted debriefing confirmed previous findings, in that debriefing is a vital element to the effective use of simulation. A benefit of real-time simulation and debriefing is the feedback on participants' thoughts, decisions, and interventions that can be discussed immediately using the taped video recording and the simulation manikin. (Brown & Overly, 2016). The intervention group's higher knowledge assessment score postsimulation is an important finding, as knowledge of pediatric emergencies is critical to positive outcomes.

The importance of application of technical nursing skills, knowledge, critical thinking, and decision-making was evident in the pediatric simulations. Prompt identification and ongoing assessment of distress in children are especially important in achieving a positive outcome to treatment and intervention. Lack of confidence in one's knowledge or skills can increase the nurses' anxiety during critical situations. In addition to lack of confidence in skills, Monachino (2005) reported that knowledge and skills can be lost if not maintained through ongoing training opportunities. Andreatta et al. (2011) noted findings of rapid clinical skill and knowledge decline within several weeks after resuscitation skill training. Although there were no statistically significant differences or improvement in the critical elements over time, there was also no decline or decay in performance in the intervention group, which may indicate that repeated exposure to mock code simulation on a regular basis can contribute to pediatric nurses' retaining competency in emergency situations.

Implications for Nursing Professional Development

This pilot study provided the opportunity for staff nurses to be involved in research and evidence-based educational strategies to lead to improved pediatric outcomes. Focusing on integrating knowledge in an interactive, holistic, realistic program that incorporates the real participants and tools, in the actual setting where nurses need to be prepared to respond to a pediatric CPA, supports building

confidence in critical thinking and clinical decision-making (Patterson, Blike, & Nadkarni, 2008). Support for ongoing professional development requires creative and effective strategies to compete with the growing priorities for financial resources and staff's time. There has been a major shift in healthcare interests to provide safe and effective care, which measures its financial impact and return on investment, as well as outcomes to improve practice. No longer can educators provide inservice and education as the sole solution to maintaining staff competence and confidence. With the burden of rising healthcare cost, the demand to improve patient outcomes cannot be met without thoughtful assessment of need and objective measurement of outcomes for the education.

Limitations

A limitation of this study was the number of participants. Because of low enrollment in the study, there is limited generalizability of this study. This was attributed to inclement weather, changes to schedules, inability to leave work to come to off-site training, and staff job changes during the time of their participation. A second limitation was the lack of follow-up by participants in completing the final survey. Despite multiple attempts to get the participants to complete the posttest surveys, several who participated in all three interventions failed to complete the final survey. Lastly, there were several instruments to complete, which could have contributed to participant fatigue.

Conclusions and Recommendations for Future Research

Despite the small sample size for this pilot study (N = 18), nurses in the intervention group did have statistically significant higher scores on the knowledge test; although not generalizable, it provides pilot data supporting SBEs with debriefing as an effective method to educate nurses on pediatric emergency response. There was no statistically significant difference in skill indicating the possibility of little to no skill decay based on the PMCCEO; however, further exploration of this phenomena is needed. In addition, the investigators were able to confirm the validity and initial reliability of the knowledge test, self-confidence survey, and critical element checklist. The recommendation for future research is to conduct a replication study with a larger sample to determine whether the educational design of simulation and debriefing has a significant influence on nurses' knowledge, self-confidence, and competency with pediatric emergency preparedness.

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