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Improving Cardiopulmonary Resuscitation Skills Using Unit Based Simulation

Lesa R. Smith

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by

Lesa R. Smith

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Submitted by:	Approved by:
_____	_____
Lesa Smith	Dr. Anna S. Hamrick, DNP, FNP-C
_____	_____
Date	Date

Approval Page

This DNP project has been approved by the following DNP Project Committee Members.

Approved by:

_____	_____
Gloria Walters, PhD, RN Committee Member	Date
_____	_____
Daria Kring, PhD, RN Committee Member	Date
_____	_____
Cindy Miller, PhD, RN Graduate Program Chair	Date

Abstract

The performance and quick interventions by nurses during a code blue event can have significant impact on patient outcomes. Code blue events can be stressful for nurses practicing in the medical surgical environment where, since the implementation of rapid response teams, the number of code blue events has decreased. The traditional basic life support (BLS) offering in the acute care settings offers nurses the opportunity to practice cardiopulmonary resuscitation (CPR) with manikins and automatic external defibrillators (AED). However, the experience is lacking real working environment teams and equipment in which nurses practice every day. It is also well documented in the literature that this type of training is not sufficient in maintaining BLS skills. Poor retention of skills that are needed to perform BLS can lead to a decreased chance of survival in patients suffering a cardiac arrest. The opportunity for nurses to practice skills needed during a code blue event through simulation can aid in the retention of skills needed when faced with a code blue event (Sullivan, 2015). Evidence shows that simulation in the real work environment is needed to maintain basic life support skills, improve response times, and improve confidence in nurses during a code blue event.

Keywords: code blue, cardiopulmonary arrest, cardiac arrest, cardiopulmonary resuscitation, basic life support, simulation, CPR, BLS

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Table of Contents

List of Figures

List of Tables

SECTION I

Problem Background and Significance

Nurses are often the first line responders for patients who suffer a cardiac arrest during their hospital stay. The American Heart Association (AHA) (2014) reports approximately 90% of people who suffer a cardiac arrest will die from the event. Initiation of cardiopulmonary resuscitation (CPR) or basic life support (BLS) can double or even triple survival rates (Meaney et al., 2013). The American Heart Association (AHA) (2016) has established guidelines for patients suffering a cardiac arrest. These guidelines include chest compressions initiated within one minute of the arrest, first defibrillation attempt within two minutes of cardiac arrest, resulting from ventricular tachycardia or ventricular fibrillation, and first assisted ventilation within one minute (American Heart Association, 2016). Survival of a cardiac arrest event depends on early recognition of the event and immediate response including activation of a "code blue" team and initiation of high quality CPR (Meaney et al. 2013). Code blue, for the purpose of this project, is the phrase utilized to describe a medical emergency event at the project facility in which the patient has no pulse and is not breathing or in cardiac arrest. Cardiac arrest is defined by the AHA (2016) as a malfunction in the heart causing an irregular heartbeat and disruption of blood flow to vital organs. The terms cardiopulmonary resuscitation (CPR) and basic life support (BLS) are used interchangeably for the purpose of this project to describe an emergency procedure performed in response to a code blue event. Medical-surgical nurses are defined as Registered Nurses who work in non-critical care units of the hospital.

Curran, Fleet, and Greene (2012) studied the perceptions and attitudes of healthcare providers towards the retention of resuscitation skills. They found that providers with less resuscitation experience reported less comfort with resuscitation skills (Curran et al., 2012). It has been long established that CPR skills diminish starting two weeks after training and have a substantial reduction within six months (Dunn, Niday, Watters, McGrath, & Alcock, 1992). The AHA recommends that cardiopulmonary resuscitation skills be renewed every two years, during which the skills of the bedside nurse likely diminish. The initiation of high quality CPR and early defibrillation is imperative to provide patients who suffer a code blue event the best chance of survival.

Problem Statement

The purpose of this Doctorate of Nursing Practice project was to improve basic life support skills and comfort level in medical surgical nurses during code blue events. Nurses that possess the skills to initiate chest compression within one minute of a cardiac arrest at the correct rate and depth, as well as defibrillating the patient within two minutes, increase the patient's chance of survival. In medical surgical nurses, the need to use basic life support is infrequent, further contributing to declining skills.

Needs Assessment

The AHA (2014) resuscitation guidelines state that CPR should be initiated within one minute and defibrillation should occur within two minutes of the recognition of cardiac arrest. Data specific to the project implementation site reveals that nurses working in medical surgical areas report that they are unable to meet these AHA goals and feel uncomfortable with code blue skills (Novant Health, 2015). The project site is large, and the code blue team, when not responding to a code blue, is located in the

critical care areas making it difficult to arrive and perform manual defibrillation within the two minute guideline set by AHA.

The project site was a 921-bed tertiary care hospital located in the eastern part of the United States. The project facility averages 25 code blue events, also known as in hospital cardiac arrests (ICHA), every month with 37%, approximately nine per month, of the code blue events occurring outside of the critical care area (Novant Health, 2016). Morrison et al. (2013) found that 45% of all occur in a critical care setting. This is a similar finding at the project facility and indicates that medical surgical nurses have minimal opportunity to participate in a code blue event. It is difficult to retain proficient skills and knowledge in events that occur infrequently such as a code blue (Hill, Dickter, & Van Daalen, 2010). Delac, Blazier, Daniel, and N-Wilfong (2013) described that even proficient nurses experience a flight or fight response that delays initiating CPR. Castle, Garton, and Kenward (2007) revealed that 50% of nurses and 75% of providers rated their ability to perform BLS as either confident or very confident on a five point Likert scale. Collecting confidence levels of nurses and providers, Castle et al. (2007) then assessed BLS skills and compared their confidence to their competence. Results revealed that 40% of nurses and 0% of providers used the correct rate for chest compressions and 40% of nurses and 7% of providers had correct hand placement for BLS (Castle et al., 2007). Recognition, quick intervention, and accurate BLS skills that meet the AHA guidelines by the medical surgical nurse are imperative to ensure an increased chance of survival for patients suffering a cardiac arrest outside of the critical care unit.

More than half a million people in the United States experience a cardiac arrest each year crossing all ages, races, and genders (Graham, McCoy, & Schultz, 2015).

Delayed reactions in treatment of cardiac arrest have profound ramifications for patients, families, and communities. The survival rates of cardiac arrest are low and those that do survive have high cost of care and some with life disabilities (Graham et al., 2015). Figure 1 displays data from the project site on survival percentages per month for patients suffering a cardiac arrest. In a 10-month snap shot for 2016, the average survival rate is 27.6%, indicating a slightly higher rate of survival than national average of 17% (Novant health, 2016) (Girotra et al., 2012). In the hospital setting, using continuous quality improvement initiatives based on research and proven interventions to reduce poor outcomes, nurses can impact and contribute to higher quality care and better outcomes (Graham et al., 2015).

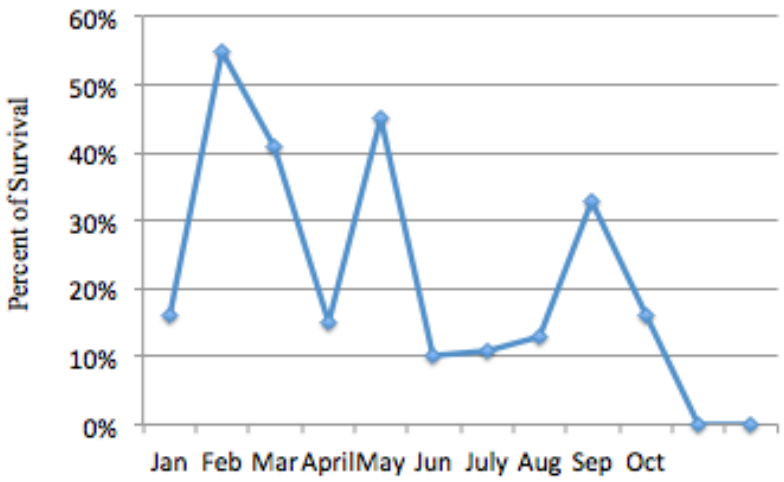

Figure 1. 2016 Novant Health IHCA Discharge Survival

The medical surgical nurses at the project facility had similar skill deficiencies as reported in the literature. In focus groups, it was found that both medical surgical nurses and nursing leaders at the project facility reported decreased skills and comfort level

during code blue events. The facility's annual learning need assessment found that nurses desired to practice code blue events beyond the current baseline BLS offerings (Novant Health, 2015). A survey was sent to the code blue team responders asking to rate their experience with code blue events in medical surgical units (see Appendix A for Code Blue Responder Survey). . Eight participants out of a possible 12 (66.6%) returned the survey. Participants were ask to rate, by percentage groups, the following observations during code blue events on medical surgical units over the last year: (a) "Were patients receiving high quality CPR on your arrival?" (b) "Did patients have the back board in place on your arrival?"(c) "Were patients attached to the defibrillator? and (d) "Were patients defibrillated using the AED function before the code team arrived? (Novant Health, 2016). Percentage groups choices ranged from "<25", "25-50", "50-75", and "75-100". Results showed only 38% believed that high quality CPR was being performed, 25% observed the backboard was in place, and only 12% reported that the patient was attached to the defibrillator in the "75-100%" category. All eight participants responded that the medical surgical nurses had used the AED function to defibrillate the patient prior to the arrival of the code team in less than 25% of code blue events they responded to (Novant Health, 2016).

In addition to the survey, a round table discussion with nurse leaders revealed concern regarding the skills and knowledge of medical surgical nurses during code blue events. The nurse leaders reported that code blue events did not always "go smoothly" and that nurses were not comfortable in their skills during a code blue event (Burnette, King, and Rogers, personal communication, October 4, 2016). Leaders report nurses in their medical surgical units did not consistently perform basic skills needed to improve

the survival rate such as high quality CPR with use of the backboard and use of the AED function on the defibrillator. Discussions with the clinical nurse educators after the annual skills fair, in which medical surgical nurses where expected to show skills in using the AED function of the defibrillator, revealed that only approximately 50% of the nurses were able to perform the skill (Crouse, Burkhead, and Caudill, personal communication, October 6, 2016).

Per current facility policy and the recommendation of AHA, BLS is currently renewed every two years. This renewal consists of online learning and testing of cognitive knowledge and a two-hour skills practice in a classroom with validation using the AHA guidelines. The skills practice, or hands on portion of the BLS renewal, is done using manikins and practice model AEDs. The practice model AEDs are for education only and are different from the AED or defibrillator used in the patient care setting. Automatic external defibrillators similar to ones that would be found in public places are used during the BLS renewal class. Manual defibrillators that have an AED function are used during code blue events in patient care areas. Manual defibrillators can be used to defibrillate, pace, and cardiovert patients and require lead placement as well as pad placement to function appropriately. The manikins used during the BLS are basic chest CPR manikins and have no identifying landmarks for hand placement. The check off is done using AHA guidelines and a 1:6 instructor to student ratio. There are very few similarities between the biennial BLS renewal and the real life patient care setting.

Sponsor and Stakeholders

Implementation of a project of this scale involved multiple stakeholders. The Director of Clinical Education and the Nurse Scientist for the health care system, both of which served on the project committee, supported and helped to champion the project. Other supporters included nursing administration and managers from medical surgical units, clinical nurse educators, and clinical unit leaders. Key stakeholders for the project encompassed medical surgical nurses, nurse managers and leaders, hospital administration, the code blue team, and patients.

Team Members

The DNP student served as the Project Leader. Clinical unit leaders, clinical nurse educators, the Project Leader, and nurse managers made up the project team. The nurse scientist also aided in guiding the code blue simulation project implementation.

Organizational Assessment Utilizing SWOT Analysis

An analysis of the project facilities strengths, weaknesses, opportunities, and threats (SWOT) was as part of the project-planning phase. Table 1 displays the SWOT analysis.

Table 1

SWOT Analysis of Project Facility in Regards to Code Blue Simulation

Strengths	Weaknesses
Rapid response team	High turnover rate for medical surgical nurses
Code blue team including critical care nurse and respiratory therapist	No practice time with AED on the unit
Advanced hospital certifications including heart failure and stroke	Minimal experience with simulation by clinical nurse educators, no simulation coordinator or lab
AHA basic life support classes every two years	
New hire essential curricula courses including emergency response	
Clinical nurse educators are AHA life support instructors	
Facility owns simulation manikin	
Nursing administration supports education	
Opportunities	**Threats**
Simulation research shows simulation can improve comfort level in students	Low volume of simulation research in acute care settings

Resources for Code Blue Simulation.

The project facility had a variety of resources to support the project. Support from nursing leaders to encourage participation aided in the simulations success. Clinical nurse educators and clinical unit leaders volunteered to help with the project and facilitated the code blue simulations while the Project Leader conducted data collection. Simulation equipment used included a high fidelity manikin and the emergency code blue cart with defibrillator located on the nursing unit. The clinical education department owned a high fidelity manikin and rhythm simulator box that was used during the simulations. Statistical support was provided from the Nurse Scientist at the project facility. The facility had IBM® Statistical Package for the Social Sciences ®(SPSS) available as a resource to use for data analysis.

SECTION II

Literature Review

A literature review was conducted using search terms “code blue,” “cardiopulmonary resuscitation,” “cardiopulmonary resuscitation skills,” “cardiac arrest,” “CPR skill retention ” and “code blue simulation” using the Cumulative Index to Nursing and Allied Health Literature (CINAHL). A search criterion was limited to scholarly, peer-reviewed articles written in the English language with dates ranging from 1999-2016. Date ranges were chosen to reflect numerous research changes recommended regarding cardiac arrest from the AHA during the past 15 years and to reflect the small amount of improvement in survival rates. The initial literature review was conducted to explore the problem of infrequent use of basic life support skills and declining comfort level in medical surgical nurses during code blue events. A second literature review was conducted in efforts to highlight best practice regarding the use of simulation to help improve BLS skills in an acute care setting.

Incidence of In-Hospital Cardiac Arrest

There are over 200,000 patients who suffer from an IHCA every year in the United States and using the highest average survival rate, only 50,000 of these patients will survive (Merchant et al., 2011). Girotra et al. (2012) found in their study of over 100,000 adults admitted to more than 500 hospitals, only 17% of patients that experience an IHCA survive. However, determining the survival rate for IHCA can be a challenge. Graham et al. (2015) explained that because of differences in data collection, study populations, and disparities in the models used to conclude results from study participants, the data of incidence of IHCA is difficult to determine. The United States

does not maintain a comprehensive surveillance registry that captures all of the cardiac arrest events (Graham et al., 2015). Merchant et al. (2011) reported that survival rates after adjustments for risk range from 12.4% to 22.7%. Despite the difficulty of knowing the actual incidence, a large majority of adults that suffer and survive an IHCA are discharged with good neurological outcomes according to Nadkarni et al. (2006). Survival of an IHCA with good neurological outcomes is associated with decreased time between collapse and return to spontaneous circulation (ROSC) (Graham et al. 2015). Outcomes of IHCA are dependent on rapid diagnosis and treatment according to Graham et al. (2015). Give a summary statement that says why this is important to the problem or the intervention.

Retention of Basic Life Support Skills

Deterioration in BLS skills has been shown to expand across a variety of professions and that there is no relationship between skill decline and education level (Curran et al., 2012). When nurses are not confident in their skills they may not be able to effectively apply their knowledge during a code blue event (Curran et al. 2012). Curran et al. (2012) used mixed-methods, explanatory study design using focus groups to explore perceptions and attitudes of deterioration of BLS skills. The focus groups were conducted in community-based, acute care, and long-term care facilities. Common themes found by Curran et al. (2012) were perceptions of needed frequent updates for boosting confidence, team performance, debriefing after an unsuccessful code blue, and importance of mock code blue events. Curran et al. (2012) found great concern among healthcare providers regarding BLS skill deterioration and lack of exposure to real code blue events. Participants in Curran et al. (2012) study responded that the preferred

method of retaining BLS skills was active learning strategies that incorporated mock code blue opportunities.

A study performed by Everett-Thomas et al. (2016) that examined the impact of high fidelity simulation and the retention of basic life support, found that detailed knowledge in adult learners of skills that are not used often are difficult to retain. The study used convenience sampling of healthcare providers and tested if simulation before testing increased the skill performance of participants. Participants who completed the test closer to the time of training with simulation scored better than those who took the test and did not receive training with simulation prior to testing. Results showed that individuals only retained about 50% of the information needed to successfully pass the BLS test (Everett-Thomas et al., 2016). Providing practice and skill feedback will increase knowledge, skill, and comfort level of code blue events in nurses working in an acute care setting who do not frequently use CPR skills.

In a literature review conducted by Hamilton (2005), it was found that nurses' resuscitation skills are poor and skills taught in the classroom are not always effectively transferred into the clinical area. Multiple studies reviewed by Hamilton (2005) suggested that BLS skills and knowledge decline starting at three months after education. Research suggested that BLS skill education and practice should be carried out every three to six months to prevent deterioration using simulation that focuses on the most current evidence based guidelines according to Hamilton (2005). Using life like manikins can help assess BLS skills of nurses in the working environment and aid in maintaining resuscitation performance (Hamilton, 2005).

In a study conducted by Behrend et al. (2011), it was determined that CPR skills were lost in medical students regardless of the time passed since training. The study found that common errors performed by participants were the initiation of CPR without checking for a pulse, not requesting a defibrillator, and compression rates below recommend guidelines. The project facility requires that the medical surgical nurses to obtain initial BLS training using the AHA guidelines and renew the BLS certification every two years. The initial and renewal of BLS is done in a tradition classroom setting using practice model AEDs and manikins. An online didactic part provided by AHA is completed prior to the hands on practice portion.

Poor retention of BLS skills is well documented in the literature. To refine and maintain skills requires on-going practice that will aid in gaining proficiency and to become comfortable during a code blue event. Meaney et al. (2013) described that monitoring the CPR effectiveness has been transformative to resuscitation science and that multiple studies have proven that poor quality CPR is associated with poor outcomes.

Simulation Use to Improve Retention

There are several interventions that healthcare providers can perform that will improve the survival rate of patients suffering an IHCA. Girotra et al. (2012) studied over 100,000 adult patients in over 500 hospitals in the Get with the Guidelines Resuscitation Registry from 2000 to 2009. Results showed that survival of IHCA was not accompanied by shorter defibrillation times. This suggested that improvement in survival may include: (a) earlier recognition of cardiac arrest, (b) shorter response time, (c) quality of acute resuscitation, (d) greater availability of trained personnel, (e) quality of chest compressions, (f) fewer interruptions of chest compressions, (g) post arrest hypothermia,

and (h) and early cardiac catheterization. Zhu and Zhang (2016) found in their review of the cardiopulmonary resuscitation guidelines that high quality chest compression increase the return of spontaneous circulation. The importance of maintaining adequate BLS skills is crucial to ensure the best chance of survival for those that suffer a cardiac arrest.

Communication is an intervention that can improve outcomes of code blue events. Pronovost et al. (2006) described in their study that failure to communicate in a team was shown to increase patient harm. Simulation based training is recommended as a method to increase healthcare workers understanding of teamwork and performance (Gaba, 2004). Poor performance was also noted during a code blue events when leadership did not assure effective communication (Marsch et al., 2004). Simulation can be an effective way to educate nurses on teamwork and communication during the events leading up to a cardiopulmonary arrest and the cardiac arrest itself.

A randomized controlled trial performed by Sarac and Ok (2010) looked at the difference in CPR skills of students using three different methods of instructions. The first group attended a face-to-face class with 70% of the class conducted in a lecture format. In Group two, participates were taught face to face with case studies and actors to provide a simulation type environment for education. The third group of students was taught using a web-based version of education of CPR. The teacher and student interaction in this group was asynchronous during the trial. Significant differences were observed in the groups when comparing skills around the compression rate, percentage of chest compressions, hand positions, and technique. Students who were taught with the web-based instruction perform significantly lower on correct rate of chest compressions, depth of compression, location of hand position, and ventilation technique.

Herbers and Heaser (2016) conducted a quality improvement program in order to increase nurses' performance during code blue events via in situ simulations. The quality improvement program aimed at increasing nurses' response times as defined by the AHA as well as improves confidence levels. An observational evaluation tool was developed by the project leaders and was used to measure current AHA guidelines including response times for calling for help, initiating chest compressions, and defibrillation (Herbers & Heaser, 2016). Data was collected each quarter during the in situ mock code blue program for a total of two years. Results of the quality improvement program revealed a 12% improvement from year one to year two on calling for help (Herbers & Heaser, 2016). Initiating chest compression was found to improve by 52% and timing of defibrillation improved by 37% between the first and second year (Herbers & Heaser, 2016). Surveys were used to measure perceived confidence levels before and after the mock code blue events. Survey questions were asked related to participant's confidence level including ability to perform chest compressions, overall confidence to participate in a code blue, and confidence in their ability to lead a team during a code blue. On the surveys received two weeks after the mock code blue simulations, 100% of participants reported confidence in initiating chest compressions, 98.8% responded favorably to participating in a code blue, and 67.4% reported favorable confidence in leading a code blue event. Surveys completed at the two year mark revealed some decline in confidence with 82% of staff reporting a favorable response of either agree or strongly agreed to their confidence to initiate chest compression (Herbers & Heaser, 2016). Eighty six percent reported favorably to overall participation in a code blue (Herbers & Heaser, 2016). Only 50% of participates reported a favorable response in their confidence to lead

a code blue events at the end of the two-year project (Herbers & Heaser, 2016). The quality improvement program on code blue events was successful in improving response times of cardiac arrest events, initiation of chest compression, and defibrillation times (Herbers & Heaser, 2016). In addition, improving confidence in nurses to initiate chest compression, participate and lead code blue events was also found (Herbers & Heaser, 2016). Additional elements noted and improved upon during the two-year quality improvement program were pad and lead placement as well as performance of bag mask ventilations (Herbers & Heaser, 2016). This quality improvement project supports frequent practice of code blue events in an environment in which nurse are familiar with. Is also lends to simulation using equipment that is used during real cardiac arrest events (Herbers & Heaser, 2016).

Delac et al. (2013) preformed an in situ mock code blue performance based education and training event monthly for medical surgical telemetry nurses in order to improve performance during the first five minutes of a code blue event. The focus of the education was on identifying declining patients and notification of the emergency response team, implementing appropriate first responder procedure, perform appropriate interventions based on patient assessment, demonstrate proper technique of BLS skills, and demonstrate clear effective hand-off communication to code blue team (Delac et al., 2013). Learning needs assessment and data from the hospital resuscitation committee initiated the implementation of the education and guided the objectives (Delac et al., 2013). In situ mock codes were chosen in order to create an experience that simulated a real environment. Results from the education reveal a significant improvement in responder's initiation time of chest compression and defibrillation. A 65% improvement

was noted on chest compression initiation and a 67% improvement on defibrillation times (Delac et al., 2013). Success was also noted on improvement of nurse's confidence in initiating first responder's interventions, their ability to operate equipment prior to the code blue team arrival as well as confidence in their hand off communication to the code blue team (Delac et al., 2013). The success of the in situ mock code blue program initiative led to adoption of the education across the hospital system as well as discussion around extension of the mock code blue events to community hospitals (Delac et al., 2013).

Hill et al. (2010) developed a mock code blue education program in response to a decrease of code blue events outside the critical care units after implementation of a rapid response team. Learning objectives for the mock code blue education was for nurses to demonstrate effective assessment of patient's airway, breathing, and circulation (Hill et al., 2010). The mock code blues were facilitated by BLS instructors and performed in an empty patient room. Data collected included time of code blue activation, time of first responder, and time of first defibrillation (Delac et al. 2013). Debriefing occurred on skills such as emergency code blue number activation, release of the patients bed for CPR, location of the units code chart, placement of the backboard, appropriate chest compression rate, ventilation rate, and application of the AED. Although formal data was not reported, results of the education program suggested improvement in confidence of bedside nurses to respond to code blue events and apply essential skills not frequently used (Delac et al. 2013). The success of the education led to simulation of advanced cardiac life support in the critical care areas of the hospital (Delac et al. 2013).

In another study, participants attending a code blue simulation training session reported that the training increased their knowledge of code blue and that the hands on practice was useful (Loucks , Leskowski, & Fallis, 2010). Intentional simulated code blue events for nurses working in an acute care facility, who report needing practice with code blue skills, will increase not only their comfort level with code blue event, it will also aid in maintaining their skills in CPR. Strategies to improve the quality of resuscitation care include the use of cardiopulmonary resuscitation (CPR) feedback devices, implementing debriefings following an IHCA, and simulation training (Graham et al., 2015). Conducting a debriefing session after an IHCA occurs correlates with better CPR quality by providing real time feedback to participants of the event (Graham et al., 2015). Targeted simulation has been found to improve the timeliness of CPR initiation and quality (Graham et al., 2015). Simulation will also deliver opportunity for nurses to gain nontechnical skills, such as communication, that will enhance quality of the resuscitation event. Current literature supports the use of simulation to practice CPR skills. An integrative review by Sullivan (2015), found that although there was a lack of studies that focused on patient outcomes, it was found that code blue simulations, video training, and e-learning were all educational strategies to improve CPR skills. Several studies have found that the strongest evidence to support the successful retention of CPR skills is simulation sessions and deliberate practice (Sullivan, 2015). In addition, nurses are generally more satisfied with simulation type learning compared to observational learning (Ballangrud, Hall-Lord, Hedelin, & Persenius, 2013). Experts recommend that team leaders monitor for CPR mechanics, encouraging transfer of roles if signs of fatigue occur, which are all skills that can be practiced using simulation (Meaney et al., 2013).

Schools of nursing have used simulation for several years to teach students skills and other concepts. Healthcare systems can benefit from using simulation to engage learners using active learning in a safe environment to practice high-risk situations in which communication is imperative.

Literature Review Summary

Sullivan (2015) reports a poor retention of CPR skills in healthcare workers and that the nurses' prompt response of accurate and high quality CPR is crucial to survival. Nearly 30% of the IHCA that occur in the facility that this project will take place are outside of the critical care area (Novant Health, 2016). This percentage equates to very few opportunities for nurses to retain their skills in BLS. According to Meaney et al. (2013), poor quality CPR should be considered avoidable harm. With reported survival rates after cardiac arrest ranging from 12.4% to 22.7%, proper technique is essential to reduce risk of poor outcomes (Merchant et al., 2011). Meaney et al. (2013) described that despite the evidence of continuous quality improvement optimizes outcomes for cardiac arrest victims, there remains a disparity in the quality of resuscitation care. A large gap exists between knowledge of BLS and the implementation of skills (Meaney et al., 2013).

Since the implementation of rapid response teams, the number of code blue events has decreased in the medical surgical units across the nation (Hill et al., 2010). In the project facility, the implementation of the rapid response team has decreased code blue events outside of the critical care by 30% (Novant, 2015). This decrease lessens the opportunity for medical surgical nurses to participate in code blue events or perform CPR. Basic life support skills are renewed every other year using the American Heart Association (AHA) standard guidelines. Nurses complete the online part of the course,

and then attend a face-to-face portion where BLS skills are performed on a manikin. Staff preparation and readiness, refining skills, and safeguarding equipment are benefits to mock code blue simulations according to Hill et al. (2010).

Limitations of Literature

Limited evidence is available that focuses on code blue simulations in the acute care setting. Simulation has been an effective methodology for education in the academic setting for a while, however, the use in acute care is in the infancy stage. Hill et al. (2010) noted that although literature was lacking on simulation use in the acute care setting, studies focusing on simulation use in education demonstrated reduction in stress and improvement in knowledge and skill.

SECTION III

Theoretical Underpinnings

The simulation project to improve basic life support and comfort level in medical surgical nurses used Kolb's Model of Experiential Learning as the framework to guide the project. David Kolb (1984) developed his learning theory in the early 1970s. His theory is based on using collective results of past experiences, heredity, and the present environment for the learning process (Kolb, 1984).

Kolb's model, also known as the cycle of learning, encompasses perception and processing of learning. The process of learning, as defined by Kolb (1984), is initiated once the learner has an experience that results in learning. Kolb (1984) believed that knowledge established through a transformational process will continuously develop. The learner uses defined ideas from past experiences to approach a situation or subject. These combinations of past experiences influence the learner's preferred learning style. Kolb (1984) described four modes of learning including concrete experience or accommodation, reflective observation or diverging, abstract conceptualization or converging, and active experimentation or assimilating. Nurses begin their learning with a concrete experience, they reflect on their observations, use those reflections to conceptualizes, and finally use an experimentation or assimilating experience such as a clinical working experience to learn.

Basic life support serves as the concrete experience for nurses. The hands on approach in BLS gives the experience of doing and learning for nurses as it relates to a code blue event. Nurses use reflection from BLS to develop meaning for a code blue event. The meaning will then link to real experiences that begin to form into new

concepts. Finally, these new concepts and experiences will emerge into active or experimentation in which nurses will imitate skills used for BLS in the real working environment (See Figure 2).

Because not every clinical experience is readily available or is considered low volume and high risk, simulation can be an alternative to the real clinical experience. Building on the progression of learning, medical surgical nurses can use established process in the acute setting to learn BLS skills that will enable them to perform as expected during a code blue event. Using simulation instead of real life code blue events to carry out the experimentation or assimilating portion of Kolb's Model of Experiential Learning provides a method for safe learning in a non-judgmental environment.

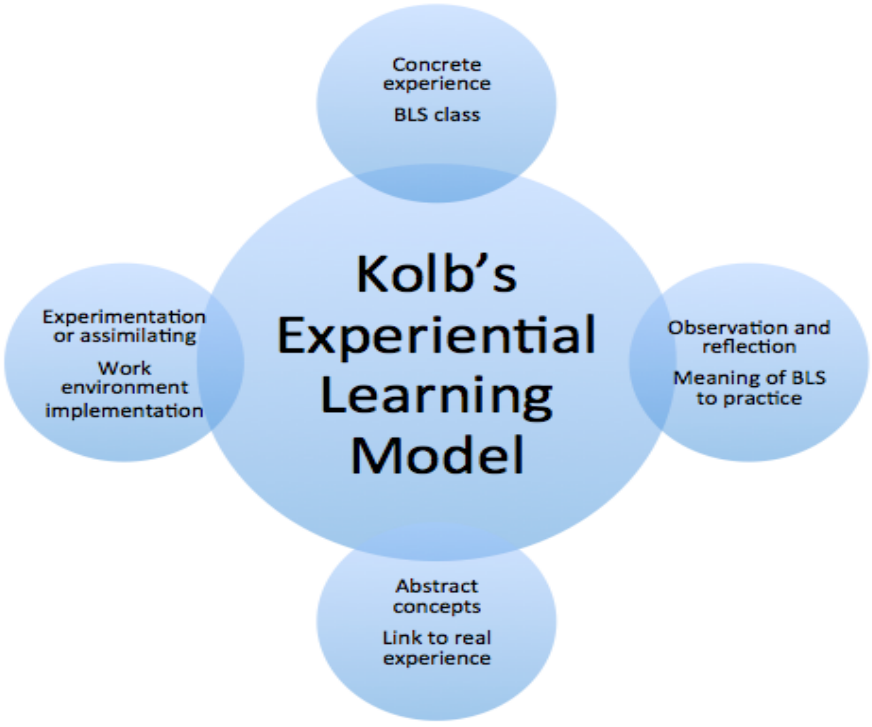

Figure 2. Kolb's Experiential Learning Model and Basic Life Support

SECTION IV

Project Design

Learning in the traditional BLS classroom has very little similarity to a code blue event in real life (Herbers & Heaser, 2016). Even though the AHA has specific teaching guidelines that are recommended and have proven benefit to increase survival, many BLS instructors permit learners to talk through the skills (American Heart Association, 2014). Assessing skills of a BLS participant on the guidelines from AHA is difficult in the classroom setting and cannot fully reproduce potential difficulties that are often encountered during actual code blue events on patient care units (Castle et al., 2007).

A project plan and timeline were discussed and agreed upon with the project chair, practicum partner, and nursing leaders in the organization (see Appendix B for Project Plan). Institutional Review Board (IRB) approval was obtained from both the organization and the University. No anticipated harm to the participants was identified and therefore the evidenced based practice project met criteria of exempt status. No identifying information was collected and survey results were stored in a locked file cabinet. Data collected during the simulations were entered into IBM® Statistical Package for the Social Sciences® (SPSS).

Four medical surgical units were chosen to participate in the code blue simulations. Units were chosen based on round table discussions with nurse managers revealing a need for code blue practice and education prior to implementation. These units care for patients with general diagnoses including heart failure, gastro-intestinal issues, renal failure, general surgery, behavior health, and diabetes. A time line was

planned for the implementation of the project and shared with the nursing leaders of the participating units (see Appendix C for Gantt Chart).

A code blue simulation was written by the Project Leader, based on a typical patient scenario, for those type units, that would assess interventions, skills, and knowledge that a medical surgical nurse would be expected to know and perform during the first five minutes of a code blue event (Bambini, 2016) (See Appendix D for Code Blue Simulation). Criteria chosen to evaluate during the simulation were based on findings from AHA guidelines, nurse manager round table discussions, and survey results from code blue responders in the facility. Initiation of chest compressions, quality of chest compressions, placement of the back board, attachment and use of the defibrillator and AED were points of concerns or opportunities for improvement found during the round table discussion and surveys.

Comfort level of medical surgical nurses was assessed utilizing a 10 point Likert scale on a pre-simulation survey and post-simulation survey. Participants were asked on the pre-survey to rate their comfort level on a Likert scale from 0, indicating not comfortable, to 10, indicating very comfortable. The same question and scale was utilized after the simulation.

The simulations of code blue events were planned to take place in the unit in which the medical surgical nurses worked, using the unit's equipment, specifically the unit defibrillator and code cart. Using the equipment located on the unit would allow assessment of knowledge and skills surrounding patient care during a code blue event. The clinical nurse educator or clinical unit leader facilitated simulations while the Project Leader gave instructions around the simulation, discussed the project details including

consent and participation, and facilitated the pre-brief. Clinical nurse educators also assisted with logistics of location and supplies needed for the simulation. Twelve simulations were offered in the participating medical surgical units.

Non-identifiable demographics collected from the sample population included years of practice as a nurse, years of employment in the current unit, employment status of full time or part time, number of code blue events that individual has participated in during the last two years, and date of their last BLS renewal. (See Appendix E for Pre-Survey Questionnaire). The participants were pre-briefed on the project. Participants were instructed that completion of the demographics and surveys were not required to participate in the code blue simulations. Completion of the demographics and pre-survey implied consent to participate in the simulation project (see Appendix F for Consent Form). Included in the pre-brief were instructions to obtain the code cart on the unit and to use the equipment located on the cart. The only content on the code cart that participants were instructed not to use was medications. The medication drawer remained locked for safety during the code blue simulations.

The code blue simulation was read aloud and depicted a typical patient population common to the work environment. Data was collected during the simulation on the timing of response or intervention in comparison to the AHA guidelines on initiation of chest compressions and defibrillation times. Other points of data collected were the use of the backboard (yes or no), quality of chest compressions (correct hand placement, correct rate, and correct depth), and attachment of the defibrillator (yes or no).

Selection of Team for Simulation

The facilitator team for the code blue simulations included clinical nurse educators and clinical unit leaders from both the medical surgical units as well as the critical care units. Facilitators were identified based on volunteering to aid with the project and their expertise in facility policy and BLS skills. Clinical nurse educators and clinical unit's leaders that aided in code blue simulations were either BLS instructors or Advanced Cardiac Life support (ACLS) instructors through the AHA. Facilitators were educated on the code blue simulations and their role in facilitating the simulations by the Project Leader. Practice time was allotted to the clinical nurse educators or leaders to ensure the ability to set up and use the manikin effectively and appropriately. Data was collected by the Project Leader during the code blue simulations.

Objectives of Code Blue Simulation Project

The objectives of this project were to improve BLS skills and comfort levels during code blue events in medical surgical nurses. The skills assessed during the simulation were guided by the recommendations from the AHA. The project included simulations in the real environment of medical surgical nurses including the day-to-day working team. The second objective of the project was to offer an educational opportunity to practice low volume high-risk skills around basic life support. Facility specific data revealed approximately 37% of all code blue events occurred outside of the critical care area, providing few opportunities for medical surgical nurses to participate in code blue events.

Mission Statement of Code Blue Simulation

The intent of the code blue simulation Doctorate of Nursing Practice project was to provide a safe learning environment to practice code blue emergency response for nurses working in a medical surgical area. The code blue simulations are also a method to assess skills and knowledge of BLS in medical surgical nurses on interventions that should be carried out before the arrival of the code blue team. Code blue emergencies are rare in the medical surgical environment but can produce a stressful situation. The code blue event simulation project was conducted in the real working environment with day-to-day working teams. The simulations allowed nurses to practice the skills and knowledge learned from initial or renewal BLS training in an effort to improve the comfort level and skills during code blue events.

Budget

The project cost was integrated into the facility's current operating budget that included education dollars allotted for bedside nurses and salaries of the clinical nurse educators and clinical unit leaders. The cost analysis included equipment required and participant salaries. The benefit analysis of the code blue simulation included increased ability of nurses to perform the recommended guidelines from the AHA on cardiac arrest. Better quality CPR including initiation time of less than one minute, defibrillation time of less than two minutes, and chest compression performed at the correct rate and depth will lead to increased chances of survival. Table 2 provides a breakdown of the cost of direct and indirect cost of the code blue simulation.

Table 2

Direct and Indirect Cost of Code Blue Simulations

Budget item	Description	Estimated total	Currently integrated into facility operation budget (yes/no)
Direct costs			
Simulation manikin	High fidelity	*$15,000.00	Yes
Simulation supplies	Defibrillation pads	$400.00	Yes
Salary-Nurse Educators and Clinical Unit Leaders Prep and Pre-brief	2 nurse educators 2 clinical unit leaders Average salary $35.00/hour Estimated hours of pre-brief time= 2 hours	$280.00	Yes
Salary- Nurse Educator and Clinical Unit Leader Lead simulation and debrief	2 (nurse educator or clinical unit leader) per simulation Average salary= $35.00/hour Estimated time of simulation with prep = 2 hours Total simulation = 25	$3,500.00	Yes
Salary medical surgical nurse	5 nurses per simulation Average salary $30.00/hour Estimated time of simulation= 1 hour Total simulation =25	$3,750.00	Yes
Indirect costs			
Communications	5 nurse managers Average salary= $50.00/hour Estimated time for meetings= 1 hour Total meeting= 2	$500.00	Yes

*Manikin purchased prior to project implantation

SECTION V

Project implementation

Upon project design approval and clearance from University and facility, IRB project implementation began. Nurse Managers were consulted regarding times of the simulations and location was decided. The code blue simulations were scheduled with each of the four medical surgical unit's nurse mangers prior to implementation. Nurses were made aware of the simulations dates and times by email and/or flyer sent out by the nurse manager. Clinical unit leaders and/or clinical nurse educators were identified to aide in facilitating the code blue simulations. Both the clinical unit leaders and clinical nurse educators were educated on the simulation scenario and the functionality of the manikin. During the pre-brief, the Project Leader informed the participants of the evidenced based practice project scope, discussed voluntary consent to compete the pre-survey and post-survey, and expectation and orientation to the simulation and manikin. Consenting participants completed the pre-survey questionnaire, facilitators read the simulation scenario, and the Project Leader managed data collection (see Appendix G for Data Collection Tool). The simulation then began and lasted approximately 30 minutes. The first simulation was completed after the nurses executed BLS skills through defibrillation or until it was clear the team would not use the AED function. After the first simulation, the Project Leader conducted a debriefing of the simulation that included skills performed well and skills that had opportunity for improvement. The Project Leader gave instructions on AHA guidelines of one minute to initiate CPR and two minutes to defibrillate the patient in pulseless ventricular tachycardia or ventricular fibrillation. Participants were shown correct hand placement for chest compressions

along with optimal rate and depth and accurate defibrillation pad placement, as these skills were most often performed inaccurately. Opportunity was also made available for participants to ask questions and review any skills for clarity. The facilitator then read the same scenario again; participants conducted the simulation again with the Project Leader collecting the data and the clinical unit leader or clinical nurse educator facilitating the simulation. A second debrief occurred after the repeat simulation and the participants completed the post-survey questionnaire, which were placed into a sealed envelope and given to the Project Leader. (See appendix H for Post Simulation Questionnaire).

Specific skills that were assessed included timing of initiation of chest compressions, correct chest compression rate and depth, use of the backboard, placement of the pads and connection to the defibrillator, and appropriate use of the AED function of the defibrillator. Desired outcomes were that medical surgical nurses were able to independently initiate BLS within one minute of recognized cardiac arrest and use the AED function on the defibrillator within the two-minutes. Anticipated findings after the simulation project was that the simulations were found useful and that nurses reported increased ability to perform BLS skills during code blue events.

Nursing leadership support in advertising the simulations facilitated a positive implementation experience. Support from the organization in providing a simulation manikin and equipment such as a code cart assisted in the success of the project. Nurses willing to participate in the simulations and agreeing to complete the pre-survey and post-survey was an essential part of the success of the project. Nurses acknowledged during the simulation the importance of education and preparation of a code blue event and valued the opportunity to practice their skills.

Barriers

Barriers noted during the project implementation included assurance of patient care coverage in order for nurses to participate in the simulations. The simulations were advertised on the nursing units to allow planning for participation, however all participants were in patient care during the simulations. Each session did, nevertheless, have a range of two to seven participates allowing for optimal simulation of a code blue event. One participant was called away for patient care before the second simulation began and therefore only completed the pre-survey.

Space was also a barrier in some of the nursing units, as all patient rooms were full and the simulations were moved to an education or meeting room located close to the nurse's station. During the simulations, census across the facility was high, causing difficulty in finding empty patient rooms. When no patient room was available, a meeting space was used to conduct the simulations. Participants were instructed to simulate the code blue as they would normally by obtaining the code cart and simulate activating the code team. Although a patient room was not available in all simulations, verbal feedback from participants revealed satisfaction with the simulation and no concerns or issues were raised during the implementation.

Battery life of the simulation manikin posed a barrier during the simulations on a day with multiple sessions scheduled. In order to continue full capacity of the manikin, it required a power source, which limited space in which the simulation could occur. Because of tripping hazards and safety using power extension, the manikin was placed closer to a power source and therefore participants were forced to maneuver in a smaller

space. This barrier did not produce any verbal concerns at the time of the simulations or reveal any concerns on written feedback.

Implementation Summary

The code blue simulations occurred on medical surgical units. The nurse manager of the unit was informed and agreed to the code blue simulations. Three simulations on four different nursing units were conducted for a total of 12 simulations. Clinical unit leaders and clinical nurse educators helped facilitate the code blue events. A simulation manikin was brought to the unit by the facilitator and Project Leader and placed in an empty patient room or designated area. Participants of the simulation were expected to obtain all equipment needed for the code blue response and perform using the same expectation as a real code event. The total time of the code blue simulation was expected to be one hour, however the average time of the simulations were 30 minutes. This shorten time frame worked well with nurses caring for patients and offered an opportunity to participate without undue stress of missing patient care needs.

Evaluation Methods

Evaluation of the code blue simulations consisted of a pre-survey and post-survey from the participants that assessed comfort level during a code blue event before and after the simulations and the intervention or debrief. Data was also collected around timing of CPR initiation, chest compression quality defined by correct rate and depth, use of the backboard, attachment of the defibrillator, and the use of the AED before and after the debrief and education. Data was collected using a data collection tool. Anecdotal evaluation from the code blue simulations included nurses verbalizing enjoyment from the simulations and request for simulations to occur more often. Nurse Managers

communicated positive remarks stating the code blue simulations were useful and expressed interest in scheduling more simulations in the future. Evaluation of the project was based on identifying if simulation is a beneficial educational tool for nurses and on the AHA guidelines for basic life support. Conducting beneficial educational offerings for a nurse is essential to ensuring nurses are skilled and possess the knowledge needed to care for patients suffering a cardiac arrest. The AHA guidelines are evidence based interventions intended to increase the chance of survival in patients suffering a cardiac arrest and therefore should be part of the standard of care in the healthcare setting.

SECTION VI

Results

Twelve simulations were conducted with a total of 39 participants. Thirty-eight participants completed both the pre-survey and post-survey for a response rate of 97%. One participant was called away for patient care before the second simulation began and therefore only completed the pre-survey. The IBM® Statistical Package for the Social Sciences® (SPSS) was used to analyze the data collected from the simulations. Preliminary analysis of the data included test of normality, descriptive statistics, and correlations of outcome measures.

Analysis of outcome measures during the simulations was compared before and after the simulation debrief and education. Data was collected around three skills including backboard placement, quality of chest compressions, and AED attachment before and after debrief and education between simulations. The descriptive statistics for these categorical variables are presented in Table 3.

Table 3

Skill Measurement during Code Blue Simulation

Variable	Frequency (n)	(%)
Backboard placement		
Pre intervention	5	(42)
Post intervention	12	(100)
Quality of compressions		
Pre intervention	5	(42)
Post intervention	11	(92)
Defibrillator attachment		
Pre intervention	12	(100)
Post intervention	12	(100)

Improvement was made in code blue skill items that were timed when comparing before the debrief education and after. A paired t-test was conducted and revealed that timing of CPR initiation (see Figure 3) showed a significant improvement in initiation time (t=6.825, p=<0.001) A paired t-test also revealed significant improvement (see Figure 4) in use of the AED function (t=7.464, p=0.001). During the initial needs assessment design phase of the project, the code blue team AED use was less than 25% of times. However, during the simulation findings revealed that the defibrillator was attached 100% of the time and nine of the twelve groups in simulations used the AED function. The use of the AED function showed improvement, which is a positive finding

as earlier defibrillation is deemed in the literature to increase the chance of survival in victims of a cardiac arrest.

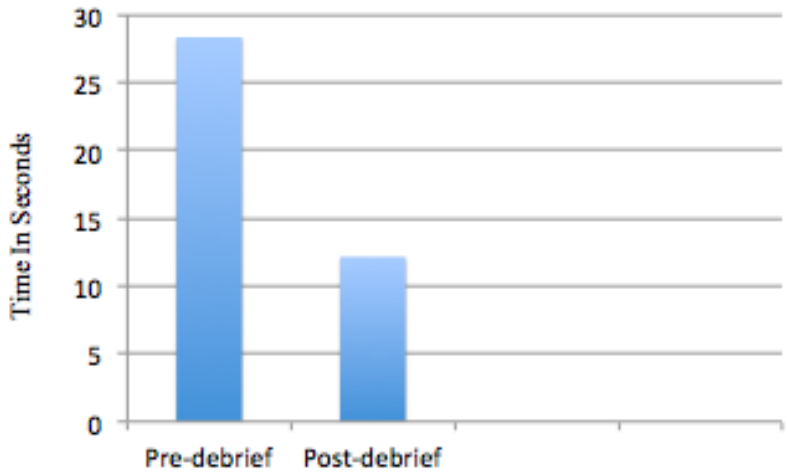

Figure 3. Timing of Chest Compression Initiation (in seconds)

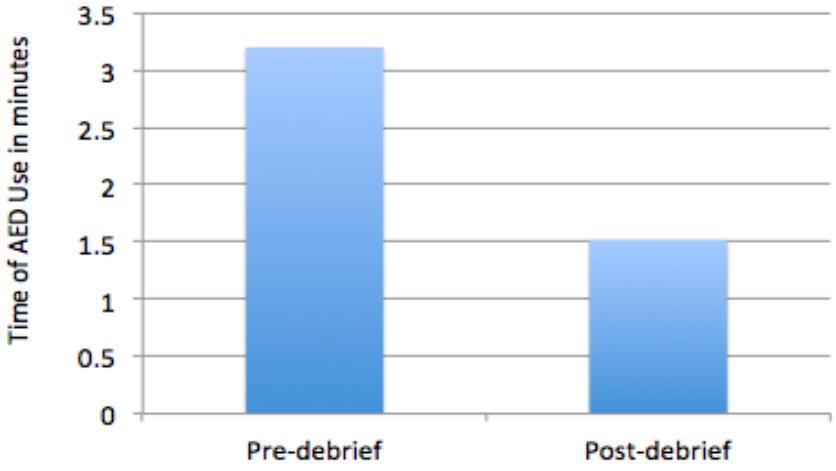

Figure 4. Timing of Initiation of AED (in minutes)

Comparing the findings of the simulation before the debrief education to data collected pre-implementation from code blue responders, discovered similar findings in the quality of compressions, however the placement of the backboard and attachment of the defibrillator revealed differences (see Table 4).

Table 4

Comparison of Code Blue Responder Results to Simulation Findings

	Code blue responders results	Simulation (Pre-debrief)
Use of Backboard	25%	42%
Quality of Compressions	38%	42%
Attachment of Defibrillator	12%	100%

To improve comfort level in medical surgical nurses during a code blue event was one of the objectives of the project. Comfort level was compared before and after the code blue simulations using a 10 point Likert Scale. A significant increase (see Figure 5) in comfort level was noted by participants after the two simulations and debrief (t= 4.938, p= 0.001).

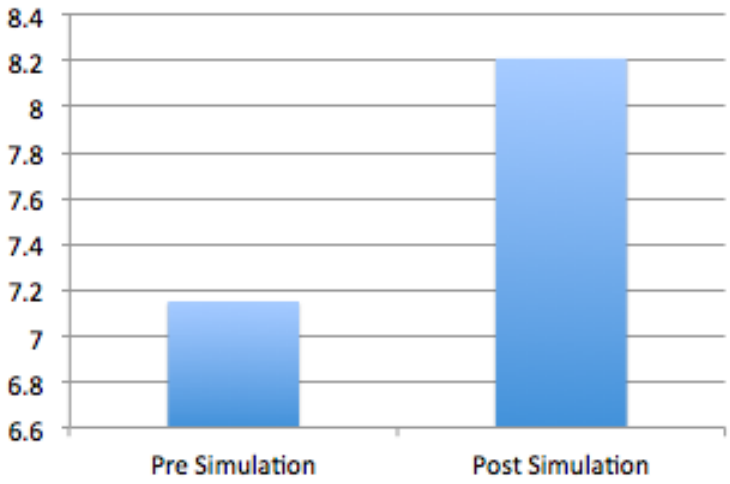

Figure 5. Registered Nurses Comfort Level

Years of experience in participants were not normally distributed and therefore a nonparametric testing was needed. A Spearman's rho test revealed that a positive, moderate correlation existed between number of years of experience and comfort level (rs=0.465,p=0.004) (See Table 5). Nonparametric testing was also used when analyzing correlations between number of code blue events participated in during the last two years and comfort level (See Table 5). Results showed a positive, moderate correlation between the number of code blue events seen in the past two years and the comfort level of nurses (rs= 0.491, p= 0.001). There was not any significant finding between the number of years nurses had worked on their current unit and comfort level after analyzing a nonparametric correlation testing (rs=.205, p= 0.224). Date of BLS renewal, either within one year or greater than a year, and comfort level was found to have no significance in an independent sample test (p= 0.828). Employment status revealed only one participant reporting a part-time status, all others reported being employed full-time (See Figure 6).

Table 5

Correlations between Comfort Level and Non-identifiable Demographics

	1	2	3	4
1. Comfort level with CPR skills	1.00			
2. Years of experience as a nurse	r=0.465 p=0.004	1.00		
3. Number of codes participated in during last past two years	r= 0.491 p=0.001	NA	1.00	
4. Years of employment on unit	r=0.205 p=0.224	NA	NA	1.00

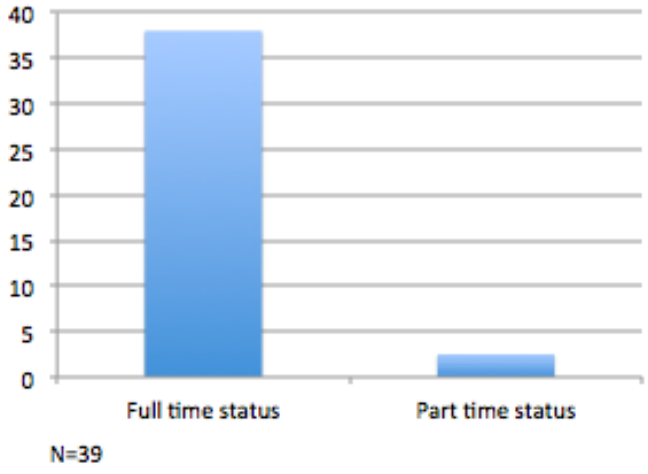

Figure 6. Employment Status of Nurses.

The second objective of the project was to determine that simulation is beneficial in educating nurses. The results of the project revealed that nurses did believe that the code blue simulation was beneficial. Participants were asked to rate how beneficial they thought the simulation was using a ten-point Likert Scale with 0 identifying no benefit and 10 identifying with very beneficial. Results revealed that over 95% of participants rated the simulation eight or above. The descriptive statistics for these categorical variables are presented in Table 6.

Table 6

Benefit of Code Blue Simulation

Variable	Frequency (n)	(%)
Response rating on Likert Scale		
3	1	2.6%
5	1	2.6%
7	1	2.6%
8	9	23.1%
9	5	12.8%
10	21	53.8%

SECTION VII

Discussion

The simulation of a code blue event project revealed improvement in backboard placement from 42% of the time before debrief to 100% of the time after the debrief. Using the backboard during a code blue ensures chest compressions are of high quality by providing a firm surface. The majority of patients who suffer an IHCA are in bed when the event occurs, making high quality chest compressions difficult on a soft surface such as a mattress. Backboards are located on the back of every code cart in the facility and are often forgotten during a code blue event. During BLS training, that occurs every two years, backboards are not discussed nor is the placement demonstrated during the skill validation. Using the venue of simulation in the real work environment utilizing equipment found on nursing units for code blue events gives nurses the opportunity to place the backboard under the manikin and keeps the knowledge and skill at the forefront. Quality of chest compression improved as well during the simulations from 42% of the time before debrief to 92% of the time after de-brief. During debrief and education portion of the project, time was spent correcting hand position, rate, and depth of the chest compressions. The BLS renewal in the project facility utilizes chest manikins that lack anatomical illustration, making the hand placement hard to assess. High fidelity simulation manikins possess anatomical markings that make assessment easier and more accurate. Nurses are more clearly able to adjust hand placement to ensure better quality chest compressions when using the high fidelity manikin.

Sullivan (2015) found that the strongest evidence to support the successful retention of CPR skills is simulation sessions and deliberate practice. Application of this

best practice to the acute care environment proved useful. The code blue simulations were successful in improving basic life support skills including timing of CPR initiation and use of the AED in medical surgical nurses. Initiation of chest compressions and earlier defibrillation is clearly documented in the literature to improve survival in patients suffering a cardiac arrest. Using simulation to evaluate the initiation times of chest compressions and defibrillation is useful in improving these skills.

Initiation of BLS can double or even triple survival rates of cardiac arrest (Meaney et al., 2013). According Merchant et al. (2011) the average survival rate of IHCA is 25%. Interventions that improve survival are limited making the importance of practice and perfecting BLS skills imperative to increasing the chance of survival in patients who suffering a cardiac arrest. The simulation project improved initiation times of BLS as well as quality of chest compressions. Continuing to provide simulations to practice, especially in nursing units that have minimal exposure to code blue events will be beneficial to nurses in gaining and maintaining BLS skills and improving the chances of survival for patients.

Analyzing the data around comfort level for nurses in code blue events, the simulation project suggested that nurses gained comfort in BLS skills from the simulations. Survey results were significant when comparing the comfort level before and after the simulations. This project's findings were similar to research in the literature regarding other code blue simulation quality improvements projects where nurses reported appreciation with the opportunity to practice, the enjoyment of working with a team, and feeling comfortable to ask questions (Herbers & Heaser, 2016). Providing

opportunity for hands on practice in a nonjudgmental environment is an effective way to increase comfort levels.

Years of experience and number of code blue events participated in during the last two years both had a positive correlation with the pre-simulation comfort level reported by nurses ($r_s=0.465, p=0.004$). The more code blue events and more experience a nurse had, the higher the comfort level they reported. This finding is not surprising in that in general the more practice one has the more comfortable they are with any skill. This finding does however aide in reinforcing that practice is key to successful BLS skills. Offering nurses frequent opportunity for hands on training will improve comfort levels, especially in newer nurses. In addition, number of code blue events that nurses participated in and comfort level has a positive correlation ($r_s= 0.491$, $p= 0.001$). This finding is also not surprising in that the more practice one has in a skill the more comfortable they are.

Ballangrud et al. (2013) reports that nurses are generally more satisfied with simulation type learning compared to observational learning. The post-survey question regarding the perceived benefit of code blue event simulations revealed that the majority of nurses found the opportunity beneficial. Ninety five percent of participants scored the code blue simulation as eight or greater on a Likert Scale of 0-10 with 10 indicating very beneficial. This finding corresponds with results of increased comfort level. Nurses had an increase comfort level after the simulations, which can explain the scoring on how beneficial the simulation was.

When evaluating the pre-implementation data from code blue responders and nurse managers around the quality of compressions, similarity was found. Thirty eight

percent of code blue responders reported low chest compression quality while findings from the code blue simulations revealed only 42% of the time high quality chest compressions where preformed before the debrief education. Use of the backboard was noted to occur 42% of the time during simulation compared to the reported 25% of the time on pre-implementation surveys. Having real time feedback and being able to observe correct position, rate, and depth helped to improve the chest compression quality. This suggested that the practice of chest compression more often will increase the quality; thereby increasing the chance of survival for patients.

Attaching the defibrillator was also reported low at a percentage of 12% on pre-implementation surveys, however it was noted during simulation that participants attached the defibrillator 100% of the time before the debrief and education. It was noted that the pre-simulation reports of the code team were anecdotal and based on individual recall rather than actual data recording. Observations during the simulations found that although the defibrillator was attached, nurses often struggled to place defibrillator pads in the correct position. Nurses also had difficulty placing the defibrillator in the AED mode. These items were not captured in the simulation data but may explain the discrepancy in reported deficiencies by nurse managers and code blue responders with findings during the simulations. Basic life support renewal does not offer nurses the opportunity to use defibrillators in skills validations that are used in real work environments. This could explain the difficulty noted in observation of attaching the defibrillator pads and setting the AED mode. The opportunity to practice with defibrillators that will be used during real code blue events is crucial to ensuring

competency. The code blue simulations offer an opportunity for nurses to practice, or learn in some cases, how the defibrillators functions in their work environment.

Although it was the request of the nursing leaders to offer the simulations during the day so that staff could participate during off times and while not caring for patients, all participants in the simulations were in staffing on the scheduled simulations days. The simulations, however, were found to be more realistic with the nurses in assignments caring for patients. Nurses reported off to other nurses in order to participate, this simulated real code blue events in which care givers are often shifted quickly to ensure patient safety and care. Hill et al. (2010) found that when simulated code blue events were conducted without prior notice, it was difficult to get staff to participate when they were caring for patients. Offering the simulations during a normal shift while nurses were caring for patient offered a real time simulations and the opportunity to practice balancing patient care and an emergency or code blue event. Having nurses in assignments can hinder participation if the nurse was actively caring for a patient of preparing for a discharge or admission. Observations noted during the simulations found that quick simulations, 15-20 minutes, would work best when planning during work hours. Having leadership support to cover the unit could also be helpful. Planning around high census times of the year, high discharge or admission times on the unit could also help in having a higher participation rate.

Unexpected findings during the code blue simulations included the inability of nurses to properly use the bag mask valve. During observations of the simulations, nurses struggled to appropriately attach and open the bag mask valve. Proper ventilations cannot occur without the bag valve being extended. During the normal BLS education that

occurs every two years, the bag mask valve is assembled by the instructor therefore the opportunity to practice is lacking for nurses.

Other findings were observed during the simulations were the use of old AHA guidelines. Some participants displayed intervention sequence of airway, breathing, and circulation instead of the new guidelines of circulation, airway, and breathing. Observations of wrong compression rates were also noted. Nurses were performing a 15:2 sequence of chest compression to breaths instead of the current recommendation of 30:2. Asynchronous breathing was observed during the code blue simulations instead of the 30:2 as recommended by the AHA. Nurses explained after the simulation that they rely on respiratory therapists to perform respirations, however, it is a skill that is expected of nursing.

Another unexpected finding during the code blue simulations was the interest from certified nursing assistants (CNA) in participation. During the majority of the simulations, CNAs expressed desire to participate in order to learn and practice. Including the CNAs in the simulations could be helpful in improving their skills in addition to nurses' skills. Certified nursing assistance are generally assigned to help care for the other patients in the unit and not participate in care of the patient suffering a code blue event. However, at times that are delegated skills such as chest compressions or equipment gathering. Including their role can attribute to real life situations and potentially improve processes and teamwork.

Recommendations

Improvement recommendations for the BLS renewal at the facility is the opportunity to assembly the bag mask valve during the skill validation portion of class as well as continue this practice during simulation. The second recommendation made after observations during the code blue event simulation is incorporating backboard placement and use into BLS classes. Both of these skills were found during simulation to need demonstration and hands on practice. Currently these two skills are not included in the BLS class offering but the addition of demonstration and hands on practice would be beneficial to all disciplines.

Interpretation of Findings

The code blue simulation project was successful in meeting the two objectives identified. Results revealed an immediate improvement in basic life support skills in medical surgical nurses as well as perceived benefit from the simulation opportunity. Simulation in the real work environment can be used to practice high-risk low volume skills such as basic life support. Nurses reported benefit on post simulation surveys as well as verbalized satisfaction during the simulations. Improvement in basic life support skills and timing of interventions that are lifesaving to patients suffering a cardiac arrest were shown to improve from the simulations. Using simulation to practice these skills and ensure quality of BLS has benefit to the organization, nurses, and patients.

SECTION VIII

Limitations

Limitations identified were that the simulations were only offered during the day shift hours. The simulations were planned for times that nurses could attend when not in coverage, however, all participants were in a patient assignment during the simulations. This had some benefit in that the code blue simulation allowed for real handoff of patient care, however future simulations should be planned for all shifts to be inclusive of differences in shifts that may be identified. Another limitation for the code blue simulations was the inability to use a patient room for all of the simulations. Planning future simulations around high census times may aid in securing a patient room in order to simulate the code blue more efficiently. In addition, only assessing the nurses skills immediately after de-brief is a known limitation. Studies conducted by Hill et al. (2010) and Herbers & Heaser (2016), who initiated code blue simulations in the acute care setting, recommend repeating simulations every quarter to maintain BLS skills and comfort. Providing repeat quarterly code blue event simulations on medical surgical units could enhance nurses' skills in basic life support and help maintain comfort levels.

Recommendations

The project design included medical surgical nurses performing BLS skills that are expected to be executed before the code blue team arrived. Future recommendations would be to simulate the entire code blue process. Simulating the code blue process to include the code team responding as well as other disciplines could be beneficial in improving quality of life support including not only basic but also advanced life support skills and knowledge. Improvement in interventions by other disciplines would

potentially increase the chance of survival of patients suffering a cardiac arrest. Processes and policy could also be tested if a code blue event was simulated from recognition of cardiac arrest to transferring the patient to a higher level of care.

The simulations took place on nursing units either in an empty patient room or a close by meeting space. Planning the simulation in a time when patient volume is lower would increase the chances of being able to use a patient room. Simulating the code blue event in a patient room would allow for a more real environment and the opportunity to assess the process and skills of the team. Additional skills and knowledge could be assessed including activating the code blue team, the use of oxygen, and bed functionalities.

Including other disciplines outside of nursing to provide inter-professional code blue event simulations is another recommendation for improvement. Patients who suffer a cardiac arrest in the acute care setting are cared for by multiple healthcare workers, simulating the process and including those disciplines would increase the effectiveness of team concepts and possibly discover processes that could be improved.

In addition, expanding the projects scope could be an opportunity for improvement. Using simulations to educate and/or practice life support skills could be beneficial for nurses outside of the medical surgical areas. Code blue event simulations have been proven useful in the medical surgical nursing units and should be scheduled quarterly to maintain skills and comfort levels. The opportunity to practice basic life support skills through simulation in patient care areas such as rehabilitation or out-patient centers that use the code blue team for assistance could prove beneficial. These areas have low volume of code blue events and therefore consider a code blue a high-risk skill.

Including instructions on backboard use and bag valve mask assembly can also enhance basic life support classes. Including these items in the BLS class can extent across multiple disciplines and staff to ensure proper technique.

Simulation can be used to improve skills and comfort levels in additional nursing topics. Other nursing skills that are high risk or low volume that could benefit from simulations could be found by the annual nursing needs assessment. Determining education methodologies for events that cause harm or near misses is also an avenue to explore for possible simulation use. Using simulation to educate, improve comfort levels, practice, or refine skills can be beneficial for nurses in acute care settings. Simulations provide opportunity to learn and practice in a non-judgmental environment with peers as well as provide a safe zone to ask questions.

Sustainability

Providing the opportunity to practice basic life support skills on a regular schedule would be beneficial to nurses and also help to maintain their skills. Graham et al. (2015) found that targeted simulation improved the timeliness of CPR initiation and quality of chest compression (Graham et al., 2015). According to Sullivan (2015), evidence suggested that utilizing brief, frequent, repetitive or purposeful practice with simulation may potentially improve nurses' retention of BLS. Sustaining the simulations and scheduling simulations on a routine bases may improve comfort levels and retention.

Including simulation as part of the core curriculum for nursing continuing education would deliver reinforcement of education and skills that would maintain competency for basic life support. Nursing curriculum is not only designed for new graduate nurses but also provides classes and learning opportunities for experienced

nurses. Simulation is not used frequently as an educational methodology in the acute care setting, but has been proven beneficial. Using simulation for other skills or circumstances that require skill and knowledge maintenance is an opportunity for educators in the acute care setting to provide a beneficial offering in which process, skills, and knowledge can be evaluated. Simulation was proven successful in code blue events to improve comfort and skills and can be used for other skills such as rapid response situations, stoke emergencies, acute myocardial infarctions, and disaster drills. All of the mentioned situations are high risk and low volume to certain nursing areas and simulation can bridge the gap and provide needed practice.

SECTION IX

Implications for Practice

Code blue events rarely occur on the medical surgical units since the implementation of the rapid response team. Nurses often report feeling inadequate in their ability and skills and have requested more practice and education on needs assessment competed at the end of 2015 at the project facility. Literature review revealed that providing a code blue simulation in the real life-working environment will support learning and improve the comfort levels of nurses in code blue situations.

Doctoral prepared nurses are poised to guide translation of best evidence into practice. By leading at a system level, the DNP prepared nurse can improve quality using simulation to improve BLS skills. Literature supports simulation as best evidence for educational offerings in code blue events and therefore should be incorporated in the essential curricula for nurses. The simulation of code blue events provided an opportunity for nurses to practice BLS skills in their work environment while also providing an opportunity to assess AHA guidelines of high quality chest compressions initiated within one minute and defibrillation within two minutes. Using analytical methods, the project suggested significant improvement in BLS skills, comfort level, and perceived educational benefit to registered nurses. It is important that nurses learn in a safe environment and believe that the educational methodology is valuable. Ensuring that AHA BLS guidelines are met will increase survival for patients suffering a cardiac arrest. Building on the success of the project, potential long-term goals include integration of additional simulations based on low-level high-risk patient situations. Potential future simulations will be based on the facility needs and may include acute stroke, respiratory

failure, sepsis, and acute myocardial infarctions. Simulation may also be useful to test processes such as rapid response initiation and patient deterioration. Future simulation should be planned to include inter-professional collaboration in order to improve patient health and outcomes. The project was effective in providing needed education and time for skill practice and improvement in BLS. The findings can translate to other needed opportunities to practice and improve. The DNP delivers current best practice and research to bedside nurses and improves outcomes in patient care. The investment of resources into simulation for the organization will provide opportunity for enhanced education and practice while improving skill and competency of nurses.

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Appendix A

Code Blue Responder Survey

1. The patient was receiving high quality CPR on your arrival to the code?

   25% or less 25-50% 50%-75% 75%-100%

2. The patient had the backboard in place?

   25% or less 25-50% 50%-75% 75%-100%

3. The patient was attached to the defibrillator?

   25% or less 25-50% 50%-75% 75%-100%

4. The patient was defibrillated using the AED function before the code team arrived?

   25% or less 25-50% 50%-75% 75%-100%

Appendix B

Project Plan

Question: "In medical surgical nurses, will using simulation to practice basic life support in the real work environment improve cardiopulmonary resuscitation skills"?

Population: Nurses working in an acute care setting on medical surgical nursing unit. Four medical surgical nursing units were chosen as the target sites for the code blue simulations to occur.

Design: Evidence based practice project

Sample: The goal is to conduct twelve simulations and have three nurses present at each session.

Project design: Code blue simulations will occur on medical surgical nursing units during agreed upon time with nursing leadership. Clinical nurse educator and clinical unit leaders will assist and facilitate the simulations with the Project Leader collecting data. Data will be collected on four skills including timing of initiation of CPR, high quality chest compression, attachment of the defibrillator, and use of the AED function to defibrillate. In addition, data will be collected regarding perception of comfort during a code blue, years of practice as a nurse,

years of employment on current unit, employment, number of codes that the individual had participated in over the last two years, and date of last CPR renewal.

Timeline:

- August 2016: met with practicum partner to discuss literature review and project idea. Scheduled bi-monthly update meetings.
- October 2016: administered surveys to code blue team members in order to

gain information about current code blue practice.

- October 2016: facilitated round table discussions with clinical nurse educators and nurse managers regarding findings from annual nurse validations. Reviewed specifics of medical surgical nurses ability to use the AED function on the defibrillator.
- October 2016: presented evidence based project in conjunction with Practicum Partner to facility Research Council
- November 2016: facilitated pre-implementation meetings with nurse leaders/managers to review the needs assessment and literature review.
- December 2016: verified availability of required equipment and supplies.
- December 2016: conducted Pre implementation meetings with clinical nurse educator volunteers who will help facilitate the code blue simulations.
- December 2016: developed the pre and post survey and discuss project plan with practicum partner.
- January 2017: complete the IRB application for project site and Gardner-Webb University.
- January 2017: conduct pre simulations process meeting to review use of the manikin, simulation scenarios, and debriefing tool.
- January 2017: conduct project information session with nurse manager regarding upcoming simulations and marketing to increase awareness.
- January 2017: Set project simulations dates during a conference call to ensure availability of simulation facilitators. Outlook calendar request will

be sent to team members with dates and times of simulations.

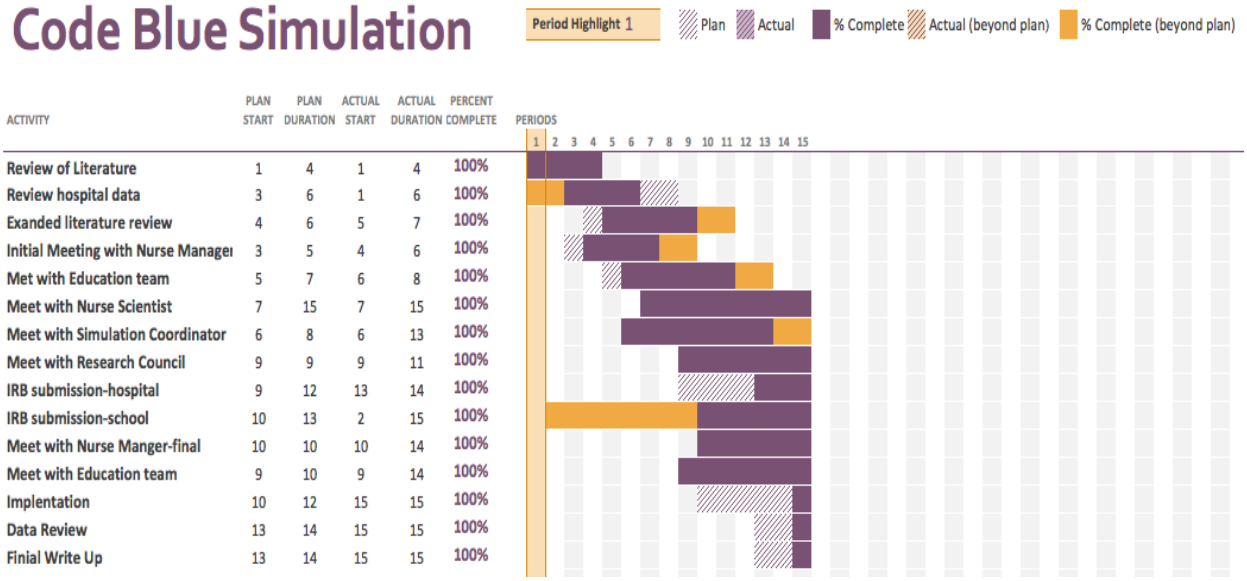
Data Collection: Tools used will include data collection tool and the pre and post survey. Analysis of data will be done using The IBM® Statistical Package for the Social Sciences® (SPSS).

Evaluation Plan: Group analysis of pre and post intervention skills and comfort level of nurses during a code blue event. Standard test of normality, descriptive statistics and correlations of variables will be assessed.

Ethical and Protective Consideration: Institutional Review Board approval will be applied for at both the University and the organization. Results will be stored in a lock cabinet and reported to Gardner-Webb University Hunt School of Nursing as well as nursing leadership at the project site.

Appendix C

GANTT Chart



Appendix D

Simulation: Code Blue/Cardiac Arrest

Primary Objective:
The participant (nurse) will recognize cardiac arrest and demonstrate patient care for the first five minutes of the code blue event.

Secondary Objective:
The participant (nurse) will perform 10-second assessment to determine unresponsiveness
The participant (nurse) will initiate basic life support /CPR including:

- Calling for help by simulating pressing the code blue button in the patient room or dialing "22" from the room phone
- Initiating chest compression and placement of the backboard
- Attaching the defibrillator pads and monitor
- Using the AED function to defibrillate the patient

Scenario:
Mr. Webb is a 74-year-old male who was admitted to the ED with chest pain one day ago. His initial sets of troponins were negative but his 12 lead showed some ST depression in leads II, III and AVF. He has a history of CAD, diabetes, and smokes one pack of cigarettes per day. His vital signs have been stable with his last set taken three hours ago. His BP was 105/60, HR 96, RR 14, and O2 saturations are 93% on room air. You are called to the room because the patient's family reports he is not responding.

Nurse Action	Simulation Manikin Response	Facilitators prompts
-Nurse #1 should assess patient and establish unresponsiveness – A Call for help and initiation of basic life support should begin.	BP- 0 RR- 0 HR- 0 SpO2- 0 Cardiac rhythm reads V-fib	Facilitator to read scenario after the brief on the simulation.
-Nurse #1 should initiate chest compression at a rate of at least 100 per minute with a depth of 2 inches. - Nurse #2 should leave to obtain the code blue chart.	BP- 0 RR- 0 HR- 0 SpO2- 0 Cardiac rhythm reads V-fib	

-Nurse #1 should continue CPR until the code chart arrives and alternate chest compression every five cycles with nurse #3.	BP- 0 RR- 0 HR- 0 SpO2- 0 Cardiac rhythm reads V-fib	
Nurse #2 should delivery the code blue chart into the room. Uninterrupted CPR should continue as possible while nurse # 2 places the backboard under the patient.	BP- 0 RR- 0 HR- 0 SpO2- 0 Cardiac rhythm reads V-fib	
Nurse # 3 uses the ambu-bag to delivery 2 breaths after 30 compressions.	BP- 0 RR- 0 HR- 0 SpO2- 0 Cardiac rhythm reads V-fib	
Nurse #3 attaches the defibrillation pads and monitor to the patient without interrupting CPR.	BP- 0 RR- 0 HR- 0 SpO2- 0 Cardiac rhythm reads V-fib	
Nurse # 3 uses the AED function on the defibrillator to shock/defibrillate the patient within two minutes of the recognized unresponsiveness.		Patient rhythm will remain in VFib until two defibrillation attempts are performed.
Nurse #3 recognizes converted rhythm after second defibrillation attempt, assesses for pulse.	BP- 80/45 RR- 10 HR- 65 SpO2- 90%	Patient rhythm will remain in VFib until two defibrillation attempts are performed
Team will prepare patient for transfer once a pulse is established.		

Appendix E

Pre-Survey Questionnaire

Participant Number_____
Demographics:
Years of practice as a nurse_____
Years of employment on your current unit_____
Employment status _____ Full _____ Part time
Number of codes that you have participated in over the last two years_____
Date of last CPR renewal _____

Pre-Simulation survey:
I am comfortable in my CPR skills during a code blue event.

Not comfortable									Very comfortable
1	2	3	4	5	6	7	8	9	10

Appendix F

Consent Form

Participant Number_____
Project Leader: Lesa Smith, MSN, RN-BC, CCRN
Dear Nurse,

As part of the requirements for the Doctorate of Nursing Practice Degree, I am conducting an evidence based practice project on code blue skills and comfort levels of medical surgical nurses. You are being invited to take part in this evidenced based practice project, which will involve simulation of a code blue event. Before you decide to participate in this evidenced based project, it is important that you understand why the project is being done and what it will involve. Please take the time to read the following information carefully.

The purpose of this project is to improve basic life support skills in medical surgical nurses during code blue events. Your expected time commitment for this project is one hour. You will be asked to complete a survey before and after the simulation. Please answer the questions on the survey to the best of your knowledge. You will be observed performing basic life support skills by the Project Leader during the simulations.

There is no anticipated risk involved in this project. You may decline to answer any or all questions and you may terminate your involvement at any time if you choose. There may be risks that are not anticipated. However, every effort will be made to minimize any risks.
Benefit to you as a participant will include possible increased knowledge and skill during code blue events. In addition, we hope the information obtained from this project may improve educational efforts in the future regarding code blue events.

Your participation in this evidenced based practiced project is voluntary. It is up to you to decide whether or not to take part in this project. If you do decide to take part in this project, your return of the survey will be considered your consent. If you decide to take part in this project, you are still free to withdraw at any time and without giving a reason. You are free to not answer any question or questions if you choose. This will not affect your employment in any way.

Your responses will be anonymous and confidential. Please do not write any identifying information on your survey. Should you have any questions about the research or any related matters, please contact the researcher Lesa Smith at l.smith@novanthealth or my professor, Anna Hamrick at ASHamrick@gardner-webb.edu .

By returning the survey at the end of the simulation, I confirm that I have read and understood the information. I understand that my participation is voluntary and that I am free to withdraw at any time.

Appendix G

Data Collection Tool

Simulation Number	Chest Compression started within one minute- Time of initiation=		Back board placed under patient Yes/No		High quality chest compression being delivered? Rate of ≥100 Depth 2 inches		Patient correctly attached to defibrillator		AED function used on defibrillator within two minute Time=	

Appendix H

Post -Survey Questionnaire

Participant Number_____
Post simulation survey:

I am comfortable in my CPR skills during a code blue event.

Not comfortable								Very comfortable	
1	2	3	4	5	6	7	8	9	10

I believe this simulation was beneficial.

Not beneficial at all								Very beneficial	
1	2	3	4	5	6	7	8	9	10