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In Situ Pediatric Mock Codes: The First Five Minutes

Josephine N. Ruiz
California State University, Northern California Consortium Doctor of Nursing Practice

ABSTRACT

The purpose of this quality improvement project was to use in situ simulation-based mock codes to evaluate the effectiveness of participants' actions and perceived confidence, and to potentially reinforce and improve knowledge retention, skill acquisition, and confidence levels of nursing staff with regards to pediatric emergencies. Simulated drills were evaluated with a tool focused on high-performance teams and team dynamics as outlined by American Heart Association Pediatric Advanced Life Support 2016. Twenty-four simulated drills were conducted from January to February 2019. Each hour-long session was composed of pre-briefing, simulated drill or scenario, and debriefing and took place in empty patient rooms in pediatrics or PICU. Participants' self-confidence and knowledge were surveyed with a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) before the study began and after each session in which they participated. The pre- and post-survey tools were the same and results were aggregated. Statistical significance for survey questions "I need more knowledge" (p=.001) about codes and "I need more experience" (p=.006) with codes suggested that nurses felt more knowledgeable and more experienced after participating in the session. Evaluation of the simulated drills show improved role identification for first rescuers roles (48%) and improved time to arrival of the code cart after it was called (65seconds-165seconds in 15 sessions).

Josephine N. Ruiz
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IN SITU PEDIATRIC MOCK CODES: THE FIRST FIVE MINUTES

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Josephine N. Ruiz

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We, the undersigned, certify that the project of the following student meets the required standards of scholarship, format, and style of the university and the student's graduate degree program for the awarding of the Doctor of Nursing Practice degree.

Josephine N. Ruiz
Project Author

Arlene Spilker
Chairperson's name (Chair) — Nursing

Lisa Walker-Vischer — Pediatric CNS, SCVMC
Committee member's name — Department name

Patricia Beebe — General Staff Developer, SCVMC
Committee member's name — Department name or professional affiliation

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One day at work, four years ago, I had an idea. The idea has shifted and changed somewhat since then. But, after a great deal of energy, some sleepless nights, and a plethora of tears, it coalesced. Here I am, whole, maybe a little smarter, and quietly happy. I am ecstatic to finally be here, writing these particular words. Now that I am here, I don't know what to say or how to say it. An immense amount of love has gone into getting here and I feel overwhelmed with gratitude for those who helped, supported, and listened. There is no one in my life to whom I don't feel thankful for something. However, for this particular achievement there are a few whom I should and will thank. Thank you Drs. Kathy Abriam-Yago, Susan Prion, Ruth Rosenblum, and other faculty, colleagues, mentors, past and present, from The Valley Foundation School of Nursing at San Jose State University, and the School of Nursing at the University of San Francisco, who have listened to me, shared with me, encouraged me, and advised me. Special thanks also to Dr. Sulekha Anand at SJSU for your phenomenal statistics skills. I mean really, you're wonderful. Thank you Dr. Lisa Walker-Vischer and Dr. Arlene Spilker, my committee advisor and committee chair, for your calm, your level-headedness, compassionate ears, and humor when I was so close to quitting. I must also give shout outs to the Santa Clara Valley Medical Center Nursing Administration, Jill Sproul, Melissa Murphy, and Sue Kehl; Staff Developers Pattie Beebe (also a committee member) and Victoria Olarte; and nursing management of inpatient pediatrics and PICU, Myrna Heredia, Debbie Gazay, Ruth Smith, Lorna Schlachet, and Beverly Ruma for their support and enthusiasm regarding my project and what it could mean to us, the staff, and to our patients. Very special thanks to the Pediatric Mock Code Committee nurses, Vien Phan, Kelsey Skovmand, Dianne Mamauag, and Amy Jo Hart, for the generosity of your time and expertise and without whom I would never have had my idea and could not have completed my project, and to the nursing staff of acute pediatrics and PICU for being eager and generous with your time and energy. Just a few more thanks to my colleagues and friends in the program with whom I struggled along, all of us frowning, open-mouthed and eyes rolling from one semester to the next; thank you to all the nurses and researchers who have gone before, leading the way and holding me up, and to those who will come after for keeping our love alight. Thank you to all my family, mom and dad especially of course, because parents--I love you tremendously; and my besties, Susie, Jennifer, Leslie and Megs because I've got a scathingly brilliant idea. I am profoundly grateful.

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CHAPTER 1: INTRODUCTION

Background and Significance

In-hospital pediatric emergencies, such as cardiorespiratory arrest, are thankfully infrequent. However, healthcare providers must have regular opportunities to practice the technical and non-technical skills (e.g. effective communication, clinical judgment, and situational awareness) necessary to develop clinical competence and clinical expertise for these infrequent events. Without developing these skills, survival rates for pediatric cardiopulmonary arrests will remain bleak (Illinois Department of Public Health, 2012). In the hospital setting, first responders to patient emergencies are commonly nurses (Hunt, Walker, Shaffner, Miller, & Pronovost, 2008; Mariani et al., 2019) and whether new nurses or seasoned ones, they often demonstrate fear, anxiety, and confusion, which can result in immobilization and delays in the provision of basic lifesaving interventions (Delac, Blazier, Daniel, and N-Wilfong, 2013).

To provide healthcare workers with opportunities to safely practice and gain expertise, simulation-based training (SBT) has been implemented as a training and education tool. Van Schaik, Plant, Diane, Tsang, and O'Sullivan (2011) and Hommes (2014) found that simulation-based pediatric mock codes can increase perceived confidence and positively impact self-efficacy, knowledge retention, and psychomotor skills.

Santa Clara Valley Medical Center (SCVMC) is a highly respected teaching facility. As part of the educational requirements for both residents and medical students, simulated-based pediatric mock code drills are organized as opportunities for both nursing and medical staff to practice critical skills and decision-making related to pediatric emergencies. Mock code drills are scheduled during shift in empty patient rooms. While the nursing staff is notified ahead of time to allow staff to plan for their participation, pediatric residents remain unaware. Participation in mock codes is not required for nursing staff who often cite time constraints for their limited or lack of participation. Though the nursing staff continues to express anxiety and fear regarding perceived lack of knowledge and skills in responding to pediatric emergencies, and have made requests for opportunities to practice and develop clinical competence, when nurses have been able to attend, they limited themselves to technical tasks and left the drill either before or during the debriefing session.

Residents rotate through acute pediatrics and pediatric intensive care unit (PICU) on weekly and monthly bases over a three-year period. Once they rotate out of the inpatient area, resident pediatricians may not return for another year. Juxtaposed to this, nurses are the most consistent feature of any patient area, spending the most time engaged in direct patient care and the nursing process. As the largest group of direct healthcare providers, nurses are the most likely to be first responders to medical emergencies. However, because pediatric emergencies occur so seldomly, and nursing staff so infrequently participate in the planned mock codes, they continue to express fear, anxiety, and a general lack of confidence regarding their knowledge and abilities to effectively respond to pediatric emergencies (V. Phan & D. Mamauag, personal communication, May 19, 2016).

Although all pediatric and PICU nursing staff at SCVMC are required to be certified in pediatric advanced life support (PALS), testing every two years is not enough to retain and develop critical reasoning and clinical judgment. SBT has been found to improve learners' knowledge, skills, and behaviors which can then lead to improved patient outcomes (Agency for Healthcare Research and Quality [AHRQ], 2019). To be effective, first responders must have the opportunity to practice team dynamics as recommended by the American Heart Association (AHA) and PALS guidelines. There are five roles associated with effective resuscitation team dynamics: team leader, cardiopulmonary resuscitation (separated in two roles for a 6-person team), automated external defibrillator (AED)/defibrillator/monitor, access and medications, and timer/recorder (AHA, 2016). As stated in the 2016 PALS manual, successful, highly reliable teams demonstrate effective communication and team dynamics, such as knowing roles and responsibilities of each team member, knowing one's own limitations and capabilities, giving constructive interventions, and using closed-loop communication.

Purpose

As a teaching hospital, there are always more than enough physicians and ancillary support to respond to medical emergencies throughout the hospital. However, nurses are often the first responders to in-hospital emergencies. With pediatric emergencies being both high acuity and low occurrence, opportunities to practice effective resuscitation team dynamics remains the challenge. The purpose of this quality improvement (QI) project was to use in situ simulation-based pediatric mock code drills to conduct the first five minutes of a simulated pediatric emergency and evaluate the effectiveness of participants' actions and perceived confidence. Offering nursing staff secured time to practice the technical and non-technical skills necessary for effective teamwork can potentially reinforce and improve knowledge retention, skill acquisition, confidence levels and self-efficacy.

Theoretical Framework

The National League for Nursing Jefferies Simulation Theory (NLN/JST) was first developed and published in 2005 as a framework for the design, implementation, and evaluation of simulations used as teaching strategies in nursing education (Jefferies, 2005; Jefferies, 2016). Since that time, it has gone through four iterations, the last published in 2012. This mid-range theory was selected to structure simulation-based mock code drills for nursing staff to learn and practice the guidelines and responsibilities of responding to in-hospital pediatric emergencies; to develop clinical judgment; and to build confidence related to these skills. There are five major concepts of the NLN/JST: facilitator; participant; educational practices, simulation and design features, and outcomes (Jefferies, 2012).

Facilitator

According to Jefferies (2012), simulations are learner-centered, and as such the educator acts as facilitator and evaluator. Included within this construct are the abilities of the facilitator to utilize reflective thinking and their knowledge of learning theory, student abilities, and simulation design and applications (Jones, Reese, & Shelton, 2014). The International Nursing Association for Clinical Simulation and Learning (INACSL, 2016b) lists five criteria for the simulation facilitator role. The facilitator must have specific skills and knowledge in simulation pedagogy; must understand the level of learning, experience, and competency of the participants; must include preparatory activities, including pre-briefing, for the participants of the simulation-based experience; must be able to deliver cues that will assist participants to achieve expected outcomes; and, must support participants in achieving expected outcomes. Additionally, the facilitator should consider the emotional trauma that may be exposed during simulation learning and safeguard the environment against destructive criticism. In general, the facilitator must be able to develop and share the simulation experience in a meaningful way while supporting the learner.

Participant

Originally labelled as "student", the learner has more recently been termed "participant" as a more inclusive term, allowing all involved in simulated learning, such as educator, facilitator, embedded actors, and others, to be included (Durham, Cato, & Lasater, 2014). Participants in simulation experiences are expected to be self-directed and motivated as active partners in the learning environment. Having a non-competitive, collaborative attitude, and reflective practice can potentially enable learners to integrate knowledge with other experiences. This can enable learners to meet expected outcomes while offering them the opportunity to learn with other professionals and benefit from an array of perspectives (Hallmark, Thomas, & Gantt, 2014; Jefferies, 2005; Jefferies, 2012).

Participants' preparation, learning styles, motivation, and self-efficacy are also important considerations. It must also be remembered that participant immersion into simulated learning scenarios can bring up past life experiences that can profoundly affect learning by bringing up feelings of anxiety and vulnerability as well as concerns regarding a safe learning environment (Durham et al., 2014).

Educational Practices

Educational practices combined with certain theoretical frameworks can greatly assist student learning and satisfaction (Clapper, 2010). Jefferies (2005) outlined seven principles of educational practices to be used to guide simulation design and implementation. Subsequent research has identified alternative, consistent terminology and clarified definitions regarding the seven principles initially identified: faculty/student or learner-centered interaction, active learning, collaboration, diverse learning styles/multiple learning strategies, high expectations/defined outcomes/benchmarks, and feedback (Adamson, 2015; Hallmark et al., 2014: Jefferies, 2012).

Active learning. Active learning requires learners to be engaged and participative (Jefferies, 2005). Collaborative learning suggests a team approach toward meeting interdependent or shared goals (Hallmark et al., 2014). Contrarily, competitive learning is done in isolation and does not build on the social, cooperative behaviors that health care professionals must engage in to deliver high-quality, safe care. Both active and collaborative learning practices share the concept of interactivity. Participants in simulation learning must work together, not in competition, if learning outcomes are to be met.

Feedback. Although the terms debriefing and feedback are often used interchangeably in the literature (Adamson, 2015; Hallmark et al., 2014), they are not the same. As previously mentioned, feedback is often subsumed in the debriefing process. The INACSL Standards Committee (2016b, p. S42) defined feedback as "information given or dialog between participants, facilitator, simulator, or peer with the intention of improving the understanding of concepts or aspects of performance." Feedback assesses performance and offers suggestions for improvement. Debriefing is a process in which participants are encouraged to think reflectively and provide performance feedback regarding the simulation experience (Hallmark et al., 2014) and allows participants to link theory to practice and research (Jefferies, 2005).

Diverse learning styles. Students, whether matriculated or licensed professionals, come with a myriad of life experiences. Age, sex, socioeconomic statuses, ethnic backgrounds, learning styles and expectations, value for learning, and educational history are just a few of the diverse characteristics that students bring to the simulation learning experience. Facilitator must respect the diversity of the learners and develop teaching strategies and methods that will accommodate diverse learning styles (Hallmark et al., 2014).

Student-faculty feedback. Student-faculty feedback can affect the learner's ability to retain information and have a deeper understanding of the learning experience. Adamson (2015) identified evidence stating that simulation activities be learner-centered in order to meet the needs and promote engagement of the learners. Collaboration and support from the teacher/facilitator of the simulation experience can enhance students/participants critical decision-making skills, thereby increasing learner confidence and satisfaction (Hallmark et al., 2014).

High expectations. High expectations for simulation-based learning and its outcomes can be achieved with guidance and support and the belief in one's success (Jefferies, 2012). If goals and objectives for the simulation experience are communicated between facilitator and participant, the outcomes can be positive. In a safe learning environment, participants feel empowered to strive for greater learning and competency.

Simulation and Design Features

According to Adamson (2015) and Hallmark et al. (2014), there is limited evidence regarding best practice for simulation design. Five areas were identified by Jefferies (2012) regarding simulation design: objectives/information, fidelity, problem-solving, participant support and cues, and reflective thinking.

Objectives. Objectives, as with any educational endeavor, are essential and should be clearly defined and reflect the intended outcome (Adamson, 2015; Jefferies, 2012). Not only is it necessary to define and communicate learning objectives, it is also necessary to communicate information regarding the simulation activity, process, role expectations, time requirements, and expected outcomes to ensure achievement.

Fidelity. Simulation fidelity generally refers to the realism of the scenario and not necessarily the sophistication of the manikin. Scenarios can be quantified as high, moderate, or low fidelity, depending on the degree of authenticity and number of realistic environmental factors (Adamson, 2015; Groom, Henderson, & Sittner, 2012). However, it is important that scenarios be useful and transferable to clinical practice (Ballangrud, Hall-Lord, Persenius, & Hedelin, 2014). A scenario with a state-of-the-art manikin, but with a limited number of details regarding patient situation, history of illness, and a brief assessment may not be considered high fidelity. A more detailed scenario that included a history and physical, social background, and embedded actors or participants that offer information and cues may have more educational value.

Problem-solving. Problem-solving refers to the complexity of the simulation (Jefferies, 2012). A learners' ability to participate in critical-thinking and critical decision-making behaviors is reflected in their problem-solving skills. Complexity, as originally stated by Jefferies (2005), can refer to number of patient problems (e.g. confusion, respiratory distress, history of depression), patient's social or family dynamics, and clinical information (vital signs, assessments, labs), and/or how these details might relate to one another. However, it is important to remember the intention of the simulation is usually that of offering the nurse the chance to prioritize nursing assessments and interventions, and then evaluating those actions (Jefferies, 2012).

Reflective thinking. Reflective thinking, as stated by the INACSL (2016a), is a necessary component of simulation-based learning and generally occurs during debriefing. Debriefing sessions occurring immediately after a simulated experience can help participants remember the context of the scenario and see the bigger picture (Jefferies, 2012).

Outcomes

Learning outcomes, including the concepts of learning, skill performance, learner satisfaction, critical thinking, and self-confidence, must be established and discussed before a simulated experience begins (Jefferies, 2012). The practice of critical thinking and clinical judgment is cultivated by self-confidence and self-efficacy. O'Donnell, Decker, Howard, and Miller (2014) suggested rephrasing outcomes of knowledge as knowledge/learning, critical thinking as critical thinking/clinical judgment, and self-confidence as self-confidence/self-efficacy and stated that learner satisfaction and self-confidence/self-efficacy are important measurements of programmatic evaluation regarding scenario design, deployment of education practices, and effectiveness of instructional approaches. The skills gained during simulation and the transferability of knowledge to clinical practice is an important outcome of simulation learning.

Application of Theory to In Situ Hospital Training

Clinical competence is directly related to patient safety and is of primary importance (Gundrosen, Solligård, & Ardahl, 2014). Inter-professional teamwork is crucial to the delivery of effective, safe patient care, and improved patient outcomes (Zimmermann et al, 2015). Simulation-based training can assist health care professionals to foster situational awareness, inter-professional communication, teamwork, and critical decision-making. In situ hospital training also offers health care professionals and ancillary staff the chance to observe and improve team performance by increasing awareness of importance of effective communication; the availability of human resources; and the clarification of roles and responsibilities (Ballangrud et al., 2014). Although challenging to conduct in the workplace, simulated experiences are realistic, more easily available to staff, and takes place in familiar environs.

During a mock code, clinicians and ancillary staff are able to experience in real-time the actions and effects of critical decision-making, clinical interventions, and effective communication. Oftentimes, because staff educators want to instill a sense of urgency, participants in mock codes are taken unaware (much as in real life). However, the evidence previously discussed suggests that preparation for simulated learning does not diminish the realism of the scenario for the learners. For instance, high fidelity scenarios that include patient information, including current vital signs, responses to interventions, and an anxious 'family member' at the bedside can easily increase the intensity and realism of the scenario. Preparation for simulation learning can also enhance effective communication, in the form of cue cards or scripts. As well as fostering collegiality, learners with varying levels of education and practical experience have the opportunity to train alongside their professional peers, in a safe environment.

CHAPTER 2: LITERATURE REVIEW

The review of the literature provided guidance for developing this project. Initially, evidence for interdisciplinary or multidisciplinary training with regards to simulation was searched. However, with few exceptions, these studies still focused mainly on physician training in hospital settings. A search for evidence regarding the use of simulation as an educational and training tool for post-licensure nurses in the hospital setting followed with better results. This search brought up questions regarding the development of clinical expertise, especially for pediatric nurses who may not have consistent and frequent opportunities to learn from actual medical emergency situations.

Databases and libraries accessed for this project include: Cumulative Index to Nursing and Allied Health Literature (CINAHL), Elsevier, Medline, AHRQ, National Clearinghouse, OVID Technologies, EBSCOhost, American Academy of Pediatrics, American Heart Association, National League for Nursing (NLN), American Association of Critical-Care Nurses (AACN), Institute of Medicine (IOM), PubMed Medline, ProQuest Nursing and Allied Health Database, and National Institute of Health. Keyword search terms for the literature review included simulation, simulation-based, in situ simulation, in-hospital simulation, pediatric mock code, pediatric mega code, American Heart Association-Pediatric Advanced life support recommendations, simulation in nursing education, simulation theory, simulation-based training, simulation-based team training, simulation and self-confidence, simulation and self-efficacy, and simulation and theory. Eleven articles from 2014-2019 specific to in situ simulation and nursing were found. These articles also highlighted self-efficacy, knowledge retention, skill acquisition, and competency evaluation. Eight other articles focusing on simulation and interdisciplinary team training with similar highlights were also found. Articles focusing on prelicensure nursing and medical students, though helpful, were discarded. Articles relevant to this project were chosen for inclusion and review.

Herbers and Heaser (2016) conducted a quality improvement study over a two-year period at the Mayo Clinic to determine if in situ mock code drills improved nursing confidence levels and response times during medical emergencies. In situ simulations were delivered on two progressive care adult units with a total of 124 RNs and 18 nursing assistant participants. Participants' years of experience ranged from 0 to 40. This QI program collected data from electronic pre- and post-intervention surveys and a mock code evaluation tool. both instruments were developed using 2010 AHA guidelines for in-hospital arrest and their institution's competency checklist. Pre- and post-surveys were analyzed using the Chi-square test. Fisher exact test was used to measure changes in combined responses to *strongly disagree* and *disagree* and combined responses *strongly agree* and *agree* from presurvey and postsurvey responses. Median results showed response times and confidence levels were significantly improved after the simulated code. Drills also revealed hesitation by staff to assess and call for help which then resulted in delayed responses. Though the staff members were appropriately certified in 2010 guidelines for basic life support (BLS), it was noted that many were still using older guidelines of airway, breathing, circulation instead of current guidelines of circulation, airway, breathing. Mock code drills were unannounced which did not require staff to be at work on a scheduled day off, nor did it require preparation on the staff's part or waiting in line for individual turns. Nursing assistants were also empowered to begin lifesaving BLS without having to wait for licensed responders. Another positive note was the opportunities provided by the drills that allowed staff to familiarize themselves with emergency equipment. Overall, staff feedback was very positive, referencing teamwork, critical thinking, locations, resources, and a controlled, safe environment. Participation performance and survey results were not matched so individual data or team to team data could not be correlated.

Delac et al. (2013) conducted a QI initiative using in situ mock code simulation to improve RN responders' performance. Mock code drills, followed by debriefing, post-surveys, and evaluations were held in empty patient rooms in the medical-surgical/telemetry units four times per month. Two scenarios were presented using a simulation manikin in which participants also utilized oxygen, suction, and the hospital arrest cart. This initiative was named the "Five Alive Program" as it focused on responders' (RNs) performance during the first five minutes of a medical emergency. Five objectives were identified:

1. Identify the declining patient health status requiring urgent intervention and notification of the emergency response teams.
2. Execute the proper first responder procedure per hospital policy.
3. Perform the appropriate interventions based upon patient assessment.
4. Demonstrate the proper techniques of basic cardiac life support including 1 minute to CPR and 3 minutes to defibrillation.
5. Demonstrate clear effective hand-off communication to the arriving health team members. (Delac et al., 2013, p. 245)

This program was first initiated in March 2011 and remains on-going. Data from the first ten months and 103 participants were collected. Results revealed a significant decrease in responder's time to CPR initiation (65% improvement) and defibrillation (67% improvement) between the first and second scenarios; other findings were reports from nursing staff of improved confidence in initiating first responder interventions and utilization of emergency equipment before the arrival of rapid response or code teams. Latent errors that were noted included unfamiliarity with emergency equipment, including the arrest cart, defibrillator, bag-valve-mask resuscitator, using the backboard, effectiveness of compressions, and adequate ventilation.

Auerbach et al. (2014) also conducted a QI initiative between February 2010 and November 2012 at Yale-New Haven Children's Hospital's in the tertiary pediatric emergency department. The initiative used in situ trauma simulation (ISTS), to evaluate team dynamics including technical and non-technical skills. Latent errors were also identified. As part of the preparation for this program, the Agency for Healthcare Research and Quality's Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) was implemented throughout Yale-New Haven Children's Hospital. Three hundred ninety-eight trauma care providers responded to pediatric trauma activations for critically injured simulated patients in 22 unannounced trauma drills. After the simulation, the aggregate team composed of all those who responded to the code/trauma, including RNs, advance practice nurses, physician's assistants, medical students, residents, fellows, attending physicians, emergency medical services, clergy, hospital security, social work, child life, diagnostic imaging, respiratory therapy, pediatric surgery, pediatric emergency medicine, anesthesia, neurosurgery, orthopedics, trauma, blood bank, transport, and PICU, participated in a formal debriefing facilitated by the lead investigator of study. Two hundred fifty-one participants (63%) completed the validated assessment instrument (which contains teamwork, airway, intubation, breathing, circulation, and disability as the six subcomponents of care) and offered feedback regarding this program. Over the course of project, changes were made after feedback to improve acceptance of program. Data were collected by a single rater. The nonparametric Mann-Kendall trend test was used for trend analysis. The authors concluded that the use of ISTS for pediatric traumas was an effective training technique, providing opportunities for increased practice and provision of care in a safe environment. The study also showed that ISTS is feasible and associated with improved overall trauma team performance scores when measured against subsequent simulation data. Noted drawbacks include the use of a single rater for data collection and use of a validated though unnamed data collection tools.

A multi-disciplinary QI project utilizing TeamSTEPPS and a plan-do-study-act (PDSA) sequence was conducted by Lutgendorf et al. (2017) in the antepartum and postpartum units at Naval Medical Center in San Diego, which aimed to assess participant comfort with managing obstetrical emergencies. This study used in situ SBT with structured team debriefing. A total of 112 participants completed the 16 exercises and pre-/post-surveys over a two-day period. Pre- and post-survey responses were collected using a five-point Likert scale measuring providers' comfort levels in managing obstetrical emergencies with one being very uncomfortable and five being very comfortable. Conducting the drills in situ helped identify and rectify real time system improvements and gaps in knowledge for units where the study was performed. Statistical analysis of survey responses to hypertensive emergencies, shoulder dystocia, and post-partum hemorrhage was completed using paired *t*-test. Mean scores for each scenario (with corresponding confidence intervals) showed higher comfort levels in managing obstetric emergencies after simulation exercises compared to before. Also noted was a decrease in time to prepare simulated blood and a decreasing trend in postpartum hemorrhage cases which continued after simulations exercises were completed. Authors concluded that adult learners retain more knowledge and skills with hands-on/simulation experience than through traditional lecture. Multidisciplinary training also resulted in a decreased trend of post-partum hemorrhage cases which continued after the initiation of post-partum hemorrhage simulation exercises.

Yager et al. (2016) conducted a yearlong QI program with a dual-hospital pediatric response system. The objectives of this QI program were to identify gaps and inefficiencies in a code response that was infrequently activated, correlate these inefficiencies to current workflow, apply an iterative process to test QI interventions in a safe environment, and measure performance before actual implementation at the institutional level. Three measurable outcomes were identified by the researchers: code response time for secondary providers, time to initiation of CPR, and time to acquired vascular access. Twelve drills and PDSA cycles were completed with enhancements and changes made after each iteration. Latent errors were linked to process issues such as "unreliable code pager activation, slow elevator response, and lack of responder familiarity with layout and contents of code cart" (p. 42). Authors did not state how and by whom data were gathered, or with which tool and method data were analyzed. Authors did however report improved/decreased times to response (from 29 minutes to seven minutes), CPR initiations (from 90 seconds to 15 seconds), and successful vascular access (from 15 minutes to three minutes). It was also noted that in situ SBT assisted in exposing latent safety threats, offered opportunities to implement corrective measures and test efficacy of measure.

Dowson, Russ, Sevdalis, Cooper, and De Munter (2013) conducted a mixed method study to evaluate clinical confidence of qualified pediatric nurses in London, UK. Twenty nurses were divided into two equal groups. Intervention groups received three simulation-based training sessions and the control group maintained their usual clinical practice. Each nurse was interviewed and completed pre- and post-training clinical confidence questionnaires. The intervention group participated in three simulation training sessions over a three-month period while concurrently maintaining their usual clinical practice. Possible significant changes in each group's mean scores over time was assessed by the Wilcoxon signed rank test. A Mann-Whitney test compared mean scores from clinical confidence rating scale at month one (beginning of study) and month three (end of study). The Colaizzi framework was used to analyze qualitative data. The control group did not show significance improvement in technical confidence total, overall management, or total score over time. The intervention group showed highly statistically significant improvement in all areas over a 3-month period ($Z = -2.52$ to -2.04, $p < 0.05$) and a highly statistically significant improvement in total score ($Z = -2.66$, $p<0.01$) which the control group did not over the same period of time ($Z = -2.26$, $p < 0.05$). The Whitney-Mann U-test did not show a statistically significant change in confidence scores between the two groups after month three of simulation training. Qualitative analysis generated two main themes: real life experience (subthemes: confidence, knowledge, team functions) and simulation experience (subthemes: lack of realism regarding team size, preparation for real life situations, improved practice directly related to feedback/debriefing). Researchers concluded that simulation-based training can produce improvements in confidence in experienced nurses. Although this study was limited by the very small, convenient sample size, its contributions to new knowledge regarding in situ simulation-based training demonstrates some evidence in favor of this approach in increasing nurses' confidence levels.

Simulation, Knowledge Retention and Skill Acquisition

Since the publication of *To Err is Human: Building a Safer Health System* (Kohn, Corrigan, & Donaldson (2000), the objective of simulation in team training has been to improve knowledge, either through acquisition, generation, or reinforcement. Likewise, skill acquisition comes not from attempting and succeeding once, but through continued practice before it can be learned, understood, and refined. Studies using SBT for mock codes and other high-risk scenarios, such as in an emergency department trauma room or in an operating room, and in high-risk patients, such as premature neonates, have shown marked improvements in the recognition and management of pediatric deterioration (O'Leary, Nash, & Lewis, 2016). Other improvements include the early recognition and management of adult emergencies (Martin, Keller, Long, & Ryan-Wenger, 2016), higher knowledge assessment scores (Mariani et al., 2019), improved correlations between knowledge and clinical judgment (Letcher et al., 2017), improved skills and familiarity with equipment, technical skills and timing, and reinforcement of knowledge (Auerbach et al., 2014; Herbers & Heaser, 2016). Sapyta and Eiger (2017) used simulation to survey knowledge, accuracy, and confidence of documentation by pediatric nurses during a code situation demonstrating significant improvements in all three areas. Improved response times to the initiation of cardiopulmonary resuscitation (CPR) and improved time to defibrillation were noted in four studies (Delac et al., 2013; Herbers & Heaser; Sullivan et al., 2015; and Yager et al., 2016). As in these studies, improved performance of technical and non-technical skills was also noted by Auerbach et al. and Dowson et al. (2013), suggesting that all aspects of resuscitation training are necessary to limit and decrease deterioration of knowledge, skills, and attitudes necessary to gain and maintain expertise.

Of note, there were few articles and studies found by this researcher discussing the frequency and duration of SBT in the hospital setting, whether in a simulation lab or in situ. Regular, recurrent practice opportunities throughout the year, and every year for all staff would be the most serviceable. More studies regarding the most beneficial frequency and duration and that are cost-effective are needed.

Simulation, Perceived Confidence and Self-Efficacy

The use of simulation to measure, support and strengthen the knowledge and skills of healthcare workers also ties into the perceived confidence and self-efficacy that can be gained through experience and feedback. Studies by Dowson et al. (2013), Herbers and Heaser (2016), and Mariani et al. (2019) have made connections between experience and practice gained through simulation and improved confidence reported by healthcare providers. Delac et al. (2013) and Herbers and Heaser reported the improved confidence levels of nurse participants when initiating calls for help and first responder interventions. O'Leary et al.'s (2016) work with simulation and deteriorating pediatric patients showed improved median scores for nurses in both confidence and self-efficacy while Roh, Lee, Chung, and Park (2011) and van Schaik et al. (2011) also showed significant increases in nurses' self-efficacy. These studies and others strongly suggested that with the increase of knowledge and skills, perceived confidence also improved (Dowson et al.; Lutgendorf et al., 2017; Rautava et al., 2013; Sapyta & Eiger, 2017; and van Schaik et al.).

In Situ Simulation and Improved Patient Outcomes

Much of the results of the previously mentioned studies support the conclusion that improved skill, knowledge, and confidence would ultimately lead to improved patient outcomes. Patient safety, clinical competence, and inter-professional teamwork are directly related to the delivery of safe, effective patient care and positive outcomes (Zimmermann et al., 2015). The study by Letcher et al. (2017) not only supported an overall increase in perceived confidence, knowledge, and improved clinical judgment, but that these improvements also positively affected patient outcomes**.** Inferences can be made regarding the improved patient outcomes with the improvements in times to response and initiation of interventions, knowledge retention, and skill acquisition.

These are not the only means by which patient outcomes were safeguarded. The PALS guidelines (AHA, 2016) are specifically intended to improve outcomes for pediatric patients. Through didactic instruction and SBT, healthcare providers can be taught the tools necessary to save a child's life. However, once every one or two years is not enough to acquire expertise in guidelines and recommendations that are frequently studied and revised. Delac et al. (2013), Herbers and Heaser (2016), and Knight et al., (2014) noted that participants in their respective studies had previously unknown or had difficulty remembering PALS guidelines for roles, responsibilities and algorithms, and that after study interventions and surveys were completed improvements in technical and non-technical skills were observed.

Studies that emphasized in situ locations (Auerbach et al., 2014; Knight et al., 2013; Lutgengorf et al., 2017; and, Zimmermann et al., 2015) were also able to discover latent safety errors. Such safety errors include time to complete interventions (i.e. airway, intravenous access); knowing the locations and utilization of critical supplies and equipment (i.e. crash cart, intraosseous access device, blood bank locations); massive transfusion protocols; lack of role assignment during code response; insufficient handover report; and insufficient or missing resuscitation equipment. With the identification of these latent safety threats, changes were implemented to correct the oversight and educate staff.

Summary of Literature Review

Although skills acquisition and knowledge enhancement begin during the pre-licensure phase, many licensed health care workers must learn and practice both technical and non-technical skills while on the job to become competent and maintain their skills (Gundrosen, Solligård, & Ardahl, 2014). In situ SBT can promote intra- and inter-professional collaboration through direct observation and interaction, application of critical thinking and clinical judgment, rehearsal of effective communication, and articulation of actions and rationales during feedback and debriefing (Ballangrud, Hall-Lord, Persenius, & Hedelin, 2014).

CHAPTER 3: METHODOLOGY

Project Design

This quality improvement project used a descriptive, non-experimental design to investigate the effects of recurring simulation-based in situ pediatric mock codes on the self-confidence and knowledge retention of bedside nurses in the pediatric and pediatric intensive care units. The intervention utilized the existence and training of the pediatric mock code committee (MCC) nurses. This committee consists of one pediatric intensivist (as physician lead), three PICU RNs and one pediatric RN. All RN MCC members have 10-20 years of experience as bedside nurses. PICU RNs were all educated at the baccalaureate level. The pediatric RN was educated at the graduate level and is also licensed as a nurse practitioner. The intervention consisted of pre-briefs, simulation-based pediatric mock code drills, and debriefs (collectively referred to as a "session"). The project was conducted over the course of seven weeks. Each intervention or session was scheduled for one hour in duration and held either the hour before the start of shift (i.e. evening shift or night shift) or directly after the end of shift (i.e. day shift) to allow on-coming or off-going RNs the opportunities to participate in the study without patient care concerns. Pre-briefing was scheduled for the first five to ten minutes, followed by the mock code drill which also lasted five to ten minutes. Debriefing immediately followed each drill and was scheduled to last 10-20 minutes. All sessions were facilitated by one to two RN members of the MCC. The researcher acted as the single rater for all sessions and participated in all pre-briefing and debriefings sessions with the MCC facilitator.

Ethical Considerations

Though this was considered a QI project, approval was obtained from Institutional Review Boards (IRBs) of both California State University, Fresno (see Appendix A) and SCVMC (see Appendix B). Recruitment for the study began after approvals from both IRBs were obtained. Informed consent (see Appendix C) was obtained from all recruits prior to participating in their first scheduled session. Participation in the study was voluntary. Per discussion with the chief nursing officer of SCVMC, who strongly supported this project and viewed the sessions as valuable training for nursing staff, recruited nurses were paid for their time during sessions in which they participated. The majority of the participants either arrived early for their scheduled shift or stayed after their shift work was completed. Three nurses came in on their days off solely to participate in the scheduled interventions.

All the participants of the study were known by the researcher as colleagues and co-workers in the pediatric ward and PICU. Project facilitators (MCC members) set the schedule for all sessions according to their availability and work schedule. Participants were scheduled for sessions based on these dates, their work schedules, and personal availability. Information from demographics and surveys were kept anonymous and were identified by randomly assigned numbers. Pre-intervention and post-intervention surveys were not paired. Results and analysis of all surveys and mock code evaluation tools were scored by a statistician who did not know any participants of the study. The primary researcher was employed by SCVMC as a bedside nurse at the time of this study. All sessions were conducted during the researcher's non-work hours.

Research Questions

1. Do simulation-based pediatric mock code drills improve pediatric nurses' knowledge retention and skill acquisition?
2. Do simulation-based pediatric mock code drills improve pediatric nurses' confidence levels and self-efficacy?

Setting

The QI project was conducted at SCVMC on the acute pediatrics and pediatric intensive care units. SCVMC (2019a) is a 700+ bed level one trauma center. Inpatient pediatric services include a 33-bed acute pediatric ward and pediatric rehabilitation, a 12-bed PICU, and a pediatric infusion and sedation unit (SCVMC, 2019b). There are three 8-hour shifts beginning at 7A.M., 3P.M., and 11P.M. All simulation sessions were held in empty patient rooms in the general pediatric ward or in the PICU.

Sample

A convenience sample of 38 nurses was recruited. All pediatric and pediatric intensive care nurses were eligible to participate except those who were in orientation to either unit. Thirty-one (81%) nurses completed the demographic survey (see Appendix D). All but two nurses (5.2%) were female. Of those surveyed, the majority (29%) were between 45-55 years of age (see Table 1). However, 36.6% of those surveyed, had less than 5 year of experience in pediatric nursing (see Table 2) and 30% had 5-10 years of experience in nursing (see Table 3). The majority of those surveyed were educated at the baccalaureate level (73.3%) (see Table 4).

Table 1.

Age

Age in years (n=31)	Percentages
22-28	9.6
29-35	22.5
36-44	16.1
45-54	29
55+	16.1

Table 2.

Years of experience in pediatric/pediatric intensive care nursing

Years of experience (n=30)	Percentages
Less than 5 years	36.6
5-10 years	30
11-20 years	23.3
21-30 years	3.3
30+ years	3.3

Table 3.

Total years nursing experience

Years of experience in nursing (n=30)	Percentages
Less than 5 years	19.4
5-10 years	30
11-20 years	32.2
21-30 years	12.9
30+ years	6.5

Table 4.

Highest level of education

Highest educational level (n=30)	Percentages
Diploma	3.3
Associate degree	13.3
Bachelor's degree	73.3
Master's degree	10

Investigation Techniques

Sessions were planned over a seven-week period from January through February 2019 and were scheduled in one-hour increments at 2 P.M., 3:45 P.M., and 10 P.M. All sessions were also scheduled and observed by the researcher and facilitated by one to two MCC RN members. All MCC members received initial training on the Pediatric HAL simulation manikin through Gaumard Scientific in 2016. Training and education regarding scenario development and facilitation, and debriefing were completed through self-study by all members of the MCC. The researcher observed all mock code sessions. MCC facilitators were responsible for developing scenarios (of which there were eight), pre-briefing the primary nurse or team leader (TL) of the scenario, operating the simulation manikin (Gaumard Pediatric HAL, five-year-old), and leading debriefing sessions. Participants were instructed and reminded that they must complete critical actions, including retrieving the actual pediatric crash cart and other supplies, setting up the defibrillator when appropriate, performing CPR as necessary, and using closed-loop communication.

Intervention

Pre-briefing included review of the AHA PALS 2016 guidelines of the roles and responsibilities the primary rescuers during of the first five minutes of a medical emergency and an overview of the scenario. A total of eight scenarios were used per the facilitator's discretion. Scenarios were: 1) four year-old asthma exacerbation and respiratory failure; 2) five year-old dry drowning followed by pulmonary edema; 3) five year-old with ventricular tachycardia; 4) five year-old, status post motor vehicle crash (MVC), negative focused assessment with sonography for trauma (FAST) with bradycardia; 5) five year-old with supraventricular tachycardia; 6) seven year-old, status post MVC, FAST inconclusive; 7) six year-old with respiratory distress and bradycardia; and 8) six year-old with history of upper respiratory infection, dehydration, abnormal vital signs (sepsis). Mock code drills lasted five to ten minutes and were immediately followed by debriefing. Debriefing was facilitated by the MCC RN in attendance for the session and utilized the remaining scheduled time. Debriefs were centered on participants' simulation experience.

Instrumentation

The adult mock code committee at SCVMC currently uses a Likert scale questionnaire concerning knowledge and perceived confidence to survey staff and a mock code evaluation tool. The researcher and MCC nurses collaborated over the modifications of both the survey tool and the mock code evaluation tool with permission from the adult mock code coordinator. Both tools were modified to reflect AHA PALS 2016 recommendations and algorithms.

The survey tool asked participants to name the roles of high-performance teams as listed in PALS. Participants were surveyed using this modified tool before the study began and again after each mock code drill in which they participated. The tool for both pre-intervention and post-intervention surveys were identical (see Appendix E).

Mock code drills were observed and evaluated by the researcher using the modified pediatric mock code tool (see Appendix F). This tool focused on the five roles of high-performance teams (i.e. team leader, compressor and airway, access and medications, automated external defibrillator and monitor, and scribe) and their responsibilities as identified by AHA PALS guidelines (AHA, 2016).

Data Collection

Demographic information and pre-intervention surveys were collected at the same time as consents, and before participants were scheduled for sessions. Post-intervention surveys were distributed at the end of each drill, during debriefing, and were returned to the researcher before sessions were adjourned. The mock code evaluation tool was used to guide data collection (e.g. time to initiation of CPR, effective CPR, successful vascular access, arrival of code cart, delegation of roles, and use of closed-loop communication) during the simulated scenarios. The primary researcher timed all simulation sessions and made notations regarding time of assessments, critical actions and interventions using the evaluation tool.

Data Analysis

Collected data were organized on Microsoft Excel and analyzed using SPSS version 25. Descriptive statistics were used to summarize the numeric and categorical variables of the mock code evaluation tool. Pre-and post-intervention surveys were analyzed using Levene's test to determine equal variance with a *p*-value of greater than 0.05 showing significance and a *p*-value of less than or equal to 0.05 showing unequal variance. Welch's approximation was used to interpret the sample *t*-test results if homogeneity was not met. Unpaired *t*-tests were then used to determine if the means differed between the results from the pre-intervention surveys and the post-intervention surveys. Survey responses for confidence were also summed to determine the overall perceived confidence score.

CHAPTER 4: RESULTS AND DISCUSSION

Results

A total of 24 mock code sessions were completed. Thirty-eight RNs volunteered to participate in the study, of which 37 were able to attend sessions at least once. Nine RNs were able to participate only once. Of the remainder of the volunteers, eight (27.5%) participated twice; five (17.2%) participated three times; seven (24.1%) participated four times; four (13.8%) participated five times; one (3.4%) participated six times; and, three (10.3%) participated seven times.

Nurses coming onto shift at 11P.M. participated in a total of three sessions scheduled from 10P.M. to 11P.M. Those coming onto shift at 3P.M. participated in a total of 10 sessions that were scheduled from 2P.M. to 3P.M. Off-going nurses from day shift participated in a total of 12 sessions that were scheduled from 3:45P.M. to 4:45P.M. On two occasions when the sessions were scheduled after the shift was over and there were no time constraints for participants, debriefing ran 45 minutes for a total of 75 minutes for both sessions. Otherwise, sessions ran for the full allotted time of one hour.

Review of PALS guidelines regarding the roles and responsibilities of high-performance teams and reminders that all actions must be completed in real-time occurred during pre-briefings. Pre-briefing ended after other participants exited the room to allow the scenario TL the opportunity to receive a concise patient report. At the end of each simulation, participants often expressed their thanks and approbation for the opportunities to practice responding to pediatric emergencies.

Evaluation of Mock Code Drills

Observations of the mock code drills were illuminating for both the facilitators and the participants. All participants, as employees of SCVMC, are required to maintain PALS certification, wherein the roles and responsibilities of high-performance teams are reviewed. Of the 24 mock codes that were conducted, the primary nurse (who "discovers" the patients and activates an emergency response) assumed the leadership position 75% of the time. Delegation of duties by the TL occurred 8.3% of the time. Delegation of duties was often self-assigned by responding nurses (other participants) 62.5% of the time. Otherwise, the TL did not delegate roles (29.2%) to other responders. The role of scribe was not delegated or self-delegated in 41.6 % of the drills.

Positive take-aways from the drills revolved around the initiation and effectiveness of CPR by nursing staff. Most notably these include adequate and effective compressions (80%) as noted by the Gaumard Pediatric HAL software, time to initiation of breaths (94.4%), adequate bag-valve ventilation (75%), and correct compression to breaths ratio (80%).

Latent Errors

Code cart knowledge and utilization. Latent errors were discovered during drills and discussed during debriefing. One such error involves the code cart. All code carts are maintained by sterile processing and pharmacy and only opened during an actual emergency when it is then charged to the patient's account. All code carts are locked with numbered, easy break-away zip ties. Once the cart has been opened it must be exchanged in its entirety for a new cart. The unit nursing staff is responsible for checking that all necessary equipment and supplies on the outside of the cart are available and not expired, and that the zip tie remains intact. When items inside the cart are ready to expire, the cart is exchanged. All nursing staff from all shifts received a 15-minute in-service by the MCC nurses from October to November 2018 to review all the aspects of the outside of the code cart including how to prepare and utilize the equipment while awaiting secondary responders. During these in-services nursing staff often expressed concern that because code carts are only opened during those infrequent emergencies, they feel unprepared and incompetent regarding its contents.

During this project, it was also noted that critical items (e.g. oxygen flowmeter and oral suction catheter) were sometimes missing from the top of the cart and which might not have been noticed until they were needed during an actual emergency. The AED and portable suction machine were often left on top of the cart, near the head of the bed during simulated mock codes. This made navigating around and utilizing the contents of the cart difficult. During the first eight drills of this study the portable suction device was initially overlooked as participants left the bedside to collect and assemble suction equipment. The AED was also left on top of the cart during the first six drills, making the code cart either inaccessible near the head of the bed, or creating a hazard as cables stretched from the patient to the cart. By the last six sessions, participants moved both pieces of equipment to the patient's bedside without being tethered to the code cart, allowing rescuers to more easily and safely utilize the equipment.

Delays in care. Twenty scenarios (83.3%) required CPR. In four scenarios, CPR was initiated more than 60 seconds after compressions were deemed necessary. Often delays occurred because participants did not know how to operate the CPR function of the hospital bed. This led to delays in lifesaving interventions as the head of the bed was either slowly lowered to a flat position (12.5%) or left in place with head of the bed up as CPR was initiated (12.5%). After the CPR bed function was known and practiced, participants often did not to use the backboard (41.7%), believing the "max-inflate" function of the bed which was automatically activated with the use of the bed's CPR would suffice. Time to compressions, 60 seconds or less, or more than 60 seconds, was evenly split over the 24 drills and unnecessary interruption of CPR occurred only 8.3% of the time.

Three drills with SVT as the main concern were conducted in which all three nurses who retrieved ice for vagal maneuvers returned with ice in a cup, not prepared as an ice pack. Nor were other supplies brought that could be used for other vagal maneuvers. The primary nurse for all three scenarios also remarked on the amount of time it took for the nurse with the ice to return to the room, feeling the time to be excessive though only 20-30 seconds had elapsed when the nurse with the ice did arrive. Extra time was then spent as a resealable plastic bag was found to make an ice pack, or to retrieve other supplies. On two occasions, medications were not prepared or considered, and the defibrillator was not attached even though TLs expected cardioversion, either medical or mechanical, to take place once the pediatric team arrived at the bedside. Medications when needed were drawn up correctly 31.8% of the time. This segued into requests from participating staff for training with Bristojets and medication administration.

Communication breakdown. The most difficult skill/competency to practice and learn was closed-loop communication. Of all the drills conducted, closed-loop communication was used consistently and effectively only twice (8.3%) though it was used inconsistently and with some effectiveness 15 times (62.5%). The arrival of the pediatric crash cart after it was called for, or after a rapid response or pediatric code was called by the primary nurse, took 110 seconds to 300 seconds to arrive for the first seven drills and was related to lack of clear communication among the rescuers. After the seventh session, the pediatric crash cart usually arrived within 60 to 165 seconds. In less than half (45.8%) of the drills, the scribe did not record all the interventions, including frequency and duration of CPR interruptions (33.3%) nor did the scribe communicate effectively with the TL or other responders (33. 3%).

For all 24 drills, the TL always went to the door to call for the other participants who were waiting outside the patient room. Only five times did the TL also state that they would use the staff assist or pull the call bell from the wall to call for help so they would not have to step away from the bedside. Participants cited the awareness of waiting co-participants as the reason for going to the door to call for help. However, this prompted a review of other means of calling for help, such as using Vocera to send an emergent call to all staff, using the staff assist or code buttons located in each patient room, or dialing the hospital operator from the patient's bedside for a rapid response or code team.

Survey Results

Participants were asked to rate the statements "I need more knowledge about codes" and "I need more experience about codes" before their first session and again after each simulated drill in which they participated. Unpaired *t*-test indicated a statistically significant decrease in the responses to survey questions "I need more knowledge about codes" and "I need more experience about codes", each with *p*-values = .001 (see Table 5). Pre-intervention and post-intervention mean scores for these statements suggest that nurses believed they needed less knowledge and less experience with codes (see Table 6) after participating in the mock code sessions. With few exceptions, the results from statistical analysis of the remainder of the survey questions did not show statistical significance for knowledge or confidence.

Table 5.

Two Sample t-Test

	t	df	Sig. (2-tailed)
Codes scare me.	.113	150	.910
I need more knowledge about codes.	3.275	150	.001
I need more experience about codes.	2.786	146	.006
I know the PALS algorithms.	-.556	148	.579
I am confident in my ability to perform CPR correctly.	-.830	150	.408
I am confident in my ability to utilize AED and provide a shock if indicated.	-.662	150	.509
I am confident in. my ability to set up suction immediately.	-.727	150	.469
I am confident in my ability to assess airway and provide Ambu ventilation.	-1.621	48.242	.112

Table 6.

Group Statistics

	Pre/Post	N	Mean	*SD*	*SEM*
Codes scare me.	Pre	35	.94	1.235	.209
	Post	117	.92	.790	.073
I need more knowledge about codes.	Pre	35	.57	.558	.094
	Post	117	.12	.756	.070
I need more experience about codes.	Pre	34	.68	.475	.081
	Post	114	.32	.708	.066
I know the PALS algorithms.	Pre	34	.35	.734	.126
	Post	116	.45	.917	.085
I am confident in my ability to perform CPR correctly.	Pre	35	.37	.690	.117
	Post	117	.48	.664	.061
I am confident in my ability to utilize AED and provide a shock if indicated.	Pre	35	60	.976	.165
	Post	117	.72	.908	.084
I am confident in my ability to set up suction immediately.	Pre	35	.60	.651	.110
	Post	117	.68	.582	.054
I am confident in my ability to assess airway and provide Ambubag ventilation.	Pre	35	.43	.698	.118
	Post	116	.64	.566	.053

Of the five roles of high-performing teams, the role of CPR was named 93.9%, followed by scribe (92.2%). Team leader was named 88.7%, access and medications 87.9%, and AED and monitor 56.9%. After the first four sessions, the researcher and facilitators included in the pre-briefs a review of the roles and responsibilities of high-performance teams. Previously, participants often listed responsibilities but not roles or incompletely listed roles by separating the role of CPR into compressions and airway and neglecting AED/monitor or scribe. After a review of roles was added to pre-briefing, participants were better able to correctly and completely list all five roles; however, responses to this portion of the survey continued to be incomplete.

Debriefing

Debriefing sessions averaged 43.3 minutes during which time participants were allowed and encouraged to reflect on and discuss their actions and rationales, to discuss what went well and why, and how to improve or manage what did not go well. Other topics during debriefing include the importance of team dynamics and closed-loop communication, physical positioning of rescuers, placement of crash cart and AED in relation to patient and rescuers, utilization of crash cart contents, especially supplies located on top of and on the sides of the cart, AED function and use, and resource utilization (both staff and supplies). Three areas of concern were specifically identified: pediatric code cart, automated external defibrillator, and communication and resource management.

Regarding the code cart, staff is prohibited from opening a code cart unless there is an actual emergency. All adult code carts are standardized and labeled for easy location of resources. Pediatric code carts are also standardized but are not labeled. As such staff is often unaware of the contents of the code carts or the locations of supplies and medications. Many nurses stated this as a significant concern during debrief and asked for opportunities to learn the contents of our code carts.

Participants cited issues with the AED/defibrillator set-up and medication preparation as one of the most common concerns. Once discussion was complete, the participants often practiced setting up the AED or drawing up emergency medication for pediatric patients until session adjournment was called.

Early, effective communication and resource utilization were also found to be lacking. Some of the observations made during debriefings included calling for assistance sooner (once concerns were raised) as opposed to waiting for more conclusive signs of the patient's instability; quickly preparing the patient for emergency interventions and initiating basic life support earlier; calling for and bringing the crash cart to the beside early and utilizing crash cart equipment and supplies; more effective and consistent closed-loop communication; and requesting feedback and suggestions from other team members. An observation initially made by a participant and which occurred on two other occasions, was the quietness of the scenario as the TL was able to direct, delegate, and communicate with other team members without having to speak loudly or repeat themselves. As the sessions took place in an empty patient room in the pediatric ward or PICU, participants were able to utilize their knowledge and experience of the lay out and locations of critical supplies. Doing the drills in real-time allowed participants to experience how much could be done in five minutes as well as appreciating the time necessary to accomplish certain tasks. As well as a discussion of latent errors, participants were able to reflect on and discuss their actions and rationales and critical decision-making. Actual events and case studies were also considered, offering perspectives and lessons learned.

Post-Study Questionnaire

A post-study questionnaire (see Appendix E) was distributed to all participants with 13 (35.1%) returned. All respondents to the post-study questionnaire were interested in continuing to be pre-scheduled for mock code drills. Ten respondents (76.9%) suggested once a month, or one to two times every two to four months would be the most acceptable. Seventy-five percent of respondents preferred to do overtime either before or after a scheduled shift as opposed to being scheduled on a day off. Continuing education credits were considered by all as an added incentive to participation. Answers to the question "What would you have liked to learn?" included "learning roles of code team skills", especially that of team leader, "practicing prolonged CPR", "practicing closed-loop communication", "preparing medications", and "learning and practicing how to record events".

Discussion

The ultimate goal of this study is tied to the Triple Aim of the Institute for Healthcare Improvement (IHI): enhancing patient experience, improving population health, and reducing healthcare costs per capita (Berwick, Nolan & Whittington, 2008). Research suggests that knowledge retention, skills acquisition, confidence and self-efficacy can affect patient outcomes (Auerbach, et al., 2014; Delac et al., 2013; Letcher, Roth, & Varenhorst, 2017; Rautava et al., 2013; and van Shaik et al., 2011). Simulation-based mock codes are a method of training and education that allows participants to gain experience and practice through the retention and utilization of knowledge, skills and attitudes. With improved confidence and efficacy in their abilities to provide competent, compassionate care as may be gained through SBT, some of the concern and anxiety felt by bedside nurses could be alleviated.

Though the study's data does not provide strong evidence for the utilization of in situ SBT, observations by the researcher and facilitators, discussions and feedback from participants during debriefings reflect positively on this method of education and training.

Limitations

Though the sample size (n=37) was large enough for statistical significance, it was relatively small, and sampled from among pediatric and PICU nurses at a single hospital making its generalizability limited. All interventions took place over a seven-week period during which time most of the participants took part in more than one session. Another limitation was the lack of validated tools used to survey the participants and evaluate the mock code sessions. The researcher chose to use tools modified from those currently used at the hospital where the QI project was conducted. As sessions were focused on the first five minutes of a pediatric emergency, only nurses were eligible to participate and so could not benefit from practicing with an interdisciplinary team beyond the first five minutes. This diminished some realism for several nurses.

CHAPTER 5: CONCLUSION

Implications for Practice

Literature suggests that simulation can enhance the capacity to recognize unstable patients and begin life-saving measures sooner, which can then add to confidence and improved self-efficacy. This was evident by the improved time to the initiation of CPR, the improved time to the arrival of the code cart, and the increased and safe utilization of the portable suction device and AED. Since the end of the quality initiative, project participants have expressed interest in continuing the simulated drills of this QI initiative. Two participants have begun training with the simulation manikin and learning how to facilitate mock codes. Other nursing staff who were not involved in the study have also verbalized interest in participating in future simulated mock codes. Although there were 38 recruits, other staff nurses verbalized an interest in participating in mock codes and cited personal constraints or prior obligations for not participating in the study. This indicates a willingness of staff nurses to participate in potentially stressful training and educational events if they feel the learning environment is safe and if they are compensated.

Overall, the outcomes of the study were positive. Performing the critical actions of rescuers during the first five minutes gave insight to participants regarding the challenges of following PALS guidelines and how important it is to continue practice to maintain competence. Study participants were also able to practice these roles and responsibilities in their work environment while maintaining patient safety.

Recommendations

Of note, there were few nursing articles and studies that discussed the frequency and duration of SBT in the hospital setting, whether in a simulation lab or in situ, that were found by this researcher. More studies are needed that investigate the efficacy of in situ SBT to improve knowledge, skills, and attitudes of in-hospital providers. With the cooperation and support of nursing administration and management, plans have moved forward to continue offering these sessions over the long term, including integrating an interdisciplinary approach. Though inconclusive, the study and its results add to the volume of nursing research, specifically regarding pediatric nursing staff and in situ SBT.

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APPENDICES

APPENDIX A: INSTITUTIONAL REVIEW BOARD APPROVAL LETTER, CALIFORNIA STATE UNIVERSITY, FRESNO

FRESNO STATE
College of Health and Human Services

California State University, Fresno
School of Nursing
IRB Approval

Date: December 22, 2018

RE: DNP 1831 Using the situ simulation-based training focusing on the first five minutes of pediatric medical emergencies

Dear Josephine Ruiz,

As the Chair of the School of Nursing Research Committee, serving as the Institutional Review Board for the School of Nursing, I have reviewed and approved your review request for the above-referenced project for a period of 12 months. I have determined your study to meet the criteria for Minimal Risk IRB review.

Under the Policy and Procedures for Research with Human Subjects at California State University, Fresno, your proposal meets minimal risk criteria according to section 3.3.7: Research in which the risks of harm anticipated are not greater, probability and magnitude, than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.

The Research Committee may periodically wish to assess the adequacy of research process. If, in the course of the study, you consider making any changes in the protocol or consent form, you must forward this information to the Research Committee prior to implementation unless the change is necessary to eliminate an apparent immediate hazard to the research participant(s).

This study expires: December 22, 2019

The Research Committee is authorized to periodically assess the adequacy of the consent and research process. All problems having to do with subject safety must be reported to the Research Committee. Please maintain proper data control and confidentiality.

If you have any questions, please contact me through the CSU, Fresno School of Nursing Research Committee at nishanair@csufresno.edu.

Sincerely,

Nisha Nair, DNP, RNC, CNS, CNE, IBCLC
School of Nursing, Research Committee, Chair

School of Nursing
California State University, Fresno
2345 E. San Ramon M/S MH25 • Fresno, California 93740
P 559.278.2041 F 559.278.6360 *www.FresnoState.edu/nursing*

APPENDIX B: INSTITUTIONAL REVIEW BOARD APPROVAL LETTER, SANTA CLARA VALLEY MEDICAL CENTER

SANTA CLARA VALLEY MEDICAL CENTER

PLEASE NOTE: THE IRB OFFICE HAS MOVED!
Santa Clara Valley Medical Center
777 Turner Dr. Building N, Room 2N106
(408) 885-2383

November 2, 2018

Josephine Ruiz, RN
Pediatric Intensive Care Unit
751 S. Bascom Ave.
San Jose, CA 95128

RE: Project entitled "Using in Situ Simulation-Based Training Focusing on the First Five Minutes of Pediatric Medical Emergencies"

Through an expedited review process on November 1, 2018 the Institutional Review Board (IRB) of Santa Clara Valley Medical Center, declared the above-referenced project to be quality improvement (QI) and therefore does not meet the definition of research (45 CFR 46.102). As such, it is not subject to further IRB review.

Further guidance from the IRB includes should a publication or presentation be completed on this project, it should not be indicated that the project is IRB-approved or referred to as "research".

Should you have any questions, please contact the IRB office.

Sincerely,

Elisabeth A. Muilhot, MD, Chair
Research and Human Subjects Review Committee

EAM/kb

Cc: Committee Members

1112 (07/19/07)

APPENDIX C: CONSENT FORM

CONSENT FORM

You are invited to participate in a Quality Improvement (QI) Project conducted by **Josephine Ruiz, MSN, RN**. This QI project will offer nursing staff an opportunity to practice and improve their technical and non-technical skills and knowledge regarding pediatric medical emergencies by participating in pediatric mock code drills focusing on the first 5-10 minutes of a pediatric medical emergency. You were selected as a possible participant in this study because you specialize in pediatric nursing.

If you decide to participate, dates and times will be scheduled with a group of 4-6 nurses per meeting. Meetings will be conducted outside of scheduled work hours, that is before or after scheduled shifts, or on days off. Meetings will be conducted in the inpatient pediatric department wherein one pediatric medical emergency scenario per meeting will take place. Scenarios will be introduced with a short pre-brief. Scenarios will then proceed using American Heart Association Pediatric Advanced Life Support guidelines to determine recommended actions and timeliness of interventions. A debrief lasting 15-20 minutes will follow each scenario. During debriefs, participants will be encouraged to reflect on their actions and clinical reasoning, and possible gaps in knowledge. The QI project will last from December to February, meeting 4-6 times per week for 45-60 minutes each from pre-brief through debrief.

Participants will also be required to complete a short (half page) Likert survey regarding perceived self-efficacy and knowledge regarding pediatric medical emergencies. Surveys will be collected before simulated drills commence. For volunteers who participate in only one scenario per day, a post-intervention survey will be collected after each scenario. For those volunteers who attend more than one simulated drill per day, post-intervention surveys will be collected at the end of the last participated drill. Survey information will be kept confidential.

There is no risk to volunteers for participating in this study. This QI project will not be used to test or evaluate nursing skills or knowledge. It is intended to offer a safe place to practice responding to pediatric medical emergencies, improving self-efficacy, and identifying gaps in knowledge. Scenarios will be scheduled either before or after shifts of participating nurses. It is not guaranteed that you will receive any personal benefits from this study.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. If you give us your permission by signing this document, data will be disclosed in aggregate form to maintain confidentiality. Data may be shared via published article in a peer-reviewed journal.

Your decision whether or not to participate in this study will not prejudice your future relations with California State University Northern California Consortium or Santa Clara Valley Medical Center. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without penalty. The Committee for the Protection of Human Subjects at California State University, Fresno and Santa Clara Valley Medical Center Institution Review Board have reviewed and approved the present study.

If you have any questions, please do not hesitate to ask. If you have any additional questions later, Dr. Arlene Spilker at Arlene.Spilker@sjsu.edu will be happy to answer them. Questions regarding the rights of research subjects may be directed to Dr. Kris Clarke, Chair, CSU Fresno Committee on the Protection of Human Subjects, (559) 278-2985.

You will be given a copy of this form to keep.

YOU ARE MAKING A DECISION WHETHER OR NOT TO PARTICIPATE. YOUR SIGNATURE INDICATES THAT YOU HAVE DECIDED TO PARTICIPATE, HAVING READ THE INFORMATION PROVIDED ABOVE.

___________________________ Signature

___________________________ Date

APPENDIX D: DEMOGRAPHICS

Age

Years of experience in pediatrics

Years of experience in pediatric intensive care

Total years of nursing experience

Types of experience

Highest educational degree National certification

APPENDIX E: PRE-/POST-INTERVENTION SURVEY

Code White Simulations

For the **PRE-/POST-ASSESSMENT**, please rate your confidence in ability to execute the Code Blue Skills using the following 1 to 5 scale:

1 = Strongly disagree
2 = Somewhat disagree
3 = Neutral (neither agree or nor disagree)
4 = Somewhat agree
5 = Strongly agree

Post-Assessment

Codes scare me.	1	2	3	4	5
I need more knowledge about codes.	1	2	3	4	5
I need more experience about codes.	1	2	3	4	5
I know the PALS algorithms.	1	2	3	4	5

1 = Not at all confident
2 = Almost no confidence
3 = Neutral (neither confident or nor unconfident)
4 = Somewhat confident
5 = Very confident

I am confident in my ability to perform CPR correctly.	1	2	3	4	5
I am confident in my ability to utilize AED and provide a shock if indicated.	1	2	3	4	5
I am confident in my ability to set up suction immediately.	1	2	3	4	5
I am confident in my ability to assess airway and provide Ambu Bag ventilation.	1	2	3	4	5

Name the 5 Roles of the First 5 Minute Team:

1.
2.
3.
4.
5.

APPENDIX F: MOCK CODE WHITE DRILL EVALUATION TOOL

Mock Code White Evaluation Tool

Date______________ Unit/Location_____________ Facilitator(s)________________________ Timer_____________

Start Time__________ Stop Time___________ Manakin___________

		TIME	Correct Critical Actions	Incorrect Actions	Response Time	Comments
1.	Assesses patient/establish patient stability		☐ Obtain history, if available ☐ Assess circulation, breathing, airway ☐ Assess vital signs ☐ Recognize instability	☐ No history/report obtained ☐ Partial assessment completed ☐ No vital signs assessed ☐ Does not recognize instability	0 sec	
2.	Call for help		☐ Uses Vocera ☐ Calls out ☐ Uses call bell (pulls out of wall) ☐ Pushes staff assist button	☐ Leaves patient to get help ☐ Does not use established methods for emergency notification		
3.	Delegates roles to responding staff		☐ Primary RN assumes leadership until code team arrives ☐ Delegates/assigns team roles	☐ Does not assume position of leader ☐ Does not assign staff		
4.	Time manakin becomes pulseless/apneic	00:00				
5.	Staff establishes patient as unresponsive		☐ ≤30 seconds ☐	☐ ≥ 30seconds ☐ Not done		
6.	Primary RN begins CPR/rescue breathing		☐ Patient flat and supine ☐ Backboard placed before chest compressions	☐ Patient not in flat, supine position ☐ Backboard not placed during mock code	40sec	

			☐ Backboard placed shortly after chest compression initiated			
7.	Calls for pediatric RRT or Code White		☐ Code cart brought to bedside @ _____ ☐ Delegates interventions to subsequent responders ☐ Assumes leadership position	☐ Code cart not brought to bedside ☐ Code cart stationed outside of patient's room		
8.	Team member/role assignment					
	Team leader		☐ First responder/primary nurse maintains leadership role until Code Team arrives ☐ Begins compressions until second responder arrives ☐ Delegates other roles ☐ Uses closed-loop communication ☐ ☐ Communicates current situation to responders in 2-3 sentences	☐ Does not assume leadership ☐ ☐ ☐ Does not begin rescue maneuvers until code team arrives ☐ Does not delegate assignments ☐ Does not use/enforce closed-loop communication ☐ Does not communicate effectively with code team		
	Compressor		☐ Time to compressions ≤ 60 seconds ☐ Correct ratio for Compressions to respirations: **30:2** OR **15:2** ☐ Compressions rate at least 100/min ☐ Correct hand position and body mechanics ☐ Recoil ☐ Performs 2 minutes uninterrupted CPR unless defibrillating	☐ Time to compressions ≥ 60 seconds ☐ Compressions and respirations not coordinated between 2 rescuers ☐ Compression rate less than 100/min ☐ Incorrect hand placement and/or body mechanics ☐ No recoil ☐ Stops CPR before 2 minutes (for any reason)		
	Airway:		☐ Able to set up ambu-bag appropriately	☐ Does not set up ambu-bag efficiently ☐ Delays rescue breathing		

			☐ Time to first assisted ventilation ≤ 60 seconds ☐ Head-chin tilt or jaw thrust ☐ Mask positioned correctly ☐ Adequate mask seal ☐ Establishes chest rise ☐ Ambu-bag attached to oxygen ☐ Oxygen turned up to 10-15L	☐ ☐ ☐ Mask positioned incorrectly ☐ Improper mask fit ☐ Does not assess chest rise ☐ Does not attach to oxygen ☐ Oxygen less than 10 L		
	AED:		☐ Knows how to turn on AED ☐ Proper paddles (adult or pediatric) ☐ Knows how to place paddleless leads ☐ ☐ No interruption of CPR ☐ Pauses CPR for analysis, then return to CPR ☐ Knows how to charge AED ☐ Knows how to safely shock patient	☐ Does not know how to turn on AED ☐ Wrong paddles ☐ Improper placement of paddleless leads ☐ CPR interrupted ☐ ☐ Does not charge AED ☐ Shock not delivered safely		
	IV/IO/ Medications:		☐ Checks/ initiates IV/IO access ☐ Administers medication			
	Timer/recorder:		☐ Records times of interventions and medications and announces when next doses due ☐ Records frequency and duration of interruptions in compressions ☐ Communicates information to team leader and rest of team			

APPENDIX G: POST-STUDY QUESTIONNAIRE

Questionnaire

1. Post-mock code white drills survey
2. How many drills did you participate in?
3. Did you have an opportunity to be the team leader?
4. If you believe your patient is deteriorating, are you more likely now to call for assistance sooner than to try to manage the situation on your own?
5. Do you believe you have a stronger understanding of the AHA PALS recommendations for the 5 roles of a medical emergency?
6. What, if anything, do you feel was the most valuable skill or concept that you learned during the drills in which you participated?
7. What would you have liked to learn?
8. In the future, how often would you be willing to participate in mock code drills? Would you be willing to help facilitate a mock code drill?
9. Would you be willing to be prescheduled for mock code drills that are 2-4 hours in duration?
10. Are you interested in participating in a mock code committee? Or being a mock code champion?