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Reducing "Failure to Rescue" Occurrences: A Pilot Project Incorporating High-Fidelity Simulation During Mock Codes, to Enhance Pediatric Nurses' Clinical Knowledge and Skills

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Reducing “Failure to Rescue” Occurrences:
A Pilot Project Incorporating High-Fidelity Simulation during Mock Codes,
to Enhance Pediatric Nurses’ Clinical Knowledge and Skills

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California State University, Northern Consortium
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Doctor of Nursing Practice

A thesis
submitted in partial
fulfillment of the requirements for the degree of
Doctorate of Nursing Practice
in the School of Nursing
California State University, Fresno
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Abstract

Thanks to advances in technology, the survival rate of infants and children with critical illnesses has improved. One consequence has been an increase in the acuity levels of hospitalized pediatric patients, which may heighten the risk of in-hospital cardiopulmonary arrest. Patient safety can be compromised by nurses who do not detect subtle clinical changes in a patient's condition, do not perform accurate interventions, or do not apply critical thinking (failure to rescue). The Institute of Medicine (IOM) in 1999 estimated that approximately 100,000 people died each year as the result of poor care.

Patients and families place great trust in nurses, relying on them to take care of their loved ones. Health care education needs to address the safety of patient care, in order to ensure that it is effective and reliable. Simulation education can improve patient care by focusing on the American Association of Critical-Care Nurses Quality and Safety Education for Nurses (QSEN) competencies, and applying quality improvement (Cronenwett, et al., 2007). Patient-centered scenarios, team collaboration, and pediatric advanced life support (PALS) practice guidelines scenarios can be applied through a quality improvement program, by having nurses participate in mock codes (responses) to address core competencies.

For this doctorate of nursing practice (DNP) project, mock codes were conducted at a central California hospital pediatric unit. Participants completed a modified American Heart Association (AHA) PALS pre-test prior to and post-test after participation in the mock code. Soon after the mock codes, the registered nurses (RNs) participated in multiple real codes. RNs who were surveyed stated that the mock code helped their performance in the actual codes that followed, in terms of decreasing their levels of anxiety and enhancing their confidence with regard to feeling well-prepared.

A project submitted in partial
fulfillment of the requirements for the degree of

Doctor of Nursing Practice (DNP)
in the California State University Northern California Consortium DNP Program
California State University, Fresno and San José State University

May 6, 2014

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Denise Dawkins

Acknowledgement

Though only my name appears on the cover of this dissertation, a great many people have contributed to its production. I owe my gratitude to all those people who have made this project possible and because of whom my graduate experience has been one that I will cherish forever.

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Table of Contents

Introduction.....	6
Background and Significance.....	6
Purpose.....	8
Research Questions.....	9
Conceptual Framework.....	9
Operational Definition of Terms.....	10
Literature Review.....	11
Methodology	17
Project Design.....	17
Setting.....	18
Population and Sample.....	18
Investigative Techniques and Interventions.....	22
Instrumentation.....	23
Validity and Reliability.....	23
Study Procedure.....	23
Data Collection.....	24
Data Analysis Plan.....	26
Ethical Consideration.....	26
Human Subject Protections.....	26
Potential Researcher Bias.....	26
Summary.....	27
Results.....	27
Statistics and data Analysis.....	29
Discussion and Assessment of Results.....	30
Limitations.....	32

Conclusion and Implications for Nursing Practice.....	33
References.....	35
Appendix A...Project Consent Form.....	41
Appendix B...Demographics Sheet.....	42
Appendix C....Pre-Post-Test.....	43
Appendix D...Performance Check off	45
Appendix E...IRB Approval.....	46

Introduction

Patient safety can be compromised by nurses who do not detect clinical changes in a patient’s condition, do not perform an accurate assessment, or do not adequately apply critical thinking (Brown, 2012). This phenomenon of not acting in response to a rapidly deteriorating condition is called “failure to rescue” (Brown, 2012). Intervention at this critical juncture represents the last and best chance the nurse has to avoid a poor patient outcome. Failure to rescue is of course something that should never happen. Failure-to-rescue rates, unfortunately, are often not tracked in the pediatric population (Brown, 2012).

One strategy to address failure to rescue is to increase advanced training of nurses, to help them recognize complications and to enhance communication, teamwork, and skills by means of routine mock codes. The use of protocols from clinical practice guidelines makes interventions reliable and repeatable. Instituting repeatable quality protocols (mock codes) within the pediatric unit can teach nurses to intervene sooner and improve patient outcomes (Brown, 2012).

Background and Significance

Simulation has long history of being used for improving safety (GABA, 2004). A good example is the use of simulation in the military and aviation. One of the earliest uses of simulation in military strategy occurred during the sixth century when chess games were used to practice skills, problem solving, and judgment. In 1934, in an effort to avert fatal accidents, the military started using link trainers (an early form of flight simulator) to improve performance. By the 1950s, simulation became more commonplace. Commercial aviation merged with civil aviation, flight simulation was required of commercial pilots seeking recertification, and analog computers enhanced the complexity and realism of flight

simulators. Between the 1960s and 1970s, National Aeronautics and Space Administration (NASA) joined the simulation movement with full flight simulators. The ground crew utilized simulation to do the extensive problem solving and safety exercises that were credited for bringing Apollo 13 safely home (Ray, 1996). At this time, it was determined that human factors were the major cause of flight accidents. During the 1980s, the National Transportation and Safety Board (NTSB) authorized the use of training and evaluation of pilots, in response to 41 flight-related deaths. By the 1990s, simulations were integrated into technical training for crew and cockpit personnel (Rosen, 2007). On January 15, 2009, a US Airways jet landed on the Hudson River after being disabled by a flock of geese. The pilot from that flight, Chesley Sullenberger, had repeatedly practiced similar scenarios in a simulation lab, to which he attributed his ability to respond so adeptly to the crisis (<http://www.biography.com>, 2013).

Practice guidelines have evolved to care for the seriously ill pediatric population. By 1985, the first PALS course was offered by the American Heart Association (AHA). Advanced life support courses became the gold standard for emergency care and the effectiveness of computer simulation in health care education was widely demonstrated (Rosen, 2007 and Dempsey, Barrington, & Pammi, 2011).

The IOM in 1999 estimated that 100,000 people died each year as a result of poor care on the part of health care providers. The three million nurses in the health care system, are in the trenches, so to speak, closely interacting with patients (ANA, 2011). It is the duty and responsibility of the bedside nurse to help keep the patient safe. Patients and families place great trust in nurses, relying on them to help take good care of their loved ones. It is important that health care education addresses the safety of patient care, in order to ensure that it is effective

and reliable. Simulation offers an attractive, practical solution for the kind of enhanced training that leads to an improvement in patient safety (Burns & Poster, 2008).

Instituting repeatable quality protocols (mock codes) within the pediatric unit can teach nurses to intervene sooner and improve patient outcomes by helping nurses acquire the new skills needed to address complex patient issues (Brown, 2012; Burns & Poster, 2008). One of the best examples of quality protocols is the implementation for the pediatric population of advanced life support, as it is based on scientific research and evidence (American Heart Association, 2008). AHA courses, which represent the industry standard for emergency care guidelines, have been adopted worldwide. Most hospitals require pediatric nurses to be PALS certified as a condition of employment in their units. The goal of the PALS course is to “aid the pediatric health care provider in developing the knowledge and skills necessary to efficiently and effectively manage critically ill infants and children, resulting in improved outcomes” (AHA, 2011, p.1). The PALS course teaches “recognition and treatment of infants and children at risk for cardiopulmonary arrest; the systematic approach to pediatric assessment; effective respiratory management; defibrillation and synchronized cardioversion; intraosseous access and fluid bolus administration; and effective resuscitation team dynamics” (AHA, 2011, p.1).

Purpose

The aim of this DNP project was to explore how high-fidelity simulation in the form of mock codes could be used to enhance knowledge and skills on the part of pediatric nurses, for the purpose of recognizing and preventing cardiopulmonary arrest in infants and children. An additional potential benefit explored was the acquisition and retention of skills necessary in the care of pediatric patients with complex issues.

Research Questions

1. Do high-fidelity simulation mock codes improve the pediatric nurse’s knowledge and skills necessary for recognizing and preventing cardiopulmonary arrests in infants and children, as well as performing effective intervention?
2. Do high-fidelity simulation mock codes improve confidence on the part of pediatric nurses?
3. Do high-fidelity simulation mock codes enhance team collaboration?

Conceptual Framework

David Kolb’s Experiential Learning Theory (ELT) was selected as the conceptual framework for this DNP project. ELT is a holistic, theory developed to address adult learning, modeled on various aspects of the learning process (Sewchuk, 2005). The theory involves an instructional strategy to help people learn more effectively by engaging them in some kind of activity or encounter (in other words, experiential learning) that impacts behaviors and attitudes acknowledged by the learner. In simulation education, the participants are engaged in hands-on activities, with evaluation offered through feedback. This type of active, experiential learning has been proven to be considerably more powerful than passive education, such as lectures or reading (Karlowicz & Palmer, 2006). In addition, Kolb’s theoretical model offers a way to address the various learning styles of nurses. According to Kolb (1984), learning is a process whereby knowledge is created through the transfer of experience. The Kolb learning cycle includes: concrete experience, observation and reflection, abstract conceptualization, and active experimentation. Concrete experience in simulation scenarios provides learners with the opportunity for hands-on application, critical thinking, and multidisciplinary collaboration. (In the context of nursing, for example, “If the patient’s vital signs look like X, I will do Y.”) Observation and reflection transfers knowledge that continuously creates and recreates

ideas, stimulating critical thinking (Lisko & O’Dell, 2010). The students participate in debriefing with their instructors, after participating in the learning scenario. The process of debriefing involves open-ended questions and critical thinking. In abstract conceptualization, students work through questions, facilitated by the instructors in combination with a videotaped review, in order to arrive at certain conclusions (Hetzl & Daily, 2013). Active experiential learning involves the transfer of experience in both objective and subjective forms (Kolb, 1958). In the process of active learning (in a simulation context), students were determined to have successfully acquired skills and concepts for a clinical setting (Durham & Alden, 2008).

Operational Definitions of Terms

The following definitions are used for purposes of this study:

- Registered nurse (RN): A graduate trained nurse, an authorized health care provider from the Board of Registered Nursing to deliver patient care (DCA, 2011).
- Pediatric Advanced Life Support. The PALS course is designed for health care providers to provide advanced life support care to the pediatric population (AHA, 2010).
- Simulation. According to Morton (1995), the purpose of simulation is “to replicate some or nearly all of the essential aspects of a clinical situation so that the situation may be more readily understood and managed when it occurs for real in clinical practice” (p. 76).
- Skill acquisition. The act of learning, acquiring and mastery of technical abilities. (Hardin & Kaplow, 2005).
- Critical Thinking. The act of reflective reasoning. Either way, the principle is parallel structure.]
- Clinical competencies. The possession of applicable knowledge, psychomotor skills, attitudes, and the ability to successfully apply oneself to a clinical situation. This is the

preferred method of achieving proficiency through active learning and participation in direct patient care (Birkhoff & Donner, 2010; Cronenwett et al., 2007).

- High-fidelity patient simulator. This refers to a full-body, life-like manikin type of simulator that closely models human physiology (Hopkins, 2014).

Literature Review

The review of literature provided a framework for examining the concepts for the project. The following databases were used: Cochrane, Agency for Health care Research & Quality (AHRQ) Evidence Reports, Evidence-Based Journals CINAHL, and PubMed. The search utilized the following keywords and phrases: health care simulations, simulation effectiveness, pediatrics, pediatric life support, high-fidelity simulators and simulations, and quality safety education for nursing (QSEN). The original searches yielded approximately 18,200,000 results. The sources identified were abstracts, nursing journal articles, national organizations, and government databases. The search was limited to scholarly publications from 2000 to 2013. The bulk of the articles uncovered were published from 2009-2013. The only two exceptions were [title] (IOM, 1990) and (Morton, 1995), which are considered classic, landmark articles in this area. The original search uncovered articles in a broad range of subject areas, including technology, practice settings, students and participants, types of simulators, scenarios, and teaching and learning methods. The search was subsequently narrowed to articles relating specifically to the pediatric population, advance life support courses, high-fidelity simulators, and simulations concerning patient safety and quality outcomes. The review that follows is organized according to these 14 categories: [list level one subheadings].

Healthcare Quality. According to Melnyk and Fineout-Overholt (2011), clinical practice guidelines represent the highest level of evidence because the guidelines are drawn from a

variety of evidence available. The AHA Pediatric Advance Life Support practice guidelines were used for the project. The authors of the course are the AHA and American Academy of Pediatrics which both are dedicated to the health care of all children using evidence-based science (AHA, 2010): “The goal of the PALS course is to improve the quality of care provided to seriously ill or injured children, resulting in improved outcomes” (AHA, 2010, p. 1). All the acute care hospitals and free-standing surgery centers in the central California area require PALS certification for the nurses. The life support courses incorporate an event-based approach to training as a strategy to enhance patient safety. This includes training scenarios and performance measures that can be downloaded from the AHRQ site.

Goals and outcomes, such as QSEN competencies and evidence-based guidelines (e.g., AHA Advanced Life Support), were identified. The QSEN competencies cover quality and patient safety. QSEN was funded by the Robert Wood Johnson Foundation to address for the purpose of assessing the best way to learn the competencies, in response to IOM national initiatives (Cronenwett et al., 2007).

Simulation in health care education. Health care simulation is a technologically oriented approach to active learning that has substantially changed the medical education paradigm (Gaba, 2004). Learners can enhance critical thinking by analyzing and synthesizing information to solve problems in a variety of contexts, while working effectively in a safe environment. Health care simulation encompasses a large variety of technology, teaching and training modalities that enable the learner to improve performance and increase confidence in a clinical setting (Gaba, 2004; Carroll & Messenger, 2008). Gaba (2004) defines simulation not as a technology, but as a technique to replace or enhance real-world situations. Scenarios are designed to mimic real life medical or clinical situations and are aided by task trainers and

simulators. The High Fidelity Simulators (HFS), which were used in this pilot project, are computerized manikins modeled on human physiology. Simulation is not only used for purposes of education, but also evaluation, team building, teaching ethics, and problem solving (Gaba, 2004; Durham & Alden, 2008; and Houston, 2013).

Simulation and health care quality. Simulation in health care education has grown substantially for purposes of patient safety (Gaba, 2004; Durham & Alden, 2008 ; IOM, 2010). In the past, nurses learned about patient safety issues through lectures, and case studies. In the context of what is widely considered to be an unacceptably high rate of medical error - given the great complexity of illnesses, chronic diseases, and technology-- simulation is regarded as a leading potential solution for improving patient care (Gaba, 2004; Durham & Alden, 2008; IOM, 2010).

Simulation is being used in risk management as a strategy for containing legal costs. According to Huston (2014), Harvard University developed training courses in crisis resource management principles as a way of limiting the costs of malpractice, mitigating adverse perinatal events, reducing malpractice insurance by 10%. In the handbook created by the Agency for Healthcare Research and Quality (AHRQ), it is stated that simulation education should be used as a strategy to optimize patient care and outcomes by providing learning opportunities to experience scenarios in a safe and supervised environment (AHRQ, 2011; Huston, 2014). According to Gaba (2004), after a clinician has completed initial simulation-based training, the required level of continuing education and training is minimal. The nurses at the hospital where the project was completed were all PALS certified, with renewals required every two years, but they did not have any opportunities to practice mock codes. Simulation can not only improve quality and risk management, but help facilitate retention of skilled personnel.

The eleven dimensions of simulation reported by Gaba (2004) was deemed a good fit for purposes of guiding this literature review. In accordance with these dimensions, it is important to consider the purpose, site, target population, experience level of simulation participants, target population of the project, technology used, the population of participating nurses, and mode of feedback.

Dimension 1. This dimension relates to the education and training of clinicians, emphasizing conceptual knowledge-based skills (Gaba, 2004). Databases were searched, to gauge the effectiveness of simulation for the purpose of training. Cook et al. (2012) examined the effectiveness of simulation technologies for training health care professionals, relative to other instructional modalities. The study demonstrated that technology-enhanced training achieved higher learning outcomes, with a low level of effect on knowledge but a high level of effect on skills and behavior. Simulation education, however, was determined to be highly dependent upon the skills of the facilitator.

Another meta-analysis (Cook, 2013) confirmed the effectiveness of technology-enhanced health care simulation. This review summarized 609 studies--137 randomized and 67 non-randomized (with two or more groups)--with 405 using a single group, with a pre- and post-test design. The results revealed that clinicians and medical students trained using simulation showed markedly better knowledge, skills, and behaviors than their peers who did not have simulation training. A qualitative systematic review conducted between 2003 and 2009 (McGaghie et al., 2010) critically evaluated earlier and contemporary research on simulation-based medical education (SBME) and related best practices. Best practices included: feedback; emphasis on cultivation of skills; curriculum integration; outcome measurement; simulation fidelity; skill acquisition and maintenance; mastery of learning; transfer to practice; team

training; high-stakes testing; instructor training; and educational and professional context (McGaghie et al., 2010).

In another randomized study (Gates, Parr, & Huguen, 2009), 100 nursing students were examined to determine the effects of high-fidelity simulation participation on knowledge acquisition. The findings suggested that HFS helps to develop the knowledge required for actual practice. This finding was supported by other articles located for purposes of this literature review (Gaba, 2004; McGaghie et al., 2010).

Dimension 2. This dimension covers some of the health care units that can benefit from participation in simulations (Gaba, 2004). Several articles emphasized AHA Advanced Life Support programs and mock codes, in the context of HFS, confirming the effectiveness of such training, which offers the added benefit of a safe environment for health care providers to practice and acquire desired skills (Mayette & Mohabir, 2013; Nadir, Natal, & DeSouza, 2013; Birkhoff & Donner, 2010).

Dimension 3. This dimension refer so the experience level of simulation participants. According to Gaba (2004), health care simulation can be applied to all aspects of medical education from the first years (for any health care student), as well as experienced clinicians. Though none of the articles reviewed were specific to pediatric nurse populations, this study extrapolates conclusions that apply specifically to medical surgical pediatric nurses.

Dimension 4. This dimension applies to the health care domain in which the simulation is applied (Gaba, 2004). Articles were reviewed that referred to pediatrics, intensive care units, or both. The focus was not on the intensive care unit itself, but rather on patients with serious illnesses. Numerous articles associated improved patient outcomes with mock code training (e.g., Collette & Allen, 2013; Knight & Gabhart, 2013). Knight and Gabhart (2013) documented

significant increases in post-resuscitation survival without increases in neurology morbidity. The use of checklists as part of the evaluation was associated with study reliability (Hesse et al., 2013; Wheeler et al., 2013). Such checklists were found to create an effective framework for pre-test and post-test training analysis (Guimond, Sole, & Salas, 2011). Another study found that modified AHA Advanced Life Support checklists were adequate for achieving an accurate rating by non-experts (McEvoy et al., 2012). A modified AHA PALS checklist was used by the researcher for purposes of this study.

Dimension 5. This dimension describes the various categories of health care workers who utilize simulation for training purposes (Gaba, 2004). The studies reported on in the articles reviewed utilized nursing students, medical students, nurses, and doctors as participants. Most of the articles did not exclusively concern pediatric nurses, but the studies’ results could be transferred to the project subject population.

Dimension 6. This dimension refers to the type of knowledge, skill, attitudes, or behaviors addressed in simulation (Gaba, 2004). Students need to have the ability to transfer textbook information and skill acquisition to the complexity of the clinical situation (Gaba, 2004). This project addressed simulations as a method for helping learners acquire new knowledge, enhance their understanding of conceptual relationships, and dynamics. For example, in simulation the importance of continuing CPR after administering medication can be emphasized by having the simulator respond to epinephrine after two minutes of CPR.

Dimension 7. The age range of the patient being simulated is the focus of this dimension (Gaba, 2004). As the setting for this study’s project was a pediatric unit, the target population was children. The AHA PALS course addresses the care of infants and children.

Dimension 8. This section addresses the use of simulation technology. The focus of the literature review was related to the use of HFSs and simulators. However, no distinction was made between different types of patient HFSs.

Dimension 9. The site of simulation participation is the emphasis of this dimension (Gaba, 2004). Simulations can be conducted in centers, offices, or patient care units. Realism of the simulation environment contributes to the success of the scenario. The mock codes were held on the pediatric unit with a high-fidelity manikin to enhance realism and to give the nurses the opportunity to practice in their patient-care environment, including the use of their unit specific equipment.

Dimension 10. The extent of direct participation in the simulation is important in this dimension (Gaba, 2004). The AHA PALS courses are cardiopulmonary-oriented, highly interactive and hands-on. All the nurses were active participants in the project simulation.

Dimension 11. The feedback method accompanying the simulation defines this dimension (Gaba, 2004). Feedback or the debriefing session after simulation is extremely important. Subjects were debriefed according to PALS guidelines. The various ways of conducting debriefing include videotaping, computer generated programs, and bedside or designated classroom/office sessions. For this project, the nurses were debriefed at the bedside in the room where the scenario was conducted.

Methodology

Project design. The research design type was a quasi-experimental pilot project. A non-probability convenience sampling method was used. Pediatric registered nurses attended mock codes, after their monthly staff meetings. The participants completed a modified AHA PALS pre-test prior to and post-test after participation in the mock code. The researcher (the only

evaluator) used the AHA PALS checklist to evaluate the nurses’ performance, as a group, during the mock code.

Setting. The mock codes were held at a children’s medical center in a central California hospital in the acute care pediatric unit. The hospital is a not-for-profit, general medical-surgical facility with approximately 406 beds (Health.US news, 2013). The hospital has a comprehensive pediatric program that includes 31 acute care pediatric beds, an eight-bed pediatric intensive care unit, and a 20-bed level II neonatal unit.

Population and sample. The study participants were recruited from the pediatric unit. Fifteen full-time, three part-time, and one casual (per diem) staff member are currently employed in the pediatric department. All RNs were PALS certified. As it happened, all the RNs in the unit were female and therefore, all the participants were female. Nineteen RNs participated in the study. Only 17 (89%) completed the demographic survey. The nurses work 12-hour day or night shifts. Four of the nurses worked nights, while the remaining 15 were on the day shift. The tables below describe the demographics of the nurses, for the 17 who completed the survey.

Table 1. Ethnicity

Ethnicity	Total	Percentages
<hr/>		
Caucasian	10	58.82%
Filipino	2	11.76%
Hispanic	4	23.53%
Mixed	1	5.88%

Table 2. Educational Level

Educational Level	Total	Percentages
<hr/>		
Associate degree	6	35.29%
Bachelor’s degree	10	58.82%
Master’s degree	1	5.88%

Table 3. RN and Pediatric Experience

RN Experience	Years of Experience in Pediatrics				Total
	0-2	2-5	5-10	>10	
	n (%)	n (%)	n (%)	n (%)	
Associate	0 (0)	1(5.9)	0 (0)	5 (29.4)	6
Bachelor	2 (11.8)	3(17.7)	3(17.7)	2 (11.8)	10
Master	0 (0)	0 (0)	0 (0)	1 (5.9)	1

Four of the nurses (23%) had 2–5 years of experience; three nurses had 5-10 (18%); eight (47%) nurses had over 10 years of experience as an RN. Only two (12%) of the nurses that participated in the mock code had 0-2 years of experience as an RN. Most of the nurses’ practice (94%) experience as an RN was in the pediatrics department at the project hospital.

Table 4. Years certified in PALS

Years	Total	Percentages
<hr/>		
0-2	4	23.5%
2-5	4	23.5%
5-10	4	23.5%
>10	5	29.4%

Table 5. Number of Times Re-Certified in PALS

Times	Total	Percentages
<hr/>		
0-2	5	29.4%
2-5	5	29.4%
5-10	4	23.5%
>10	3	17.7%

All the nurses were current with their PALS certification.

Table 6. Most Recent PALS Re-Certification

Time	Total	Percentage
0-6 months	3	17.7%
6-1 years	4	23.5%
1-2 years	10	58.8

Investigative techniques and interventions. The project intervention was a PALS pediatric upper respiratory code, using a Laerdal.SimJunior™ HFS. The code scenario was a 3-year-old male admitted to the pediatric unit after being diagnosed with asthma exacerbation. The patient’s initial state was: awake and alert, with vital signs in normal range. The scenario involved the patient’s mother reporting to the nurse that her child is short of breath after returning to bed from the bathroom. The scenario also involved audible wheezing throughout the lung field, with oxygen saturation of 88% on room air, and deterioration into cardiopulmonary arrest. The code included stable/unstable tachycardia and ventricular fibrillation rhythms. The nurses were informed that the rapid response team was unavailable, requiring that they conduct the code on their own. Six codes were conducted during a five-

month period. The months the codes were conducted were August, September, November, and December (2013).

Instrumentation. The survey instruments used in the project were as follows:

1. Ten-item multiple choice pre-test. The test questions were extracted from the PALS certification exam. The nurses were administered this test immediately prior to the code. The nurses took approximately ten minutes to complete this test.
2. Ten-item multiple choice post-test. The questions on the post-test were the same as the pre-test.
3. Modified performance check list (Appendix D). The items on this check list were taken from the AHA PALS performance check list.
4. Demographic survey (Appendix B). The survey recorded the participants' demographics and PALS certification information, for the 17 who completed this particular survey.
5. A p-test was used to determine the significance of the relationship between the results of the pre-tests and post-tests.
6. Microsoft Excel was used to manage, analyze, and report means and percentages.

Validity and reliability. AHA courses are the industry standard for emergency care guidelines (Dempsey et al., 2011). Most hospitals require pediatric nurses to be PALS certified as a condition of employment (Dempsey et al., 2011). These guidelines have been adopted internationally (Dempsey et al., 2011). The AHA PALS course was developed on the basis of scientific research and evidence (AHA, 2011). The AHA developed PALS in 1988 in conjunction with the American Academy of Pediatrics (AHA, 2013). Team code performances were evaluated by the researcher utilizing a standard checklist, for the purpose of uniformity in

the evaluation process. The use of checklists in mock codes has been determined to contribute to the reliability of evaluation (Hesse et al., 2013; Wheeler et al., 2013). Checklists provide an objective framework for pre-test and post-test training analysis (Guimond, Sole, & Salas, 2011).

Data Collection. The data collected consisted of the information supplied by the demographic sheet, pre- and post-test, and completed code performance checklist at the time of each team code. The demographics survey was collected after the nurses signed the consent-to-participate form. The pre-test was completed by each nurse participating in the code, immediately prior to the code. The post-test was completed after the debriefing sessions. The mock codes took 10-18 minutes, while the debriefing took 20-30 minutes.

Study steps sequence.

1. Approval was obtained from the researcher’s project committee and California State University (CSU) Fresno Institution Review Board (IRB).
2. Permission was granted by the hospital administration, including the hospital’s chief nursing officer, pediatric nurse manager, and the staff education department.
3. A meeting was held with the pediatric nurse manger, hospital simulation educator, and the researcher present, to determine the start date, times, dates, and the type of scenario that would be utilized. In view of the high number of asthma exacerbation admissions, a respiratory scenario was selected.
4. The nurses were recruited through a monthly staff meeting on August 29, 2013 to participate in the project.
5. The project details were explained to the nurses and questions were answered.
6. The nurses who volunteered signed the informed consent.
7. Nurses complete a demographic sheet (Appendix B).

8. The nurses were administered a pre-test, consisting of multiple choice questions taken from the AHA PALS exam (Appendix C).
8. The nurses were provided with an orientation to the Laerdal.SimJunior™ simulator, the room, and the patient monitor.
10. The nurses participated in a respiratory code, modified from the PALS upper respiratory scenario. The team code groups were identified in terms of Group 1, 2, 3, 4, 5, and 6, to correspond with each session.
11. During each code, the researcher evaluated a group of 4-5 nurses, utilizing the checklist, as described above. The researcher was the only evaluator.
12. Immediately after the code, a debriefing session was held at the bedside. The topics covered during the debriefing session were: the nurses' description of how well the code was performed; assessment findings and communication steps; reversible causes of arrest and team member roles. QSEN competencies, environmental safety, patient safety, delegation of responsibilities, establishment of priorities, interventions and nurses' actions on the PALS checklist (Appendix D), were reviewed.
13. The participants were administered the 10-item post-test.
14. After each mock code session, the data collected through the processes described above were given to the statistician for analysis after.

The nurses in the code groups were evaluated as a group rather than individually, because the researcher as the sole evaluator would not have been able to perform individual evaluations. Seven of the nurses from the original three groups returned to participate, alongside nurses who had not yet participated, for a second code during the months of November and

December. The nurses who attended a second code went through the same study procedures (with the exception of signing a new consent form) and completed a second pre- and post-test.

Data analysis plan. Descriptive statistics, such as percentages, were used to analyze the demographic data from the sample. Percentages were used to report the nominal and categorical data. A 0.05 p-value level of significance was used to qualify the statistical significance of the tests administered.

Ethical Considerations

Protection of human subjects. The research proposal was submitted to CSU Fresno’s IRB for an expedited review of the informed consent form (Appendix A) and the research tools (Appendices B-D). Approval was granted from CSU Fresno’s IRB to conduct the study (Appendix E). The rights of the human subjects, who were all volunteers, were protected by guaranteeing confidentiality. No names appeared on any of the survey instruments. Subjects had ready access to the principal investigator throughout the study for clarification with regard to any questions via telephone or email.

Potential researcher bias. The nurses’ pre-test and post- test data were identified by randomly assigned numbers. The researcher kept track of the nurses who completed the pre-test and post-test, without identifying them by name. The pre- and post-test, the demographic surveys, and the completed performance checklists were coded and scored by the statistician. The researcher was unaware of the results of the study until the analysis was completed by the statistician. The researcher did not have a relationship with any of the participants, with the exception of one, who was also a colleague, in another setting. The researcher was never employed by the hospital.

Summary. The research was a quality improvement project. The project researcher attended a staff meeting to recruit participants. All of the nurses who volunteered did in fact participate. Mock codes were scheduled after monthly staff meetings. Surveys used in this project identified various demographics for the 17 out of 19 who completed the demographic surveys. Six mock codes were completed. All of the participants completed at least one code. Pre- and post-test and performance checklists were used to evaluate the nurses, as groups. A second set of nurses (21%) who participated in one of the first three codes returned for a second code. The second group of nurses repeated the same respiratory scenario, as well as the pre- and post-test.

Results

Statistics and data analysis. Nineteen nurses participated in the first mock code. The nurses were given the opportunity to return for a second mock code. Nine nurses (21%) returned for the second mock code.

The data analysis paired the total pre-test and post-test scores for each participant. A t-test was used to compare the means. The post-test scores were higher than the pre-test, at a level of statistical significance ($p=0.000794$). In other words, all of the participating RNs scored significantly higher on the post-tests, relative to the pre-tests, suggesting that they had benefitted from the mock codes.

The mean score for the pre-test was 7.84, whereas the post-test mean score was 8.95. Since the p-value was set at <0.05 (0.000794), the null hypothesis that there is no mean difference between the pre-test and post test scores can be rejected.

First-Time Mock Code Participants’ Test Scores

Pre-Test Total Post-Test Total

6	9
9	10
10	9
8	9
9	9
8	8
7	8
8	8
7	8
6	9
7	9
8	10
8	9
6	8
9	9
8	10
9	9
9	9
7	10
Mean	7.842105 8.947368

The results of the second test were not as conclusive. Nine nurses returned for a second mock code, to take the same pre-test and post-test. The p value was again set at 0.05, with a result of 0.275518. As the p-value was set at > 0.05, the null hypothesis in this case is not rejected. There was no statistically significant difference between the pre-test and post-tests scores for the second group of nurses. This result is addressed in the discussion section below.

Second-Time Mock Code Participants' Test Scores

	Pre-Test Total	Post-Test Total
	9	7
	8	9
	10	10
	9	10
	8	10
	10	10
	8	7
	8	10
	8	10
Mean	8.666667	9.222222

A total of six mock codes were completed. The first three high-fidelity simulated mock code groups participated during the first three months of the project, on August 29th, September, 5 and 26th (2013). The last three groups participated on November 7, 24, and December 12th (2013). The performance checklist scores were coded as follows: 1 = done correctly, 2 = done incorrectly, and 3 = not done at all. The higher the score, the less satisfactory the performance, with a lower number indicating a better performance. The mean score for the first three groups was 104, while the mean score for the last group was 93. This indicated improvement in the mock code performance of teams in all groups. The major areas of improvement that were revealed were: proficiency with regard to the use of the code cart, starting cardiopulmonary resuscitation (CPR) skill level, remembering to place the back board underneath the patient, use of the Baslow tape, analyzing and identifying heart rhythm, checking the patient's pulse, reassessing every two minutes, checking history, and preparing the patient for transfer.

Research question two asked, “Do high-fidelity mock codes improve confidence on the part of pediatric nurses?” Five nurses who participated in the mock code were part of one of the real codes that subsequently occurred in the pediatric unit. The researcher was able to speak with one of these nurses, who stated that the mock code significantly improved her confidence, by decreasing her anxiety, helping her feel better prepared for the emergency. Four other nurses who renewed their PALS certifications in March 2014, upon being interviewed by the researcher, stated that their anxiety levels had decreased considerably, prompting them to feel well prepared when participating in the mock code in the process of re-certification.

Discussion

After synthesizing the data and information, mock codes proved helpful for the nurses who participated in this study. In response to project question one (“Do high-fidelity simulation-based mock codes improve the pediatric nurse’s knowledge and skills needed to recognize, prevent or perform during cardiopulmonary arrests, in infants and children?”), the answer is yes, because the nurses benefited from the project, as evidenced by the pre-test and post-test scores. The nine nurses who participated in a second mock code had pre- and post-test scores that were inconclusive. The logical explanation for this would seem to be that these individuals had already “peaked” in terms of improvement they evidenced as a result of participation in the mock code the first time around. They retained the gains going into their second mock code and therefore did not evidence significant changes with regard to pre- and post-test scores the second time around. This speaks well for the effectiveness of the mock code experience. The nurses in this project demonstrated the QSEN competencies in the following ways:

1. Patient centered care. The RNs performed focus assessments on the simulated patient. They recognized when the patient’s condition had changed, prioritizing nursing interventions and

adjusting accordingly. In the particular pediatric unit where the mock codes were conducted, for example, two code carts needed to be brought into the room, the Braslow cart (specifically for infants and children) and the adult code cart (sometimes needed for taller or larger children), where the defibrillator is located (there is no defibrillator of any kind on the Braslow cart). The nurses recognized the appropriate treatment for unstable tachycardia and ventricular defibrillation, requiring the defibrillator, located on the adult code cart, which the nurses accessed in an expeditious manner.

2. Teamwork/collaboration. Based on the first-hand observations of both the researcher and the staff educator who was also present, the RNs’ teamwork improved. This was evidenced in part by the fact that they delegated roles as needed in the code. In addition, their communication was appropriate and professional. As a team, they agreed on a schedule for mock codes that included the night and day shift as well as the PICU.

3. Evidence-based practice. The nurses followed the AHA PALS protocol for cardiopulmonary arrest algorithm, which is continuously adjusted based on new evidence.

4. Quality improvement. The nurses requested that the PALS algorithm cards and rapid response protocols be laminated and placed on the code cart. They requested mock codes quarterly, to be rotated between the pediatric unit and the PICU. They identified the need for learning different roles during a code. After the nurses had completed the project, they decided to assign PALS team roles for each code, to practice being the team leader, as well as the airway, compression, medication, and documentation nurse.

5. Safety. The nurses pulled the patient’s bed rails up and placed the bed in the low position 100% of the time. They identified the patient, using the two designated patient identifiers (checking the name badge and asking the parent the patient’s name and date of birth). They used

the Breslow measurement tape and patient medication safety rights, in administering medication. Most important, the nurses detected subtle clinical changes in the patient’s condition, performed accurate interventions (respiratory treatment, labs, and chest x-ray), and did not fail to rescue their patient. They called for help (rapid response team and physician) but because this was a mock code, the help was not available. Even if everything was done accurately, the scenario was designed to have the patient go into cardiopulmonary arrest.

Completing the mock codes on the pediatric floor identified systems issues concerning pediatric emergencies related to the patient population, as well as adding to the realism of the simulations.

The researcher attended the March 13, 2014, staff meeting to capture post-project data. The hospital staff educator observed how the nurses work together and recognized areas for improvement. The educator stated, for example, that the nurses were not sufficiently confident in their use of the code carts. Code cart review was therefore included in the yearly pediatric unit competencies. Mock codes will be conducted quarterly on the pediatric floor and the PICU.

Limitations

The small sample size (19 nurses) lacked sufficient statistical power for inferring to other groups of pediatric nurses. The hospital where the project was conducted may not have the same issues as other units, such as a pediatric open heart facility. Some of the nurses’ experiences, as nurses, was limited to this unit. It would be helpful to do a study using the didactic or virtual computer generated mock codes as the intervention, as opposed to mock codes using high-fidelity manikins.

Only the pediatric nurses were participants in the project, which did not incorporate real team dynamics or multidisciplinary communication. Not all codes are managed by nurses only. Team building and communication with members from other disciplines should be considered. According to the IOM (2001), lack of communication is a major cause of medical error.

Conclusion: Implications for Nursing Practice

High-fidelity routine mock codes can enhance the pediatric nurse's performance in the event of cardiopulmonary failure. Practicing PALS scenarios can enhance advanced training, to make it easier for RNs to recognize complications and improve communication, teamwork, and skills, using EBP guidelines. Because RNs are at the bedside, serving in the role of ultimate patient advocate, they should take ownership of quality patient care. Nurses need to be empowered to act. In light of the call from the IOM report (2010) for the introduction of innovations in health care education, the results of this study suggest that high-fidelity simulation deserves incorporation in this approach. According to Gephart (quoted in Brown, 2012), "If we can make some of the things we do more predictable, it actually enables us to respond to the unpredictable better" (p.1). Nurses need to be better prepared for high acuity, low occurrence situations such as the kind that Captain Sully was faced with when he landed his plane on the Hudson River.

This DNP project was a quality improvement project. Quality improvement is not only a hospital mandate but is also linked to reimbursement rates. Some of the area hospitals have had repeat visits from the Center for Medicare and Medicaid Services (CMS). This puts all the hospitals on notice with regard to the importance of quality as the number one goal. CMS has established pay-for-performance and quality-based purchasing incentives, so as to encourage

quality improvement. As a result of the success of this project, the hospital involved in this study plans to extend simulation education and mock codes with the enhancements suggested by their pediatric nurses. The nurse manager provided strong leadership that nurtured and supported a culture of quality and safety. The nurses were adequately empowered, working as a team to address emerging patient needs, taking ownership of their responsibility as patient advocates. Ultimately, what is most important is that the multiple benefits of applying regular high-fidelity mock code exercises translate into substantially reduced occurrences of failure to rescue.

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Appendix A

Study Title:

Evaluating Pediatric Nurses' Clinical Competency with High-Fidelity Simulation During Mock Code
- A Pilot Project

[Institutional Review Broad/Human Research approval when I obtained]

I understand I am being asked to participate in a research project that will be using high fidelity simulated Pediatric Advance Life Support mock codes. The purpose of this study is to evaluate the nurses' knowledge and retention of PALS skills after performance of a mock code using high fidelity reality-based simulation.

Your participation in this study is entirely voluntary, and you may choose not to participate. Your decision whether or not to participate will not interfere with your work status at Bakersfield Memorial Hospital. If you decide to participate, you are free to withdraw your consent and discontinue participation at any time.

If you decide to participate, you will be asked to complete a mock pediatric code on your pediatric unit or the simulation lab and will be asked to complete a demographic form, a pre-test and a post-test. The entire session should take approximately an hour. You are invited to participate in a second mock code to enhance and confirm your skills, but this is optional.

The risks for this study are minimal. Participation in the mock code may provoke mild anxiety, discomfort, or bring up past bad experiences. We cannot guarantee that you will receive any benefits from this study. However, you may benefit from the enhanced ability to recognize and manage respiratory and shock emergencies.

All data collected as part of this study will be kept confidential by the researchers and will not contain identifying information. Although, this information may be used in future publications or presentations, no participants will be identified.

You can contact Denise Dawkins, RN at (661) 654-6809, e-mail denise.dawkins04@gmail.com or Dr. Colleen O'Leary-Kelley principle investigator, from California State University, San Jose, School of Nursing, faculty, at colleen.oleary-kelley@sjsu.edu, any time during the study. For any questions regarding the protection of human subjects may be directed to Constance Jones, Chair, CSUF Committee on the Protection of Human Subjects, (559) 278-4468.

Your signature indicates that you have decided to participate. Two copies of this informed consent form have been provided. Please sign both, indicating you have read, understood, and agree to participate in this study. Return one to the researcher and keep the other for your files.

Signature of Subject

Date

Signature of Investigator

Date

Appendix B

Instructions

Please respond to each of the questions and fill in the spaces or check the response that best applies.

1. Education level of preparation. Which of the following degrees do you have? (Check all that are appropriate)

- a. Associate Degree ____ c. Masters ____
b. Baccalaureate Degree ____ d. Doctoral Degree ____

3. Years of experience as an a registered nurse

- a. 0 -2 ____ c. 5 – 10 ____
b. 2 – 5 ____ d. Greater than 10 ____

2. Years of experience as an a Pediatric Nurse

- a. 0 -2 ____ c. 5 – 10 ____
b. 2 – 5 ____ d. Greater than 10 ____

4. How long have you been certified in PALS (Check all that apply)

- a. 0 -2 ____ c. 5 – 10 ____
b. 2 – 5 ____ d. Greater than 10 ____

5. How many times have you been certified in PALS (Check all that apply)

- a. 0 -2 ____ c. 5 – 10 ____
b. 2 – 5 ____ d. Greater than 10 ____

6. Your most recent PALS certification was within (Check all that apply)

- a. 0 -6 months ____ c. 1 – 2 years ____
b. 6- 1 year ____ d. Greater than 2 years ____

7. Primary field/setting of employment (Check one)

- a. Bakersfield Memorial Hospital
b. Other

10. What is your age ____

11. Please check the appropriate category ethnicity

- a. Caucasian ____ b. Hispanic (non-white) ____ c. African American ____ c. Filipino ____
d. Asian ____ e. American Indian ____ f. Pacific Islander ____ g. Mixed ____

12. Please check the appropriate category

- a. Male ____ b. Female ____

Appendix C

1. Which of the following most reliably delivers a high (90% or greater) concentration of inspired oxygen in a toddler child?

- Non-rebreather face mask with 12L/min oxygen flow
- face tent with 15L/min oxygen flow
- Simple oxygen mask with 15L/min oxygen flow
- Nasal cannula with 4L/Min oxygen flow

2. A 2 year old is admitted to your unit. She is alert, pale, makes high-pitched inspiratory sounds (mild stridor) when agitated; otherwise breathing is quiet. Her SpO₂ is 92% on room air, mild intercostal retractions. Mom states baby has occasional barking cough.

What would be the appropriate treatment?

Administer dexamethasone

Prepare for intubation

Administer humidified O₂

Nebulizer treatment

3. Specific causes of upper airway obstruction that require intervention include all of the following except?

Croup

Anaphylaxis

Foreign body aspiration

Pneumonia

4. Identify the rhythm with the single best answer. Clinical clue: age 9 months; heart rate 38/min (I will attach brachycardia strip)

- Normal sinus rhythm
- sinus tachycardia
- sinus brachycardia
- Supraventricular tachycardia (SVT)
- Wide-complex tachycardia
- Ventricular fibrillation (VF)
- Asystole
- Pulseless electrical activity (PEA)
- SVT converting to sinus rhythm w/ adenosine

5. Identify the rhythm with the single best answer. Clinical clue: age 3 years; heart rate 188/min

Normal sinus rhythm

- Normal sinus rhythm
- sinus tachycardia
- sinus brachycardia
- Supraventricular tachycardia
- Wide-complex tachycardia
- Asystole
- Pulseless electrical activity (PEA)
- SVT converting to sinus rhythm w/ adenosine

6. Infant admitted to unit with history of vomiting and diarrhea. Your assessment is infant responses to painful stimulation, upper airway patent, RR 40, clear breath sounds, and extremities cool, cap refill more than 5 seconds, BP 85/65, glucose 30 mg/dL. What would be the appropriate treatment?

Establish IV and administer 20ml/Kg 45% sodium chloride bolus over 15 minutes

Prepare for endotracheal intubation and administer epinephrine 0.1 mg/kg 1:1000 via et tube

Establish IV and administer 20ml/Kg isotonic crystalloid over 10-20 minutes and simultaneously administer D25W 2-4 ml/kg in a separate infusion

Establish IV and administer 20ml/Kg Lactated Ringer's solution over 60 minutes bolus over 60 minutes

7. A 9 year old with increase work of breathing reveals an agitated child and leading forward in respiratory distress. You put patient on 100% non-rebreather mask. Patient speaks in small phrases, nasal flaring, severe suprasternal/intercostal retractions, wheezing, and O2 sat 97%.

What would be the appropriate treatment?

Amiodarone 5mg/kg IV/IO

Albuterol by nebulization

Procainamide 15mg/kg IV/IO

Adenosine 0.1mg/kg

8. Mom calls you to her infant's room with severe symptomatic bradycardia associated with respiratory distress. The bradycardia persists despite establishment of an effective airway, oxygenation, and ventilation. No heart block present.

Which drug should you use first?

Dopamine

Epinephrine

Adenosine

Atropine

9. You respond to a code. When you arrive a 4 year old is receiving CPR, bag-mask ventilation with 100% oxygen, chest compression at a rate of at least 100/min (15:2). You confirm apnea and ventilation with good chest expansion. You place patient on monitor and it reveals VF.

What would be the appropriate treatment?

Establish IV/IO assess and administer amiodarone

Establish IV/IO assess and administer epinephrine

Establish IV/IO assess and administer Lidocaine

Attempt defibrillation at 30J, then resume CPR beginning with chest compression

10. A 18 month with a week of running nose and cough. On you assess the toddler is responsive to painful stimuli, slow respirations and diffuse cyanosis. HR 160, respirations 10/min with severe inspiratory intercostal retractions, and the cap refill is less than 2 second.

What would be the appropriate treatment?

Administer 100% oxygen by face mask, establish vascular access, and obtain a stat chest x-ray.

Open the airway and provide positive pressure ventilation using 100% oxygen and a bag-mask device

Administer 100% by face mask obtain ABG and establish vascular access.

Establish vascular access and administer a 20ml/kg bolus of isotonic crystalloid

Appendix D

INTERVENTION	1 Done correctly	2 Done incorrectly	3 not done	Comment
Introduce self	yes	No	Not done	
Vital Sign Assessment	Yes	No	Not done	
Perform assessment on air way breathing	Yes	None	Not done	
Access LOC	Yes	No	Not done	
Perform assessment on circulation	Yes	No	Not done	
HOB >30	Yes	No	Not done	
Place patient on monitor-pt condition changes	Yes	No	Not done	
Evaluates information	Yes	No	Not done	
Identifies normal/abnormal	Yes	No	Not done	
Change O2 to mask	Yes	No	Not done	
Calls for help/code	Yes	No	Not done	
Crash cart	Yes	No	Not done	
Designate roles	Yes	No	Not done	
Start CPR (high quality CPR) after asystole	Yes	No	Not done	
Place back board under patient	Yes	No	Not done	
Use Baslow tape	Yes	No	Not done	
Attach AED/defib Leads/pads	Yes	No	Not done	
Analyze Identify cardiac rhythm	Yes	No	Not done	
Check pulse	Yes	No	Not done	
Establish or evaluate IV access	Yes	No	Not done	
Administer epinephrine	Yes	No	Not done	
Ventilate properly with bag mask device	Yes	No	Not done	
Reassess every 2 minutes	Yes	No	Not done	
Considers Hs and Ts	Yes	No	Not done	
Chart using the code sheet	Yes	No	Not done	
Give history	Yes	No	Not done	
Prepare patient for transfer to PICU - SBAR	yes	No	Not done	

Appendix E

California State University,
Fresno Department of Nursing
IRB Approval

August 23, 2013

RE: DNP1308 Evaluating Pediatric Nurses' Clinical Knowledge and Skills with High-fidelity Simulation During a Mock Code- A Pilot Project

Dear Denise Dawkins,

As the Chair of the Department of Nursing Research Committee, serving as the Institutional Review Board for the Department 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 expedited IRB review and is signed off as minimal risk.

This study has qualified for expedited review: "Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for non-research purposes (such as medical treatment or diagnosis)".

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 August 23, 2014

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 Department of Nursing Research Committee at tereag@csufresno.edu.

Sincerely,

Terea Giannetta, DNP

Department of Nursing, Research Committee, Chair