Mechanical Ventilation Simulation for Cross-Training Step-Down Nurses to the Surgical ICU

Samantha Ruszkowski

Rutgers School of Nursing

DNP Chair: Darcel Reyes, PhD, ANP-BC

DNP Team Member: Jennifer Polatchek, DNP, RN, ACNS

Table of Contents

Abstract

Purpose of Project: The purpose of this project was to modify the current cross-training program to include simulation-based education to increase step-down nurses' knowledge and confidence in providing care for patients requiring invasive mechanical ventilation while increasing learning satisfaction with simulation in cross-training to the surgical ICU.

Methodology: This quality improvement project used a one-group pre- and post-intervention design with a convenience sample of step-down nurses at a hospital in New York City. Participants evaluated their level of self-confidence, knowledge, and learner satisfaction before and after the use of simulated scenarios. Two months after the educational intervention, the participants were asked to retake the post-knowledge survey.

Results: Overall, there was a significant increase in the total participant confidence scores pre-intervention (*M* = 27.9) and post-intervention (*M* = 32.0; *p* = .003). There was a significant increase in the total number of correctly answered questions prior to the simulation intervention (*M* = 7.1) compared with the scores two-months post intervention (*M* = 10.3; *p* = .000). Following the intervention there was a significant increase in pre-intervention satisfaction scores (*M* = 20.2) and post-intervention confidence scores; (*M* =24.4; *p* = .000).

Implications for Practice: Simulation provides the ability to engage within complex scenarios without the pressure of potentially harming a patient, allowing for submersion into learning that is otherwise excluded

Keywords: simulation, mechanical ventilation, cross-training, nursing education, nursing confidence, nursing knowledge

Mechanical Ventilation Simulation for Cross-Training Step-Down Nurses to the Surgical ICU

Education is an essential factor for maintaining and expanding nurses' knowledge and optimizing team functioning during high-acuity situations (Semler et al., 2015). Methods such as didactic (i.e., classroom) and electronic learning (e-learning) have had variable effectiveness in the training of nurses (Liu et al., 2016). With the advancement in ventilator capabilities, understanding the intrinsic complexity of invasive mechanical ventilation may pose a challenge to inexperienced users who have not received thorough training (Yee et al., 2016). Misinterpreting critical alarms that alert nurses of a discrepancy between the programmed mechanical ventilator settings and the patient's response may increase the risk of poor outcomes such as iatrogenic barotrauma, ventilator-associated pneumonia, and death (Slutsky, 2015).

Patients requiring intubation with subsequent mechanical ventilation may have compromised pulmonary function or require a surgical procedure and are unable to protect their airway, which may compromise airway patency (Guilhermino, Inder, & Sundin, 2018; Torpy, Campbell, & Glass, 2010). These patients are placed in acute care settings such as an emergency department or the intensive care unit (ICU) for close monitoring. The notable difference between patients requiring invasive versus non-invasive mechanical ventilation is the method of air delivery. Invasive ventilation requires tubing placed either in a patient's nose, mouth, or surgically placed in the trachea while non-invasive ventilation delivers air through a face or nasal mask (Luo et al., 2017). These intubation methods are connected to a ventilator assembled at the patient's bedside.

A ventilator provides respiratory control, support, or a combination of both to reach a predetermined volume or pressure (Craig Hospital, 2016). Ventilators are equipped with safety alarms that alert nurses when the device deviates from programmed settings. In most facilities, respiratory therapists and physicians are present at the onset of intubation but it is registered nurses who remain at the bedside to monitor the patient's respiratory status and respond to ventilator alarms. Quality patient care requires that nurses have a strong educational foundation about ventilator settings, modes, and parameters to identify the cause of critical alarms and intervene appropriately (Chaghari, Saffari, Ebadi, & Ameryoun, 2017). Examples of pertinent respiratory competencies include the development of critical thinking skills, waveform analysis, appropriate suction techniques, lung-protective ventilation, and tidal volume settings (Guilhermino et al., 2018).

As the patient population increases in age and the number of comorbidities, there is an increase in potential respiratory complications following anesthesia (Guilhermino et al., 2018). The growing number of complex patients who require post-surgical invasive mechanical ventilation has posed a challenge for a safe nurse to patient staffing ratio in the surgical ICU. However, this increase in patients who require mechanical ventilation has provided an opportunity to educate step-down nurses to care for these patients, increase their professional development, and consequently decrease the financial impact of hiring additional ICU nurses.

The addition of simulation training as a complement to existing didactic curricula provides the needed hands-on experience to improve knowledge and promote confidence in step-down nurses who are cross-trained to care for patients who require invasive mechanical ventilators in the surgical ICU. Simulation is a type of experiential learning in which the educator designs an applicable scenario that enables participants to develop critical thinking and clinical decision-making skills (Aebersold & Tschannen, 2013). Gaba (2004) defined simulation as "a technique -not a technology-to replace or amplify real experiences with guided experiences … in a fully interactive manner" (p. i2). The definition used for simulation within the context of this project is “the replication of real-world scenarios, allowing trainees to perform skills and learn actively” (Lavoie & Clarke, 2017, p.18). The use of simulation allows the educator to create individualized scenarios using a hands-on approach in controlled environments to provide its’ users with a safe learning space.

Many disciplines, such as aerospace and the military, use simulation for education; healthcare disciplines, including nursing, promote simulation as a technique to translate knowledge and learning to clinical practice while protecting patients from harm (Aebersold & Tschannen, 2013). Aebersold (2018) concluded that healthcare education could benefit on a national level from the standardization of training nurses by incorporating simulation into practice. The National League for Nursing and the International Nursing Association for Clinical Simulation and Learning (INACSL) provide best practice guidelines for the use of simulation in education and suggest incorporating simulation into standards of practice for nursing students (National League of Nursing, 2015). Also, the Accreditation Council of Graduate Medical Education suggests the use of simulation as an adjunct to clinical encounters in residency programs for medical students (Isaak et al., 2018).

Simulation-based learning in nursing allows the user to generate custom scenarios that may be encountered in clinical settings to enhance nurses’ skills and knowledge (Lateef, 2010; Cantrell, Franklin, Leighton, & Carlson, 2017; Crimlisk et al., 2017; Generoso et al., 2016). However, simulation has not been adequately explored or standardized in training nurses to provide care to a patient requiring invasive mechanical ventilation in the ICU. This proposal discusses the implementation of a quality improvement project that uses simulation in conjunction with classroom and electronic learning to increase nurses’ confidence and knowledge in caring for a patient who requires invasive mechanical ventilation while evaluating learner satisfaction with simulation.

Background and Significance

Step-down and ICU nurses regularly make decisions regarding high-acuity patients and are required to respond to critical alarms from electronic medical devices used to monitor patients, including mechanical ventilators, promptly. The responsibilities of the ICU nurses differ from step-down nurses, also referred to as a progressive care nurse, primarily concerning the acuity of the patient population treated. The typical population of patients in the step-down unit either do not need intensive care monitoring, require advanced care from an in-patient floor, or are transferred from a post-anesthesia recovery unit (Prin & Wunsch, 2014). Although step-down nurses are required to have basic life support training, and in most facilities, advanced cardiovascular life support training, step-down nurses often do not have experience with patients who require invasive mechanical ventilation (Prin et al., 2014). Due to their lack of hands-on experience, they are considered new hires to the ICU for cross-training and are required to complete an orientation program.

After interested nurses are selected to cross-train to the surgical ICU by their manager, nurses are enrolled in an orientation program, which consists of an e-learning program, Essentials of Critical Care Orientation (ECCO), a 6-hour classroom session and a few shifts in the ICU with a preceptor. The e-learning program encompasses multiple diseases, complications of critical illnesses, and the assessment of varying symptoms, diagnostics, and treatment, that is to be completed within two months from enrollment. While enrolled in ECCO, nurses are scheduled for classroom time led by a respiratory therapist and a nurse clinical educator. The instruction covers the fundamentals of a ventilator and intubation, emergency medication administration knowledge, post-anesthesia care, central lines, and fluid resuscitation. After the completion of orientation, nurses are deemed knowledgeable and can provide care to patients requiring invasive mechanical ventilation.

To fulfill requests of step-down nurses for further training about mechanical ventilation, simulation was added to the already established orientation program. Simulation can be used to teach step-down nurses the skills needed to take care of ventilator patients and can effect lasting educational change (Boling, Harden-Pierce, Jensen, & Hassan, 2016). Simulation, specifically airway management training, is more effective and associated with improved learner outcomes compared with non-simulation techniques (Cook et al., 2012). Despite evidence demonstrating the benefits of simulation techniques for airway management, the practice(s) are not yet widely pervasive because of organizational uncertainty about the associated financial expenditures related to simulation compared to the potential benefits (Cook et al., 2012). Although there is insufficient evidence to determine the financial cost of simulation, the educational value of integrating theoretical knowledge with active learner engagement supports incorporating simulation into an educational program for invasive mechanical ventilation training (Goldsworthy, 2016). Simulation also provides a means to standardize nurses' skill development (Aebersold, 2018)

Problem Statement

The goal of nursing education is to supply nurses with the necessary knowledge that allows them to feel confident in the skills needed to provide high-quality care. The purpose of this project was to modify the current cross-training program to include simulation-based education to increase step-down nurses' knowledge and confidence in providing care for patients requiring invasive mechanical ventilation while increasing learning satisfaction with simulation in cross-training to the surgical ICU.

Needs Assessment

Step-down nurses in a surgical hospital in an urban area in the Northeast identified the need for further education regarding ICU training. During informal interviews, nurses expressed confidence in managing cardiac infusions, emergency medication administration, and care of central lines. Conversely, they expressed concerns regarding the lack of satisfaction with the training, knowledge, and confidence in caring for patients requiring invasive mechanical ventilation. Although step-down nurses showed interest in cross-training, they disclosed being hesitant to accept an assignment in the ICU even after the completion of the aforementioned cross-training orientation program. Furthermore, nurses with limited background knowledge of mechanical ventilation also professed a lack of confidence in the current cross-training program.

Training new-hire nurses for the ICU was not cost-effective. In a personal interview with a clinical education specialist and manager of professional development, the cost of training a new-hire nurse, with previous experience, to work in the ICU is approximately $45,000 (I. Herrera-Capoziello, personal communication, February 21, 2019). Currently, cross-training a step-down nurse to the ICU requires six hours of classroom time led by a respiratory therapist and a nurse clinical educator; all participating nurses are paid their respective rate of approximately $50-55/hour to attend. Also, participating nurses must complete ECCO, which contains 60 hours of electronic learning through an interactive, evidence-based educational program (American Association of Critical-Care Nurses, n.d.). The ECCO enrollment fee is approximately $300 for the course in addition to approximately two salaried weeks for the time it takes to complete the program. While the nurse trains in the ICU, they are paid their regular salary and are not counted toward staffing numbers; the preceptor gets a pay differential for their time. Cross-training step-down nurses to the ICU in this urban institution in the Northeast costs approximately $6,539 per nurse.

Although the projected initial cost for simulation is $15,000, it is significantly lower than the cost of hiring an experienced ICU nurse. Considering that the hospital in question has an average turnover rate of one to two ICU nurses per year, the investment in simulation to train step-down nurses would net the hospital annual savings ranging between $39,000 and $78,000. Consequently, because of the substantial cost savings, the administration is interested to see if the addition of simulation training is an effective training tool as it may assist in reducing financial expenditures. In addition to the financial analysis of a simulation program, a SWOT analysis was conducted to identify the strengths, weaknesses, opportunities, and threats to the implementation of simulation-based ventilator management education for step-down unit nurses. The SWOT analysis incorporated data from internal and external sources.

Strengths

One of the identified strengths of this project was the long-term cost-benefit of training internal employees when compared to hiring new nurses. Not only was this benefit reflected in the low cost to cross-train nurses, but also as a decreased financial burden of an onboarding process. The institution was already equipped with a simulation mannequin used during mock-situations; this was an efficient utilization of an existing resource. In a partnership with the hospital, clinical education specialists were eager to assist in developing a simulation-based learning program that could complement the existing training. A final strength was that the co-investigator could conduct this quality improvement project in a short period with the support of the administration, which enabled nurses to attend the simulation sessions during their regular work hours.

Weaknesses

Conversely, a weakness of this project was the small sample size due to the limited number of nurses eligible to participate. At the facility in question for this project, the step-down unit currently had 17 full-time employees between the day and night shift. Once the additional inclusion criteria were applied only ten nurses qualified for the study. Another weakness was the potential for response bias during self-scoring of perceived confidence through the pre- and post-intervention surveys. This potential tendency for inaccurately responding to questions may have resulted in a false presentation of responses and compromise the project outcomes.

Opportunities

This project presented an opportunity for step-down nurses to increase their confidence and knowledge in providing care for patients who are invasively mechanically ventilated. The incorporation of simulation into the current didactic training program outlined a future education plan for this institution and may also serve as a guide for other organizations. This project also opened the possibility to use simulation for other educational topics throughout the hospital. This project provided an opportunity for personal and professional growth for step-down nurses by expanding their bedside experience to include ICU care while increasing their knowledge of mechanical ventilation.

Threats

Numerous threats were identified to this project, particularly with reliability and validity. Due to the use of a single organization, there was a reduced variability of participants thereby creating a potential social desirability bias. Cognitive biases were present and demonstrated by reticence displayed by individuals toward allowing newly trained nurses to care for ventilator-dependent patients. Additional threats included limited availability of required equipment, external conflicts resulting in rescheduling, and participant engagement.

Clinical Question

The clinical question that prompted this quality improvement project was: “In a sample of step-down nurses who are cross-training to a surgical ICU, how does the addition of simulation-based training to the existing didactic education affect nurses’ knowledge, self-confidence, and learner satisfaction in providing nursing care to invasively mechanically ventilated patients?”

Aims and Objectives

The overall aim of this project was to modify the existing cross-training program to add simulation experiences for the care of invasively mechanically ventilated patients. Through a series of proposed objectives, the project:

- Modified orientation curricula for step-down nurses’ cross-training to the surgical ICU to include simulated experiences for mechanical ventilation training.
- Implemented the modified cross-training program.
- Tested the participants’ knowledge retention after implementation of the simulated experience.
- Evaluated the modified cross-training program for its short-term and deferred effectiveness.

Review of Literature

An in-depth literature search was conducted to identify simulation-based learning and self-confidence in caring for mechanically ventilated patients. A search of PubMed, Medline, and CINAHL for peer-reviewed topic-specific articles using keywords “mechanical ventilator,” “mechanical ventilation,” in combination with the keyword “simulation,” yielded 428 articles. Date delimitations were five years (2014 to 2019) to collect the most recent and relevant data. The search was limited to studies comprised of human participants and articles published in English. This narrowed the search to 114 results.

Inclusion criteria consisted of original research studies or systematic reviews in peer-reviewed journals that involved simulation in nursing education. The search was not limited to the United States because other countries are also adapting and researching simulation use. Exclusion criteria eliminated studies not generalizable to the nursing population or anecdotal results about simulation effectiveness. After applying the inclusion and exclusion criteria, 25 results remained (see Appendix A for the PRISMA Flow Diagram).

The included studies were assessed for methodological quality using the Johns Hopkins evidence appraisal tool. The levels of evidence assigned to each study eliminated questionable studies, leaving 17 articles in addition to one study from grey literature. Out of the 18 studies used, three were rated high quality, 14 were rated good quality, and one was rated low quality. The low-quality study remained in the review because it focused on simulation in the ICU and there were limited studies about that specialty (see Appendix B for a review of the Table of Evidence).

Although research about simulation in healthcare has increased over the years, the literature focused on students, pediatric care, medical staff, and anesthesiologists. During the comprehensive literature search, the most common problem noted was the abundance of articles about simulation in undergraduate nursing and there were few articles about mechanical ventilation for nurses. New graduate nursing simulation studies were not eliminated from the search because of the similarities in the orientation process for new hires and cross-trained nurses.

There were many themes noted throughout the literature. Articles that discussed mechanical ventilation training included the use and description of high-fidelity simulation (HFS) as well as current training modalities. Numerous studies measured confidence and knowledge while some surveyed learner satisfaction. Simulation and its' use in transferring skills to practice was another theme that was frequently addressed and became important to this literature review for its association with sustainability. Unfortunately, "simulation" and "mechanical ventilation" keywords did not yield many articles when combined with "nursing", therefore literature was limited in that section.

Mechanical Ventilation Training

Mechanical ventilators are complex and require thorough competency training to ensure proper management to avoid negative patient outcomes (American Association for Respiratory Care, 2016). These competencies include prompt recognition of ventilator-associated problems, appreciation of the function, and role of various ventilator modes, the ability to distinguish the causes of patient-ventilator desynchrony, and the recognition of patient responses to a change in the ventilator setting or mode (Grossbach, Chlan, & Tracy, 2011). While the aforementioned competencies encapsulate the perceived key elements of ventilator-associated care, it was not an exhaustive list. Additional suggestions included verifying the presence and functionality of emergency equipment, properly assessing for breath sounds, oxygen saturation, and pain management, monitoring arterial blood gases, and implementing best practices to minimize the risk for ventilator-associated pneumonia (Lippincott Nursing Center, 2019). Instructors can teach these competencies and evidence-based essentials by using simulated scenarios to provide experience in caring for patients requiring mechanical ventilation (American Nurse Association, 2012; Lippincott Nursing Center, 2019).

High Fidelity Simulation (HFS). HFS refers to computerized mannequins that can be programmed to simulate scenarios in a safe setting that mimic frequent or rarely seen clinical situations (Bultas, Hassler, Ercole, & Rea, 2014). The inclusion of HFS for critical care nursing is recommended (Goldsworthy, 2016). The differences between low, medium, and HFS can be categorized. Low-fidelity is defined as static models with no electronic programming; medium-fidelity incorporates life-size mannequins with the capability to be controlled by an outside source; and high-fidelity includes life-size mannequins with realistic anatomical structures (Shin, Park, and Kim, 2015). Although research indicated that simulation-based education yielded larger effect sizes compared to traditional learning methods, Shin et al. (2015) conducted a study and suggested that the better outcomes of HFS compared to low fidelity simulation may be the result of varying levels of educational levels among samples of participants (Shin, et al., 2015).

HFS has increased nurses' assessment skills, confidence, and knowledge (Bliss & Aitken, 2018). In a qualitative study using semi-structured interviews about medium-fidelity to HFS, participants reported that simulation increased confidence and improved assessment skills in recognizing patient deterioration (Bliss, et al, 2018). HFS was used as part of training for common post-operative complications with nurse interns in the cardiothoracic ICU (CTICU) and yielded statistically significant increased confidence ($p < 0.05$) and knowledge ($p < 0.05$) that were sustained at the 2-week follow-up; researchers concluded that HFS may improve learning and confidence for new graduate CTICU nurses (Bliss et al., 2018). The study protocol incorporated HFS scenarios for mechanical ventilation training; the positive results indicated that using HFS for nursing orientation ensured uniformity of training, as well as the possibility to improve learning and confidence among new nursing hires (Bliss et al., 2018), which is the goal of this quality improvement project.

Current Training Modalities

The traditional method of "see one, do one, teach one" provides the opportunity to observe, reenact, and subsequently display learned processes (Halsted, 1904). This method has been called into question, citing a lack of assurances and assumptions that a trainee is competent with a deficiency of continued guidance, measurement of performance, and feedback (Rodriguez-Paz et al., 2009). Simply providing a standard lecture is insufficient because critical bedside care is not a passive activity, but one that requires the practice of technical skills tailored to specific needs (Joyce, Berg, & Bittner, 2017). Specifically, critical care requires a multifaceted teaching strategy that includes simulated experiences of technical hands-on skills that cannot be learned by traditional lectures alone (Joyce et al., 2017).

Although nurses' value professional development, there is no perfect way to deliver education across healthcare (Bliss et al., 2018; Goldsworthy, 2016; Joyce et al., 2017). A systematic review of 23 studies found various educational modalities used for the recognition and management of deteriorating patients included didactic methods such as lectures, in addition to e-learning, case studies, and simulation (Connell, et al., 2016). However, the effectiveness of education increased when HFS was delivered in 40-minute sessions, contrary to perceptions that simulation is time-consuming and ineffective (Connell et al., 2016). Simulation-based education was used to evaluate critical care transport nurses' recognition and response to electrocardiogram changes, specifically, to cardiac ischemia (Berger et al., 2018). Although there was an increase in knowledge immediately post-intervention, knowledge was not sustained after three months. However, the study served as a baseline for critical care transport nurses and a guide for individual training interventions (Berger et al., 2018). Boling et al. (2016), a pilot study, evaluated the effectiveness of simulation training on learning and confidence among CTICU nurses in response to an internship program that combined preceptorship and lectures conducted by various staff members including physicians and nurses. The addition of simulation to the internship program resulted in statistically significant improvements in learning and confidence among CTICU nurses ($p<0.05$; Boling et al., 2016).

Simulation in Nursing Education

Educators can use simulation as an adjunct to passive learning modalities such as lectures, and e-learning to identify the gap between classroom training and nursing practice by reducing the variability of clinical experience during orientation (Spadaro et al., 2017; National League for Nursing, 2015). Simulation may improve clinical skills and serve as an educational guideline for effective training for critical care nursing (Joyce et al., 2017).

Simulation has been applied to educational training modalities but yields inconsistent results. A systematic review of 16 research studies concluded that simulation-based learning resulted in an improvement in nursing students' clinical judgment, self-efficacy, clinical abilities, and self-confidence (Adib-Hajbaghery & Sharifi, 2017). However, the review also found conflicting evidence about critical thinking in nursing education; half of the studies found positive results with simulation training and the other half found simulation was ineffective (Adib-Hajbaghery et al., 2017). Results of a pre- and post-intervention study indicated that skill competencies were higher for 60 nurses (25 pediatric ICU, 35 cardiac surgical ICU) following simulation-based scenarios to perform cardiac surgical resuscitation procedures (McRae, Chan, Hulett, Lee, and Coleman (2017). Goldsworthy (2016) reinforced the findings by McRae et al. (2017) by encouraging simulation for annual nursing education as well include it as an evaluation tool for a skills checklist for newly hired nurses. Bliss et al. (2018) recognized increasing workloads of the nursing profession and noted that simulation was efficient to train nurses within the time constraints of the job.

Knowledge Retention

The use of simulation has been researched in relation to its role in improving nurses' confidence and knowledge in acutely deteriorating patients (Boling et al., 2016; Crowe, Ewart, and Derman 2018; Mariani et al., 2019; Yee et al., 2016). One of the clinical competencies required to work in an ICU includes the ability to provide care to patients requiring mechanical ventilation and to stay current with knowledge as evidence-based practice changes. (Yee et al., 2016). This patient population can deteriorate rapidly and therefore the ability to recognize an acute patient change is a skill used by nurses in the ICU; lack of confidence and knowledge in performing skills pertaining to mechanical ventilation can lead to negative patient outcomes (Yee et al., 2016). Crowe et al. (2018) evaluated the impact of simulation education on general medicine nurses' confidence and knowledge to recognize, assess, intervene, and evaluate signs and symptoms of patient deterioration and found statistically significant improvements ($p < .001$) in confidence and knowledge immediately following the simulation-based education that was sustained over three months. Crowe et al. (2018) concluded that lack of knowledge may delay the nurses' ability to recognize clinical deterioration and further contribute to poor patient outcomes. Similarly, Mariani et al. (2019) used simulation as an educational tool to teach pediatric nurses clinical preparedness and found that nurses exposed to this modality of learning scored higher on a pediatric emergency preparedness knowledge assessment of infrequently used skills. Boling et al. (2016) noted that new graduate nurses are less knowledgeable or confident in patient care in the CTICU. Through the use of simulation, there was a 12.72% increase in scores for the multiple-choice knowledge test immediately before and after the simulation class; however, the test scores remained the same at the 2-week follow-up (Boling et al, 2016). This may indicate knowledge retention for critical care nurses who train using simulation.

Learner Satisfaction and Confidence

Some researchers explored simulation's relation to user satisfaction and confidence (Ballangrud, Hall-Lord, Hedelin, & Persenius, 2014; Bultas et al., 2014; Goldsworthy, 2016; McRae et al., 2017). McRae et al. (2017) reported high nurse satisfaction with simulated-based learning regardless of age or amount of years worked. With no correlation between years of work or age and satisfaction scores, it is reasonable to suggest that the more experienced nurses, who may not prefer newer learner techniques, responded well to simulation-based learning (McRae et al., 2017). Ballangrud et al. (2014) noted that simulation for ICU nurses provided a comparable learning experience to other educational methods without the concern for patient safety; nurses scored significantly higher in self-confidence in learning compared to those with no prior simulation experience (p=0.007). Also, there was a higher degree of learner satisfaction that included problem-solving, feedback, fidelity (realism), and active learning (Ballangrud et al., 2014).

Including simulation as an active learning strategy increased learner satisfaction in various medical settings (Bultas et al., 2014; Goldsworthy, 2016). Bultas et al. (2014) found an increase in team performance, confidence, and learner satisfaction after simulation was used to teach pediatric nurses to recognize a deteriorating patient. Although there were limitations to this study such as lack of validated tools, small sample size, and lack of retained participants, this study found that HFS contributed to the recognition and treatment of a deteriorating patient and learner satisfaction and levels of confidence were positive (Bultas et al., 2014).

Transfer of Knowledge to Practice

Simulation engages trainees to instill knowledge, thereby building confidence, and forming the ability to transfer knowledge into competency. A comparative experimental pre- and post-test study by Crowe et al. (2018) reported that the initial improvement of confidence and knowledge acquired through simulation-based learning was maintained at the 3-month follow up. Similarly, a randomized control trial using pre- and post-tests conducted by Bultas et al. (2014) found that nurses who participated in the simulation-based education continued to improve their respective skills six months after the training. In another study, simulation improved acute care nurses' knowledge retention and was a useful tool for the transfer of new capabilities to clinical practice (Bliss, et al., 2018). Although there was a small sample size (n = 8), participants' perception of knowledge transfer was positive and they felt it bridged the gap between knowledge and practice (Bliss, et al., 2018). O'Leary, Nash, and Lewis (2016) found a link between an increase in self-confidence and improved patient outcomes in a quasi-experimental study that demonstrated an increase in both knowledge and confidence following simulation for pediatric critical care nurses.

Although studies yielded positive results from nurses' evaluation of confidence after simulation, a few studies noted that there were no direct correlations with confidence or knowledge (Boling et al., 2016). The underlying rationale is that increased confidence allows nurses to utilize existing knowledge, thereby creating a dynamic relationship. Boling et al. (2016) evaluated the effects of a simulation program on learning and confidence among nurse interns in a CTICU and concluded that both knowledge and confidence scores increased; however, there was no correlation between confidence and knowledge when compared to actual ability. McRae et al.'s (2017) study of HFS as an intervention to increase self-confidence in nurses performing cardiac surgical resuscitation skills further supported Boling et al. (2016) by noting that although there was an increase in self-confidence, the increase can't solely be attributed to simulation; furthermore, it can't translate to better patient outcomes.

Goldsworthy (2016) used a quasi-experimental study to compare teaching methods for nurses transitioning to an ICU. In the study, experienced nurses were provided traditional teaching methods (i.e., didactic) whereas novice nurses were provided with a contemporary modality with the use of simulation. Out of ten core competencies, novice ICU nurses who received simulation interventions were least confident in the core competency of invasive mechanical ventilation; experienced nurses who did not receive simulation training felt the most confident in the core competency of invasive mechanical ventilation (Goldsworthy, 2016). These findings imply that the acquisition of relevant knowledge boosts confidence, thereby allowing the ability to transfer the learned skills into practice. The use of simulation provided an opportunity to engage in using said skills in practice in a safe method to solidify confidence and knowledge simultaneously.

Simulation for Mechanical Ventilation Education

Although many studies used simulation for critical care nurses, few specifically targeted invasive mechanical ventilation training for nurses. A mechanical ventilation boot camp designed by Yee et al. (2016) for seventeen medical residents employed a three-day simulation curriculum coupled with didactic lectures on the topic of mechanical ventilation. This intervention was found to be effective in increasing the competence, knowledge, and confidence of those completing the program. Of particular interest is the positive reaction of participants in their abilities to utilize their learned skills for clinical mechanical ventilator management. Although the population was not nurses, it is important to consider this research because it supports simulation teaching that may be acceptable across all medical disciplines. Jansson et al. (2014) assessed the effectiveness of human patient simulation (HPS) education for the nursing care of patients requiring mechanical ventilation using a randomized controlled trial. Investigators randomized thirty nurses into control and intervention HPS groups and both were assessed at baseline and after their respective training. Participant scores from the HPS group increased, however, there were no significant changes over time. The study results suggest that those receiving HPS education demonstrated a significant transfer of learned skills but had no influence on the participant's factual knowledge. Jansson et al. (2014) findings were supported by a randomized control study that found mannequin-based simulation was more effective than computer-based simulation for improving knowledge and skills (Spadaro, et al., 2017).

Theoretical Framework

The purpose of a theoretical framework is to guide the implementation of research-based interventions in practice and to justify their significance (White, Dudley-Brown, & Terhaar, 2016). Grant and Osanloo (2014) compared theoretical frameworks to the "blueprint" of a house; the theoretical framework enables the foundation of a project to be planned, developed, and constructed while identifying potential barriers.

The Knowledge-to-Action Model

The Knowledge-to-Action Model (KTA) was developed by Dr. Ian Graham and colleagues at the University of Ottawa and is an extension of their previous Ottawa Model of Research that was geared to physicians (Sudsawad, 2007). The KTA theory incorporates tools to synthesize knowledge and support research implementation while addressing stakeholders and policymakers (White et al., 2016; World Health Organization, 2012).

The KTA Framework (Appendix C) has two concepts that compose the cycle of the KTA process: (1) knowledge creation and (2) action. Although in viewing the model it appears that the two concepts are mutually exclusive, they can occur simultaneously, allowing users to transfer between the knowledge creation and action phases at any aspect of the cycle (Graham et al., 2006). Knowledge creation, which is represented by a funnel, is categorized into three phases: (1) knowledge inquiry, (2) knowledge synthesis, and (3) knowledge tools or products (Graham et al., 2006). The knowledge creation funnel is a structured channel for organizing information, refining it to be more useful to stakeholders.

Knowledge inquiry refers to first-generation knowledge such as primary studies that encompass most of the literature accessed during an initial search. After careful consideration from primary studies, knowledge synthesis or second-generation knowledge, such as systematic reviews and meta-analyses are analyzed for common patterns. The last and most refined form of knowledge identified by the KTA framework is the summary of filtered literature, such as guidelines, evaluated to develop knowledge tools or products to meet end-user informational needs (Graham et al., 2006). Surrounding knowledge creation is the action cycle, composed of activities needed for knowledge application that generally started with identifying a gap or problem. The action cycle consists of seven steps:

- Identify the problem;
- Adopt knowledge to local context;
- Assess barriers to knowledge use;
- Select, tailor, implement interventions;
- Monitor knowledge use;
- Evaluate outcomes;

- Sustain knowledge use (Graham et al., 2006 p. 20).

The overarching use of the KTA framework is to provide clear, systematic guidelines to stakeholders to facilitate sustainable strategies to promote the application of knowledge (Graham et al., 2006). It provides practical guidance in the process of translating research into practice that best fit the objective of the practice setting.

The literature search commenced with the process of knowledge inquiry. Once sufficient evidence-based research accumulated, appraisal of information relevant to this project was the second phase of knowledge synthesis, which encompassed the review of literature for this project. Following knowledge synthesis, knowledge tools or products were created using the INACSL as a practice guideline. In this phase, information for the data collection instruments was reviewed and synthesized.

The action cycle represented tasks that were needed for knowledge application. The first step, identifying a gap or problem, occurred when step-down nurses who were cross-training to the surgical ICU identified the need for more training in invasive mechanical ventilation. The nurses also expressed a lack of confidence to the Patient Care Director who determined there was an education to confidence gap in the current training regimen. The next step was adapting knowledge to the local context by assessing its value in nurses' opportunities for professional growth. Cross-training step-down nurses to the surgical ICU allowed for growth that was not only applicable within the institution but also could be utilized in another context throughout the facility or extraneously. Furthermore, in other specialties (e.g., physician assistants, residents, anesthesiologists, and nurse anesthetists), simulation had been used as an educational modality and their techniques could be tailored to nursing education.

Assessing barriers or facilitators to knowledge use was the third step. Identifying the barriers from an early stage was pertinent to successful planning, executing and facilitating knowledge. For this project, a primary barrier was the perceived inadequacy of the existing cross-training program. Other barriers included receiving permission from the Patient Care Director to allow step-down nurses to leave the unit to participate in the project, obtaining approval from the research committee, clinical nurse educators, and nursing leadership for simulation cross-training of step-down nurses; these groups needed to be convinced that simulation was appropriate and applicable to the success of nursing care for a patient requiring invasive mechanical ventilation.

The next and fourth phase was to select, tailor and implement interventions to carry out the intended change, which was the use of simulation to increase nurses' confidence in providing care to patients requiring invasive mechanical ventilation. After the intervention of simulation-based learning was completed, data was analyzed and the intervention was monitored according to the fifth phase of the action cycle, determining the effectiveness of the intervention.

According to Graham et al. (2006), three types of knowledge interventions are applied for monitoring knowledge use and they are conceptual, instrumental, and strategic changes. Graham et al. (2006) identified conceptual as the changes in knowledge creation and action, instrumental changes as those changes evidenced in practice, and strategic changes as the manipulation of knowledge attained. For this project, a pre- and post-intervention survey instrument was used to determine if the desired change of an increase in the confidence of nurses in this patient population would take place.

The sixth and subsequent step was to evaluate whether the strategy used to address the problem impacted the desired outcome, which Graham et al. (2006) stipulates is the only way to conclude a successful project. Graham et al. (2006) reports that researchers should assess if the intervention makes a difference in health and system outcomes. This project determined if simulation resulted in the desired outcome of increased knowledge, confidence, and learner satisfaction by step-down nurses to provide care for patients requiring invasive mechanical ventilation.

The last and final step of the action cycle was the project's sustainability in the institution where the project was being conducted. For short-term sustainability, two months after the simulation, the co-investigator implemented a survey of the participant's learner satisfaction, confidence, and knowledge in invasive mechanical ventilation. Also, the feedback from the step-down and surgical ICU supervisor allowed for a long-term evaluation of this practice after the DNP project was completed. Involving key stakeholders as supporters of this project by disseminating the results to the project team members, the Clinical Nursing Officer, the Assistant Vice President (AVP) of Nursing Excellence, and the manager of Patient Education and Research ensured their involvement and alignment with the success of simulation for nursing education. Some goals for sustainability included the creation of a simulation program and the inclusion of simulation for nurse competencies. In line with the theoretical framework used for this project, sustainability included adding simulation to the orientation process of any nurse caring for patients requiring invasive mechanical ventilation, integrating simulation into the new hire onboarding process, and adding a mechanical ventilator training policy to the training manual.

Methodology

This quality improvement project used a one-group pre- and post-intervention design with a convenience sample of step-down nurses at a Magnet designated hospital in New York

City. IRB approval was obtained from both Rutgers and the site hospital IRB, which served as the IRB of record. Participants evaluated their level of self-confidence, knowledge, and learner satisfaction before and after the use of simulated scenarios. Two months after the educational intervention, the participants were asked to retake the post-intervention survey to measure if the knowledge of nursing care for invasive mechanical ventilation sustained. The results from both the post-intervention surveys as well as the post-post intervention surveys were evaluated.

Design of Project

This quality improvement project used a pre-post intervention study design with a convenience sample of step-down nurses. The project used a simulation program for mechanical ventilation to improve step-down nurses' confidence and knowledge in providing care to patients who require invasive mechanical ventilation.

Setting

The intervention took place in a specialized orthopedic hospital located in an urban area of the Northeast. The hospital serves the local population and attracts patients from around the world due to its' renowned care. Services provided include total hip and knee arthroplasty, a variety of spinal surgery, as well as numerous smaller joint surgeries and non-invasive ambulatory cases. On average, 30,000 surgeries are performed at this institution per year, approximately 82 per day. Of these surgeries, the complex spinal procedures often require invasive mechanical ventilation as part of the post-operative phase. Typically, these patients are admitted to the surgical ICU for the initial recovery period. In 2019, 519 of the aforementioned surgeries have required invasive mechanical ventilation in the surgical ICU.

Study Population

The targeted population for this project was nurses working in the step-down unit of the hospital. The sample was determined using inclusion and exclusion criteria. Inclusion criteria was defined as nurses who worked full time, had an active state nursing license, advanced cardiovascular life support (ACLS) certification, had zero to 1-year experience with mechanical ventilation, and were currently working in the step-down unit. Exclusion criteria included nurses who worked in the institution’s surgical ICU for more than 1-year, advanced practice nurses, nurses who were not hired to the step-down unit, and nurses who did not wish to participate. There was no limit for the number of candidates in each demographic category, which was only used to describe the sample.

Subject Recruitment

After IRB approval, communication about the mechanical ventilation simulation quality improvement project was disseminated to the step-down nurses via recruitment flyers displayed in the break room and on the unit based informational board. Due to the specificity of the population, the co-investigator made announcements about the project during unit-based huddles and staff meetings to include both day and night-shift nurses. Also, the co-investigator used the institution’s email server to contact eligible participants about the project and garner institutional support; the email (Appendix D) included an attachment of the recruitment flyer (Appendix E).

Recruitment lasted for one month, which ensured registered nurses from both shifts received the necessary information to make an informed decision about participation. The co-investigator informed all potential participants that involvement in the project was voluntary, could be rescinded without consequence at any time, and that no monetary compensation or professional benefits would be provided.

Consent Procedure

After applying the inclusion and exclusion criteria, potential participants were notified of their eligibility and a copy of the IRB-approved consent form (Appendix F) was provided for their review. The consent form addressed questions potential participants may have had about the purpose, potential outcomes, time spent, and their eligibility to participate. Other highlighted factors included the risks, benefits, and financial implications of the project; it was noted that benefits can't be guaranteed, there would be minimal to no risk to the participant, and that no financial or professional compensation would be provided. Furthermore, the consent informed potential participants that results would be kept confidential and outcomes from the project would be disseminated to participants and the population.

A Waiver of Documentation of Consent was approved by the site's IRB and no signature was necessary for consent; the completion of the survey instruments implied consent. After all questions and concerns were addressed, if participants were agreeable to the terms, they were given a copy of the consent for their records. The participants completed the demographic questionnaire (Appendix G), learning satisfaction and self-confidence survey (Appendix H), and questions on perceived knowledge of mechanical ventilation (Appendix I). Next, an overview of information regarding the training and a tentative schedule of the training were discussed.

Risks, Harms, and Benefits

Participation in this study posed minimal risk. No personal identifiers were used in the collection of project-related data because pre- and post-intervention surveys were anonymous. There were no anticipated discomforts for participants in this study; the simulation setting and workload resembled a typical work environment. Participation in this study did not affect employment status, yearly evaluations or increase chances for a promotion. Participants may have felt anxious learning new material and while responding to pre- and post-intervention surveys. Participants were made aware that the results of the simulation outcomes were for the project and no individual outcomes would be revealed. If at any point during the simulated scenario they experienced discomfort, they were informed to alert the co-investigator and discontinue participation.

It was anticipated that both individual nurses and the institution would benefit by participating in this project. Participating nurses may have gained confidence and knowledge in caring for patients who are mechanically ventilated. The institution may have benefited from the retention of satisfied and confident nurses in addition to being able to promote a nursing guided quality improvement project; the project added to existing educational research. Upon completion of the project, all participants were informed of any new findings that may affect future mechanical ventilation training.

Subject Costs and Compensation

There was no cost to participate in this project. No professional compensation or incentives were provided for their participation in the project however, light refreshments were served at the educational sessions in appreciation for participant's time.

Interventions

On the participants assigned day, that was chosen at random, they reported to the surgical ICU where they were greeted by the co-investigator and project team member. A brief 15-minute overview of the technology and equipment was presented (e.g., mannequin, ventilator) and anticipated learning objectives from the simulation scenario were reviewed (Appendix J). During this time, reinforcement about participation, employment status, and privacy were reiterated as well as a reminder that there would be no videotaping or peer audience present.

Setup. The mechanical ventilation simulation took place in an unoccupied patient room in the surgical ICU. A mannequin representing a patient was positioned in a patient bed with an endotracheal tube in its' mouth, resembling an artificial airway, that was attached to a hospital ventilator. Connected to the ventilator was a test lung that was able to be manipulated to alarm the ventilator to simulate that something was wrong with either the patient or the machine. The participant was read the patient scenario and told pertinent information to begin. With no help from the co-investigator, the participant was expected to respond to ventilator alarms, identify the clinical presentation of the patient, and intervene appropriately. After the scenarios concluded, the co-investigator debriefed with the participant and discussed the optimal intervention to the provided scenarios. Following the debriefing the participant was able to run through the scenarios a second time if they wished.

It took the participants five to ten minutes to review the written consent and ask questions about the consent. After reviewing the consent form but before the start of the project, the pre-intervention survey assessments and the demographic questionnaire were completed; total time commitment was no greater than ten minutes, which was on a separate day than the simulation.

On the scheduled day, the educational session began with an introductory objective overview that took approximately fifteen minutes. Completion of the simulation, post-intervention survey assessments, and project evaluation took approximately twenty minutes. The total time for the intervention was roughly 50-55 minutes of the participant's time. The two-month follow-up included the post-intervention survey on learner satisfaction, confidence in providing care to invasively mechanically ventilated patients, and knowledge in the evidence-based essentials of nursing care for ventilated patients; that took about fifteen minutes to complete. The total time for the intervention was approximately 65-70 minutes of the participant's time.

Outcomes Measured

There were three dependent variables used to measure outcomes. Confidence and learner satisfaction were measured using The Student Satisfaction and Self-Confidence in Learning instrument, and the knowledge questions were developed from a white paper from the American Association for Respiratory Care University Health System Consortium (2016) as well as a senior respiratory therapist, a subject matter expert.

Data collection tools. The Student Satisfaction and Self-Confidence in Learning instrument, designed by the National League for Nursing (NLN), was modified and used to assess pre- and post-intervention confidence of the participants with invasively mechanically ventilated patients. See Appendix K for the post-survey questionnaire. This validated 13-item instrument was developed using a five-point Likert-type scale ranging from "strongly disagree" to "strongly agree", to measure student learner satisfaction (five items) and self-confidence in learning (eight items) with simulated scenarios. The reported reliability was measured using Cronbach's alpha and reported 0.94 for the Satisfaction subscale, indicating strong reliability, and 0.87 for the Self-confidence subscale, indicating moderate to strong reliability. The co-investigator modified the tool to depict the learning curriculum of mechanical ventilation instead of a medical-surgical curriculum because the learners for this project are not in school.

In addition to the aforementioned instruments, a researcher-designed demographic questionnaire was used to describe the sample population and find possible correlations between the sample's characteristics (i.e., age, gender, experience in career and specific specialty, highest degree, simulation experience) and outcomes of learner satisfaction or self-confidence using simulation. Identification of these demographics may aid in future research to determine factors that could reflect nurses learning through simulation.

In addition to Lippincott's recommendations on the essentials for nurses providing care to patients requiring invasive mechanical ventilation, the knowledge assessment questions (Appendix I) were derived from a white paper from the American Association for Respiratory Care and University Health System Consortium (2016) that provided standardized guidelines for safe management of mechanical ventilation. The senior respiratory therapist, a subject matter expert, reviewed the knowledge assessment questions developed by the co-investigator for this project.

Project Timeline

Project planning and implementation commenced in January 2019 and was completed by March 2020. After conducting a needs assessment in a hospital in an urban area, a lack of step-down nurses willing to cross-train to the surgical ICU was noted. The topic was presented to the project chair member as well as the AVP of Nursing Excellence at the site that the project would be implemented. After approval from Rutgers and the AVP of Nursing Excellence, the proposal was written and approved by the project chair and team member. By July 2019, the project was submitted to the institution's IRB and approved by August 2019. After IRB approval, participants were recruited, pre-intervention assessments were collected and the participants were made aware of their scheduled simulation day. Once the simulation was completed and all data collected, including initial post-intervention surveys and project evaluation, a two-month follow-up was conducted. The final analysis was completed by March 2020. The project will be presented in April 2020 for both Rutgers University Doctorate of Nursing Research Day and the project's site Nursing Research Day. Appendix L is a Gantt chart of the project's timeline.

Resources Needed/Economic Consideration

Although developing appropriate objectives and scenarios take research and a thorough analysis of best practices, resources needed were available through Rutgers library, outside sources, and through the described hospitals' educational center. The project budget was minimal and was the sole responsibility of the co-investigator. Included in the budget was paper for recruitment flyers, demographic questionnaires, and pre- and post-intervention survey papers as well as light refreshments, statistician consultation and analysis, and dissemination posters. The budget was $338.75 and is reported in Appendix M.

Evaluation Plan

An evaluation process assists in identifying the effectiveness and success of a project (Saunders, Evans, & Joshi, 2005). This process is crucial for stakeholders to determine if the project was constructive and efficient as well as to evaluate how the outcome was reached successfully. The process evaluation is valuable to analyze project implementation and replication for future use. Before implementation, the project was pre-evaluated to assess for viability and was planned with guidance from numerous sources such as The Knowledge-to-Action Model, project chair, team member, and stakeholders. During implementation, project evaluation was ongoing to assure it was according to the protocol submitted to the Rutgers' IRB. The post-project evaluation was focused on the resources needed to conduct the project, the facilitators and barriers that impacted the project's objectives, intended and unintended consequences, and how barriers were resolved. Process-evaluation questions include fidelity, dose delivered, dose received, reach, recruitment, and context (Baranowski & Stables, 2000; Steckler & Linnan, 2002). These questions were used to evaluate the intervention:

- Were all intervention components completed for each participant?

- Did participants like simulation as an additional educational component to invasive mechanical ventilation training?
- Did the project reach at least 80% of eligible nurses in the step-down unit?
- Was the recruitment strategy effective?
- Did the site give time to nurses to participate in the project?
- To what extent was the project implemented as planned?
- What were the facilitators and barriers to the project's objectives?

Data Analysis Plan

Bivariate statistical analysis, in conjunction with descriptive statistics, was used to evaluate the relationship between three dependent variables in this project, participants learning satisfaction with simulation and their confidence and knowledge in caring for patients requiring mechanical ventilation. A Pearson correlation was used to assess relationships between variables. A paired t-test was used, based on abnormally distributed data because the data was being compared within one group to assess differences and significance before, and following the intervention. Analysis of data was completed using the statistical software package SPSS 24 (IMB, 2017).

Student Satisfaction and Self-Confidence in Learning scale is a Likert-type scale that collected ordinal data and was coded by the co-investigator to ensure the coding was performed the same way each time. The Student Satisfaction and Self-Confidence in Learning scale also had a place for a neutral response, which had a discrete code to ensure inclusion in data analysis. Descriptive analytics were used to describe the demographics of the participants.

Data Maintenance & Security

The demographic questionnaire and pre- and post-intervention surveys were encoded with an ID number and no personal identifiers were collected. Only the co-investigator and project team member had access to the list with the participants' names linked to ID numbers that stayed in a locked cabinet in the project team member's office. Once all data had been coded, all data was de-identified. Individual demographics were not discussed in the results and reported in the aggregate. Upon the completion of the project, closure of the IRB, and final writing of the manuscript, all data was destroyed per Rutgers University guidelines.

Findings

Demographics

A total of ten nurses from the step-down unit who fit the inclusion criteria expressed interest in participating in education for invasive mechanical ventilation training. All ten provided demographic data before completing pre-intervention surveys on confidence, knowledge, and learner satisfaction with simulated education regarding care for mechanically ventilated patients. Next, they participated in targeted simulated scenarios; all participants then completed post-intervention surveys regarding confidence, knowledge, and learner satisfaction. Of these ten nurses, 100% completed the two-month follow-up survey on knowledge.

Demographics for the total sample are detailed in Appendix N; mean, standard deviation, and frequency were analyzed. The majority of participants were female (60%), 26-30 years of age (40%), employed as a nurse between three and five years (60%), and worked in step-down between three and five years (60%). The highest degree held by the nurses was a Bachelor's degree (80%) and seven of the participants took part in simulation programs in the past (70%).

Self-Confidence in Learning

There was a significant difference in the average scores of the pre (M = 27.9, SD = 3.478) and post-intervention (M = 32.0, SD = 2.981) total participant confidence scores, $t(9) = -4.324$, $p = .003$ of the participants. Post-intervention total confidence scores were 4.1 points higher, 95% CI (-6.244, -1.955) compared to pre-intervention total confidence scores. There was a significant difference in the pre (M = 3.4, SD = 1.07) and post intervention (M = 4.5, SD = .527) scores in the items measuring confidence in the current development of skills and required knowledge to perform necessary tasks when caring for a mechanically ventilated patient, $t(9) = -3.973$, $p = .003$. The post-intervention confidence scores were 1.1 points higher [95% CI (-1.726, -.473)] than pre-intervention scores. There was a significant difference in the pre (M = 2.9, SD = 1.1) and post-intervention (M = 4.2, SD = .632) scores in the items measuring confidence in currently mastering care for mechanically ventilated patients; $t(9) = -3.284$, $p = .009$ post-intervention confidence scores were 1.3 points higher, 95% CI (-2.195, -.404) (Appendix O).

Changes in Knowledge

Knowledge questionnaires were completed pre-intervention, immediately after, and then approximately two-months after the simulated intervention. Within the pre-knowledge questionnaire, participants were requested to answer topics regarding ventilation alarms and immediate interventions, ventilator modes, and basic ventilator settings. Overall, there was a significant difference in the total number of correctly answered questions before the intervention (M = 7.1, SD = 2.02) and two-months after the intervention (M = 10.3, SD = 1.16); $t(9) = -7.236$, $p = .000$. Additionally, there was a significant difference in the total number of correctly answered questions immediately after (*M* = 8.5, *SD* = 1.649) and two-months post-intervention (*M* = 10.3, *SD* = 1.16); *t*(9) = -4.323, *p* = .002; knowledge scores are displayed in Appendix P.

Ventilator alarms. Based on the results of correct answers to question nine in the knowledge questionnaire, there was a significant difference in correctly identifying an intervention for high peak pressure pre (N = 4) and two-month post-intervention (N = 8); *t*(9) = 2.449, *p* = .037. The number of correct answers to question 11 led to the conclusion that there was a significant difference in correctly identifying an intervention for high respiratory rate alarm pre (N = 1) and two-months post-intervention (N = 8); *t*(9) = 4.583, *p* = .001 as well as immediately after simulation (N = 0) and two-months later (N = 8); *t*(9) = 6.000, *p* = .000.

Ventilator modes and settings. The results were positive in the explanation of a volume control mode immediately after (N = 4) and two-months post-intervention (N = 8); *t*(9) = 2.449, *p* = .037. There was a significant difference in correctly answering a question regarding volume control ventilation pre (N = 3) two-month post-intervention (N = 9); *t*(9) = -7.236, *p* = .000.

Learner Satisfaction

Prior to the simulated scenarios, participants completed a survey on satisfaction with current learning modalities including classroom and e-learning for mechanical ventilation training (M = 20.2, SD = 2.394). Following the simulation intervention, there was a significant increase in satisfaction scores (*M* = 24.2, *SD* = 1.619); *t*(9) = -6.000, *p* = .000. Post-intervention confidence scores were 4.2 points higher, 95% CI (-5.508, -2.492). There was a significant difference in the before the intervention (*M* = 3.0, *SD* = 1.247) and after the intervention (M = 4.8, SD = 0.422) satisfaction scores regarding the helpfulness and effectiveness of teaching methods currently used for caring for mechanically ventilated patients , *t*(9) = -5.014, *p* = .001; Post-intervention scores were 1.8 points higher, 95% CI (-2.612, -.987; Appendix Q).

Discussion

The results of this project support previously established literature about the use of simulation for nursing education. Research in simulation for nursing education has provided evidence that the creation of individualized scenarios using a hands-on approach in controlled environments is effective (Aebersold & Tschannen, 2013; Yee et al., 2016). The overall aim of this project was to modify an existing cross-training program to include simulated experiences for the care of invasively mechanically ventilated patients. To evaluate if this project would complement the established cross-training program, confidence, learner satisfaction, and knowledge were measured pre- and post-intervention in addition to a two-month sustainability follow-up in knowledge. The positive results of this project may indicate that the addition of simulation to the education of step-down nurses providing care to patients requiring invasive mechanical ventilation is effective.

The recruitment strategy was effective because after the inclusion and exclusion criteria were applied ten nurses qualified to participate in the project; the project reached 100% of eligible nurses in the step-down unit. All nurses surveyed for participation endorsed the opportunity and completed all required components. Based on the post-intervention survey results on learner satisfaction, participants enjoyed simulation as an additional educational component to invasive mechanical ventilation training. There were statistically significant increases in confidence before and after the intervention, evident in specific questions relating to confidence. Overall participant knowledge was significantly increased, with particular attention to questions regarding ventilator alarms and ventilator modes and settings. Of note, the knowledge advances were found to persist at two months post-intervention, suggesting the sustainability of said knowledge. A significant increase in satisfaction scores following the intervention suggests a relationship between confidence, knowledge, and overall satisfaction.

This project demonstrated that the use of simulation resulted in greater self-confidence compared to didactic education alone. The results for self-confidence in learning complement those of McRae et al. (2017), who reported high nurse satisfaction with simulated-based learning regardless of age or amount of years worked and Ballangrud et al. (2014), who found that simulation for ICU nurses provided a comparable learning experience to other educational methods without concern for patient safety.

Due to the complexity and pressures associated with caring for patients requiring invasive mechanical ventilation, nurses' confidence in their abilities is integral. Identification of an educational modality that allows learners to gain confidence in independent abilities while increasing knowledge results in a universally beneficial strategy. Confidence is imperative for successful decision making and appropriate awareness of abilities, including recognizing when additional support is necessary.

Although there were positive results in confidence before and after the simulated scenarios, it is important to note that self-reported confidence is not necessarily associated with an improvement in care (Boling et al., 2016). While step-down nurses' confidence may facilitate eagerness to apply learned skills, the ultimate way to measure improvement is to measure patient outcomes; self-confidence alone is insufficient. An educational intervention should ensure the step-down nurses can perform the tasks required to maintain patient safety and the quality of care as well as increase their confidence in caring for invasively ventilated patients.

The ability to retain knowledge learned through educational modalities and prompt application to clinical scenarios are skills expected of nurses (Crowe, et al., 2018). Knowledge retention was measured to establish if mechanical ventilation education would be sustained two-months later. The increase in correctly answered questions from pre-intervention to the two-month post-intervention questionnaire indicated that simulation for mechanical ventilation education had a positive effect on knowledge retention.

Misinterpreting critical alarms that alert nurses of a discrepancy between the programmed mechanical ventilator settings and the patient's response may increase the risk of poor outcomes such as iatrogenic barotrauma, ventilator-associated pneumonia, and death (Slutsky, 2015). Therefore, when developing knowledge questions, it was essential to include a review of critical alarms such as high peak pressure and respiratory rate. With the advancement in ventilator modes and capabilities, understanding the intrinsic complexity of invasive mechanical ventilation poses a challenge to inexperienced nurses who have not received thorough training (Yee et al., 2016). The site where the project was conducted mainly uses volume or pressure control modes; therefore, those were the area of focus for the knowledge questionnaire and intervention.

Evaluation of this intervention indicates that the information disseminated was retained, and the participating step-down nurses developed new skills and expanded their knowledge base; this provides evidence of the effectiveness of simulation as an educational modality for invasive mechanical ventilation training. The training is built on existing knowledge and aims to expand the skill set of the learner to promote safety, confidence, and compliance with evidence-based practices for invasive mechanical ventilation education. Additionally, the previously established implementation of simulation may alleviate discrepancies in clinical practice and enhance adherence to evidence-based practice guidelines.

Including simulation as an active learning strategy has been noted to increase learner satisfaction in various medical settings (Bultas et al., 2014; Goldsworthy, 2016). This project evaluated learner satisfaction because it is crucial to the success of an educational intervention; learners absorb information better if they like and understand the method in which the content is delivered (Bultas et al., 2014; Goldsworthy, 2016). Honing learned skills, however, requires practice and regular feedback regarding the efficacy of the simulation. Certain concepts perceived as difficult by nurses can be simplified with interventions that emphasize visual and applied learning as opposed to a concentration on didactic teaching. Additionally, practice and repetition increase nurse engagement thus improving educational experience and knowledge retention.

Facilitators and Barriers

There were a few key facilitators that impacted the project's objectives. The project team member was readily available to retrieve equipment and space for the simulated scenarios and was available to review data. The unit manager was amenable to allowing extra nursing coverage on assigned days nurses had to participate in either surveys or interventions. Having support from the unit manager, team members, key stakeholders, and nurse educators helped facilitate efficient and informative simulated intervention. This project provides a framework for nurses in the hospital that provide care to invasively mechanically ventilated patients and also serves as a reference for other educational topics where simulation can be applied. Lastly, from a financial aspect, the mannequin was purchased previously and no additional expenses were accrued by the co-investigator, the participant, or the facility.

Several barriers affected the projects' objectives. On the scheduled week of project implementation, the lead respiratory therapist was unable to participate because of illness and the test lung for the ventilator was not available for use; consequently, the start date had to be moved twice to accommodate the use of the test lung. Also, the surgical ICU predominantly uses pressure and volume control modes, therefore it was predetermined to only address those modes and settings in the knowledge questionnaire and simulated scenarios to decrease information about unlikely circumstances. To enhance learning, the project was designed for only one participant at a time to be actively involved in the simulation activity. Although the unit manager was amenable to extra nursing staff during implementation, patient care duties superseded implementation and at times interrupted the training activity.

Another barrier encountered was the lack of realistic interaction that occurs during the care of human patients. In a simulated environment, some participants may not take the activity seriously. The short time allowed may be a barrier to this project because learners do not have time to review or practice the skills; conversely, a longer wait for follow-up assessment of knowledge retention, may provide an opportunity for the participant to learn from other sources and an increase in knowledge may not be attributable to simulation.

Lastly, the project had a small convenience sample, a lack of diverse demographics, and was restricted to a single institution; there may be an incorrect positive interpretation of results and therefore should not be generalizable. Despite the barriers listed, the overall positive outcomes throughout this project indicate that simulation for mechanical ventilation education should be added to the cross-training curriculum for step-down nurses.

Unintended Consequences

A few unintended consequences were noted throughout this project. Due to the positive feedback in simulation training, most participants suggested other scenarios where simulation may be included. Negative unintended consequences included emotions and feelings of being judged or watched while participating in the simulation. Moreover, anxiety about corrective actions or constructive criticism by a peer may have deterred some nurses from participating. Nurses may have a false sense of security in knowledge after simulation or may have memorized the answers from pre-surveys instead of comprehending the information.

The participants in this project completed the demographic survey, and pre-surveys on confidence, knowledge, and learner satisfaction before the simulation. Immediately after, the post-intervention surveys on confidence, knowledge and learner satisfaction were complete. At the two-month post-intervention survey, the final knowledge questionnaire was completed. The time needed for data collection, implementation, data entry, and analysis were factored into scheduling for the primary investigator and participants. Finally, feedback given throughout the process assisted in evaluating the generalizability of this project to other areas of nursing as well as provides further guidance to nurse educators who may consider simulation for cross-training nurses in other areas of the hospital.

Implications

Clinical Practice

Incorporating simulation into clinical practice had many positive outcomes for nurses providing care to invasively mechanically ventilated patients. Simulation assists in the transfer of theoretical knowledge to practice and provides a hands-on experience for nurses to gain confidence and knowledge in complex scenarios (Goldsworthy, 2016). Novice ICU nurses as well as step-down nurses were familiar with institutional practices but lacked self-confidence regarding caring for patients requiring invasive mechanical ventilation. Adding simulation to an established didactic program generated positive outcomes in confidence and learner satisfaction, as well as an overall increase inappropriately answered questions from the pre-intervention to the two-month post-intervention knowledge questionnaire.

Educational interventions have been instrumental tactics for translating and developing knowledge in clinical care. Modalities such as computer-based education, didactic classroom teaching, and workshops have been studied in the past. With rapid technological advancements in healthcare, the ability to improve outcomes and create individualized scenarios in a safe learning environment has become a reality due to simulation. Simulation allows for objective reflection and debriefing which provide the users with valuable feedback. Furthermore, the participants are free to ask questions and have an opportunity to repeat the scenarios until they are confident in their skills. This technique may not only provide a more desirable cross-training program but also better outcomes for the patient population in question. The findings from this project reinforce the use of simulation for cross-training step-down nurses to a surgical ICU setting. Additionally, the outcomes complement other positive results noted in different nursing domains. These outcomes support the change of practice throughout healthcare as a whole.

Healthcare Policy

Training and education for nurses that are either learning a new skill or transitioning to different specialties oftentimes require numerous resources. This concern is particularly highlighted when exposed to the population of step-down nurses' cross-training to the ICU. A chief difference between the two roles that harbor specific and intensive training is the scope of confidence and knowledge associated with providing care to invasively mechanically ventilated patients. The nature of this project, supported by the presented results, suggests there are significant implications for healthcare policy.

Commencing from a higher, universal perspective, a notable policy implication is the official inclusion of simulation training as a cost-efficient and effective training modality for invasive mechanical ventilation. Supported by this project, and numerous studies regarding the benefits of simulation training as a complement to didactic training, the acknowledgment of this practice as evidence-based would cement it as a standard convention. With national organizations providing guidelines and standards that promote the use of simulation, local institutions and practitioners would be more likely to adopt this modality. Inadvertently, this would result in the standardization of education, which would increase opportunities for mobility between positions and secure confidence that all institutions and individuals are held to the same standard.

With support from a governing body, standardization of training would inevitably allow for smoother transitions between roles for nurses. This project highlighted the increase in confidence demonstrated by nurses when they were able to learn new skills via simulation. Increased confidence ultimately contributes to increased satisfaction, and it has been discussed that satisfied nurses are more likely to be more engaged in their current role, as well as strive to advance their abilities to contribute to patient safety (Institute of Medicine, 2011). Furthermore, nurses who participated in the simulation can share their experience with their peers and manager, as well as the AVP of Nursing Excellence and nurse educators. Incorporating frontline nursing input in addition to presenting positive results to institutional administration emphasizes nurse engagement at the institutional level and builds a foundation to complement local, regional, and state standards. Moreover, national quality and safety benchmarks set by The Joint Commission as well as The Magnet Recognition Program recognize performance improvement in health care for patients through motivated and valued nurses and simulation can be included in the submission to these organizations.

Healthcare Quality and Safety

Quality and safety within healthcare encompass a myriad of factors deemed necessary for an optimal outcome. The two components are not mutually exclusive but their respective elements are often interchangeable in various ways. The terms quality and safety constitute attributes applicable to numerous domains regarding simulation: organizational guidelines, institutional standards, individual and global expertise, and universal accountability. Quantifying the specific elements of both terms presents an understanding and conceptualization of the impact that nurses providing care to invasive mechanically ventilated patients may have.

The quality of simulation training can be characterized as the ability to provide the desired skills needed, substantiated by existing and proposed universal guidelines and standards. This speaks to the accountability of the training, as it appears the information provided to the nurses is appropriate and that the dissemination of the skills learned is suitable. In assigning accountability as a measure of quality, the role and importance of standardization are invoked. Standardization implies meticulous review and acceptance, thereby promotion of a desirable action. Ultimately, the two components are intrinsically linked as they ensure that the quality of training is optimal. Also, the impact of quality is the successful harmonization of the process, resulting in a comprehensive pathway from the established guidelines to the care provided to patients. The International Nursing Association for Clinical Simulation and Learning (INACSL) provides best practice guidelines for the use of simulation for education and has suggested it be incorporated into standards of practice (National League of Nursing, 2015).

Ideally, an effective process of training nurses to use their skills to care for mechanically ventilated patients will result in a significant improvement in patient safety. As patient outcomes are generally evaluated according to safety and satisfaction scores, the impact of endorsing simulation as a universal and validated method for training nurses would display its positive impact on patient safety. In a safe learning environment, educators can create individualized scenarios using a hands-on approach in a controlled situation to complement established education methods.

The impact of high quality and safe healthcare practice contributes to nurses' satisfaction by improving their confidence. Simulation reduces the risk of poor patient outcomes by formalizing training for all nurses that translates into better clinical practice. Creating a safe and structured learning environment, free of bias, will allow nurses to feel more confident and knowledgeable in mechanical ventilation training and ultimately, provide a positive impact on healthcare quality and safety.

Education

As hypothesized, the addition of simulation to a cross-training program may have benefits over didactic education alone. The variability noted within existing research may be due to the lack of universal outcome measurement tools. Differences in the types of simulation available (i.e., high-fidelity, low-fidelity, virtual simulation) established that education modalities, learning styles, and prior experience are all potential confounders that may have a significant impact on how its use is perceived in literature and practice. During the preliminary review of literature as well as preparation of implementation, it was discovered that the use of simulation as an adjunct to standard training was already identified to be a positive opportunity for educational growth for other specialties within the institution (e.g., physician assistants, residents, and anesthesia providers). The perceived benefits others were having with simulation throughout the institution, as well as the recommendations from the National League of Nursing (2015), suggested that integrating simulation into the nursing education curriculum was appropriate.

Nurses transitioning to critical care specialties require an extensive training program to take care of the most critical patients in the hospital. In the past, step-down nurses were relying on didactic training alone to be confident and knowledgeable in invasive mechanical ventilation. While this presented opportunity for theoretical learning, clinical translation of skills was limited until presented with an active education modality. Simulation provides the ability to engage within complex scenarios without the pressure of potentially harming a patient, allowing for submersion into learning that is otherwise excluded. Presenting opportunities to gain an education that may aid in professional growth is a notable benefit. This allows individual nurses to acquire skills that will allow them to expand in their abilities, potentially with the option of rising within the organization and/or providing tutelage and mentorship to others.

Simulation for uncommon yet critical scenarios in the vulnerable population of the ICU is ultimately an efficient method for learning how to care for invasive mechanically ventilated patients. This project provided a pilot study of the implementation of such training within a single institution and harbored numerous positive results. The practice of incorporating simulation training is commonplace in numerous domains of healthcare, particularly within learning stages (e.g., school, clinical training). Integrating simulation within nursing would be a warranted and positive implication for this project because it would present a constructive educational modality as well as enforce continuance of a known and effective method.

Economic Benefits

Evaluation of economic benefits within healthcare is multifaceted and encompasses myriad components. A high-level categorization identifies the following factors as particularly applicable: employee retention, financial investment, and patient outcomes. The aforementioned constituents lend themselves as factors that may provide immediate as well as long-term benefits. In the subsequent assessment of each component, it should be emphasized that many of the benefits are applicable at the individual and organizational levels.

Since this project is focused on a specific population of nurses, it is pertinent that the topic of employee retention is the first addressed. The topic of employee retention within nursing encompasses satisfaction and confidence both in the individual and the organization. Satisfied nurses are more likely to be more engaged in their current role, as well as strive to climb clinical ladders within their institution (Institute of Medicine, 2011). Organizationally, this also presents opportunities for organizational growth arising from the increased abilities of the nurses.

The possibility of organizational growth is a nuanced segue to the reality that the implementation of a novel training program necessitates a financial investment. The initial monetary expenditure is associated with the acquisition of personnel and supplies required for the appropriate implementation of the training. Because similar training is already enforced within the institution for other purposes, there may be overlap in equipment, personnel, and overarching organizations that provide said resources. An internal SWOT analysis would assist in determining the most appropriate course of action, with the understanding that the initial investment is likely to result in greater financial benefits.

The primary rationale for the likely increased monetary return predominantly comes from the reality that such training provides nurses with the opportunity to optimize care. This is evidenced in reviewing patient outcomes; specifically, in this project, regarding those associated with invasive mechanical ventilation. The link between patient care and patient outcomes are measured through various quality indicators, most notable benchmarks and statistics that are collected and measured against expected norms. Although there are many benchmarks in healthcare, the most pertinent one to this project is Ventilator-Associated Pneumonia (VAP). Furthermore, shorter ICU days are associated with fewer resources and therefore less cost; an increase in available budget provides the unit with opportunities to upgrade outdated technology or purchase additional supplies to also further positive patient outcomes and increase nursing retention.

Sustainability

The translation of knowledge in mechanical ventilation is grounded in the Knowledge-To-Action (KTA) Model's action cycle that concludes with sustainable knowledge use. Translation, as it applies to this project, encompasses evaluating outcomes and sustaining knowledge use. Graham et al. (2006) stated that the only way to conclude a successful project is to evaluate if the applied intervention positively impacted the desired outcome. Simulation programs need to be evaluated to establish in accordance with the goals of evidence-based practice and institutional guidelines; facilitation of such processes ensures sustainability. Translation of the project's outcomes begins with including simulation training for step-down nurses cross-training to the surgical ICU. Following the recognition of the translation, its continued integration can be routinely assessed, allowing for continued assessments of efficacy and satisfaction. Once included in the training, yearly audits in confidence, knowledge, and learner satisfaction will be pertinent. Such practice allows for feedback not only from nurses but also to account for changes in evidence-based practices in ventilator training. Additionally, the involvement of key stakeholders ensures their alignment with the vision of simulation, which inevitably increases the likelihood of success.

Successful translation of knowledge concerning simulation training for nurses on the topic of invasive mechanical ventilation in patients then transitions to the goal of sustainability. Some goals for sustainability may include the creation of a simulation lab, inclusion of simulation for nurse competencies, and the use of peer-to-peer education by allowing interested surgical ICU nurses to participate in simulation scenario training. This provides an opportunity for various providers to be engaged in the creation of scenarios, the development of knowledge questions, and the support of implementation, formulating an interdisciplinary approach. In line with KTA, sustainability may also include the addition of simulation to the orientation process of any nurse who will be caring for patients requiring invasive mechanical ventilation such as the post-anesthesia recovery unit (PACU). However, given the anticipated small sample size from one hospital, the results may not be generalizable and may need further evaluation for sustainability.

While this project focused on confidence, knowledge, and learner satisfaction, a future direction can be the inclusion of measurement for a skills checklist during the simulation. Moreover, interruptions during simulations may have impacted the outcomes for participants and consideration for future projects may include conducting simulated scenarios in a simulation lab. Furthermore, the participants were informed the project was based on respiratory ailments and were not asked to identify cardiac or renal conditions that may have been differentials to the clinical situation creating a bias.

Plans for Dissemination and Professional Reporting

The results of this project were reviewed, analyzed, and translated into measured clinical outcomes. Subsequently, the importance of project dissemination and professional reporting became a priority. The primary dissemination is directed toward nursing educators because they are the main contributors to educating not only existing nurses but also new hires. Secondary dissemination occurs through informing the manager of the step-down unit and surgical ICU as well as the manager of the PACU. Furthermore, it is the utmost importance to disseminate this information to the AVP of Nursing Excellence as well as the Clinical Nurse Officer, as nursing research has an impact on professional nursing practice as well as contributes a strong foundation for future practice-focused scholarships from bedside nursing. Also, conducting a meeting with the Practice Standards Council will be imperative to include simulation into policy and evaluate the results going forward; this will be important to the principal investigator because it will guarantee sustainability, adopt practice through policy changes, and provide an opportunity to include simulation in other areas of nursing.

This proposition will be disseminated through a Rutgers project and paper as well as during the Doctorate of Nursing Practice poster day. The results of this project will be submitted to The Society of Critical Care Medicine and the International Nursing Association for Clinical Simulation and Learning (INACSL). Furthermore, publishing the project, presenting it to a journal club, or sharing findings with surrounding healthcare institutions may encourage awareness of simulation-based learning for registered nurses providing care to patients requiring invasive mechanical ventilation. To promote this project, an application to The Eastern Nursing Research Society will be submitted in hopes of being able to present these findings to support simulation for education. Furthermore, a manuscript will be submitted to the Clinical Simulation Nursing Journal, a peer-reviewed journal of the INACSL, for review.

The concept of education for invasive mechanical ventilation was carefully selected due to the gap of knowledge identified in step-down nurses cross-training to the surgical ICU. The goal was to positively influence nursing care to include a unique perspective on education that has been used in other healthcare specialties. To promote future scholarship efforts, strides will be made to become published and share these findings with any unit or specialty that provides care to invasively mechanically ventilated patients. Moreover, simulation for managing invasive mechanical ventilation training can be used for advanced practice nurses; this will be more progressive because in most institutions critical care advanced practice nurses can alter ventilator settings and modes based on their clinical judgment compared to bedside nurses who can't. This can make an impact on quality hands-on learning and effectiveness in a critical care area as well as contribute to evidence-based practice, promote patient advocacy, and improve patient outcomes.

Summary

Caring for patients requiring invasive mechanical ventilation poses a challenge to step-down nurses who are cross-training to the surgical ICU. Not only are these patients experiencing a respiratory ailment, but they are also facing complications associated with having an invasive object within the body. The development of a hands-on learning environment, including the addition of simulation to an already existing didactic program, provides a thorough comprehensive approach to complex machinery that supports or controls the breathing of patients that are invasively mechanically ventilated. The findings of this project reinforce the relevance of including simulation for invasive mechanical ventilation training in step-down nurses cross-training to the surgical ICU. Not only was there an increase in knowledge and confidence, but also there was an increase in learner satisfaction. It is important to note that although there was an increase in confidence and knowledge, there is no direct correlation to capability. Further studies are needed to support simulation for mechanical ventilation training on patient outcomes, reduction in length of stay, and nurse retention.

References

Adib-Hajbaghery, M., & Sharifi, N. (2017). Effect of simulation training on the development of nurses and nursing students' critical thinking: A systematic literature review. *Nurse Education Today*, *50*, 17-24.

Aebersold, M. (2018). Simulation-based learning: No longer a novelty in undergraduate education. *OJIN: The Online Journal of Issues in Nursing*, *23*(2).

Aebersold, M., & Tschannen, D. (2013). Simulation in nursing practice: The impact on patient care. *The Online Journal of Issues in Nursing*, *18*(2).

American Association for Respiratory Care. (2010). Endotracheal suctioning of mechanically ventilated patients with artificial airways 2010. *Respiratory Care*, *55*(6), 758-764.

American Association for Respiratory Care & University HealthSystem Consortium. (2016). Safe initiation and management of mechanical ventilation [White paper]. Retrieved from https://www.aarc.org/wp-content/uploads/2017/03/Issue-Paper-Safe-Initiation-and-Management-of-Mechanical-Ventilation.pdf

American Association of Critical-Care Nurses. (n.d.). Essentials of critical care orientation. Retrieved by https://www.aacn.org/education/online-courses/essentials-of-critical-care-orientation?tab=Successful%20Completion

American Nurse Association (ANA). (2012). Top 10 care essentials for ventilator patients. *American Nurse Today*, *7(3)*, 209-211.

Ballangrud, R., Hall-Lord, M. L., Hedelin, B., & Persenius, M. (2014). Intensive care unit nurses' evaluation of simulation used for team training. *Nursing in Critical Care*, *19*(4), 175-184.

Berger, J. D., Kuszajewski, M., Borghese, C., & Muckler, V. C. (2018). A quality improvement project using high-fidelity simulation training to improve clinical knowledge among critical care transport nurses. *Clinical Simulation in Nursing*, *14*, 54-60.

Bliss, M., & Aitken, L. M. (2018). Does simulation enhance nurses' ability to assess deteriorating patients? *Nurse Education in Practice*, *28*, 20-26.

Boling, B., Hardin-Pierce, M., Jensen, L., & Hassan, Z. U. (2016). Evaluation of a high-fidelity simulation training program for new cardiothoracic intensive care unit nurses. *Seminars in Thoracic and Cardiovascular Surgery,* 8(4), 770-775

Bultas, M. W., Hassler, M., Ercole, P. M., & Rea, G. (2014). Effectiveness of high-fidelity simulation for pediatric staff nurse education. *Pediatric Nursing*, *40*(1), 27-33.

Cantrell, M. A., Franklin, A., Leighton, K., & Carlson, A. (2017). The evidence in simulation-based learning experiences in nursing education and practice: An umbrella review. *Clinical Simulation in Nursing*, 13(12), 634-667.

Carpio, A. L. M., & Mora, J. I. (2019). Ventilator management. In *StatPearls [Internet]*. StatPearls Publishing.

Chaghari, M., Saffari, M., Ebadi, A., & Ameryoun, A. (2017). Empowering education: A new model for in-service training of nursing staff. *Journal of Advances in Medical Education & Professionalism*, *5*(1), 26-32.

Craig Hospital. (2016). Mechanical ventilation. Retrieved from https://craighospital.org/uploads/Educational-PDFs/863.MechanicalVentilation.pdf

Cook, D. A., Brydges, R., Hamstra, S. J., Zendejas, B., Szostek, J. H., Wang, A. T., ... & Hatala, R. (2012). Comparative effectiveness of technology-enhanced simulation versus other instructional methods: A systematic review and meta-analysis. *Simulation in Healthcare*, *7*(5), 308-320.

Connell, C. J., Endacott, R., Jackman, J. A., Kiprillis, N. R., Sparkes, L. M., & Cooper, S. J. (2016). The effectiveness of education in the recognition and management of deteriorating patients: a systematic review. *Nurse Education Today*, *44*, 133-145.

Crimlisk, J. T., Krisciunas, G. P., Grillone, G. A., Gonzalez, R. M., Winter, M. R., Griever, S. C., ... & Blumenthal, A. (2017). Emergency airway response team simulation training: A nursing perspective. *Dimensions of Critical Care Nursing*, *36*(5), 290-297.

Crowe, S., Ewart, L., & Derman, S. (2018). The impact of simulation-based education on nursing confidence, knowledge and patient outcomes on general medicine units. *Nurse Education in Practice*, *29*, 70-75.

Field, B., Booth, A., Ilott, I., & Gerrish, K. (2014). Using the Knowledge to Action Framework in practice: a citation analysis and systematic review. *Implementation Science*, *9*(1), 172.

Gaba, D. M. (2004). The future vision of simulation in health care. *BMJ Quality & Safety*, *13*(suppl 1), i2-i10.

Generoso, J. R., Latoures, R. E., Acar, Y., Miller, D. S., Ciano, M., Sandrei, R., ... & Fidler, R. L. (2016). Simulation training in early emergency response (STEER). *The Journal of Continuing Education in Nursing*, 47(6), 255-263.

Goldsworthy, S. (2016). Mechanical ventilation education and transition of critical care nurses into practice. *Critical Care Nursing Clinics*, *28*(4), 399-412.

Gomersall, C. (2014). Pressure-regulated volume control. Retrieved from https://www.aic.cuhk.edu.hk/web8/prvc.htm

Graham, I. D., Logan, J., Harrison, M. B., Straus, S. E., Tetroe, J., Caswell, W., & Robinson, N. (2006). Lost in knowledge translation: Time for a map? *Journal of Continuing Education in the Health Professions*, *26*(1), 13-24.

Grant, C., & Osanloo, A. (2014). Understanding, selecting, and integrating a theoretical framework in dissertation research: Creating the blueprint for your "house". *Administrative Issues Journal*, *4*(2), 4.

Grossbach, I., Chlan, L., & Tracy, M. F. (2011). Overview of mechanical ventilatory support and management of patient-and ventilator-related responses. *Critical Care Nurse*, *31*(3), 30-44.

Guilhermino, M. C., Inder, K. J., & Sundin, D. (2018). Education on invasive mechanical ventilation involving intensive care nurses: a systematic review. *Nursing in Critical Care*, *23*(5), 245-255.

IBM. (2017). SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp

Institute of Medicine (US). Committee on the Robert Wood Johnson Foundation Initiative on the Future of Nursing. (2011). *The future of nursing: Leading change, advancing health*. Washington, DC: National Academies Press.

International Nursing Association for Clinical Simulation and Learning Standards [INACSL]. (2015). Standards of best practice: Simulation. Retrieved from https://www.inacsl.org/inacsl-standards-of-best-practice-simulation/

Isaak, R. S., Chen, F., Martinelli, S. M., Arora, H., Zvara, D. A., Hobbs, G., & Stiegler, M. P. (2018). Validity of simulation-based assessment for the Accreditation Council for Graduate Medical Education milestone achievement. *Simulation in Healthcare*, *13*(3), 201-210.

Jansson, M. M., Ala-Kokko, T. I., Ohtonen, P. P., Meriläinen, M. H., Syrjälä, H. P., & Kyngäs, H. A. (2014). Human patient simulation education in the nursing management of patients requiring mechanical ventilation: A randomized, controlled trial. *American Journal of Infection Control*, *42*(3), 271-276.

Joyce, M. F., Berg, S., & Bittner, E. A. (2017). Practical strategies for increasing efficiency and effectiveness in critical care education. World Journal of Critical Care Medicine, 6(1), 1-

12Klompas, M. (2015). Potential strategies to prevent ventilator-associated events. *American Journal of Respiratory and Critical Care Medicine*, *192*(12), 1420-1430.

Lateef, F. (2010). Simulation-based learning: Just like the real thing. *Journal of Emergencies, Trauma, and Shock*, 3(4), 348-52

Lavoie, P., & Clarke, S. P. (2017). Simulation in nursing education. *Nursing Management*, *48*(2), 16-17.

Lippincott Nursing Center. (2019). Caring for the mechanically ventilated patient. Retrieved from https://www.nursingcenter.com/clinical-resources/nursing-pocket-cards/caring-for-the-mechanically-ventilated-patient

Liu, Q., Peng, W., Zhang, F., Hu, R., Li, Y., & Yan, W. (2016). The effectiveness of blended learning in health professions: Systematic review and meta-analysis. *Journal of Medical Internet Research*, *18*(1), e2. doi:10.2196/jmir.4807

Luo, F., Annane, D., Orlikowski, D., He, L., Yang, M., Zhou, M., & Liu, G.J. (2017). Invasive versus non-invasive ventilation for acute respiratory failure in neuromuscular disease and chest wall disorders. *Cochrane Database of Systematic Reviews, 4*(12)

Mariani, B., Zazyczny, K. A., Decina, P., Waraksa, L., Snyder, P., Gallagher, E., & Hand, C. (2019). Simulation for clinical preparedness in pediatric emergencies: A pilot study. *Journal for Nurses in Professional Development*, *35*(1), 6-11.

McRae, M. E., Chan, A., Hulett, R., Lee, A. J., & Coleman, B. (2017). The effectiveness of and satisfaction with high-fidelity simulation to teach cardiac surgical resuscitation skills to nurses. *Intensive and Critical Care Nursing*, *40*, 64-69.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of internal medicine*, *151*(4), 264-269.

National League of Nursing (NLN). (2015). *A vision for teaching with simulation: A living document for the National League for Nursing (NLN) Board of Governors*. Retrieved from http://www.nln.org/docs/default-source/about/nln-vision-series-(position-statements)/vision-statement-a-vision-for-teaching-with-simulation.pdf?sfvrsn=2

O'Leary, J., Nash, R., & Lewis, P. (2016). Standard instruction versus simulation: Educating registered nurses in the early recognition of patient deterioration in paediatric critical care. *Nurse Education Today, 36*, 287-292.

Open Anesthesia. (2020). Modes of mechanical ventilation: The modern approach to modes of mechanical ventilation. *International Anesthesia Research Society*

Prin, M., & Wunsch, H. (2014). The role of stepdown beds in hospital care. *American Journal of Respiratory and Critical Care Medicine*, *190*(11), 1210-1216.

Rodriguez-Paz, J., Kennedy, M., Salas, E., Wu, A. W., Sexton, J. B., Hunt, E. A., & Pronovost, P. J. (2009). Beyond “see one, do one, teach one”: Toward a different training paradigm. BMJ Quality & Safety, 18(1), 63-68.

Semler, M. W., Keriwala, R. D., Clune, J. K., Rice, T. W., Pugh, M. E., Wheeler, A. P., Miller, A. N., Banerjee, A., Terhune, K., … Bastarache, J. A. (2015). A randomized trial comparing didactics, demonstration, and simulation for teaching teamwork to medical residents. *Annals of the American Thoracic Society*, *12*(4), 512-9.

Shelledy, D. C., & Peters, J. I. (2019). *Mechanical ventilation* (3rd ed.). Jones & Bartlett Learning.

Shin, S., Park, J. H., & Kim, J. H. (2015). Effectiveness of patient simulation in nursing education: Meta-analysis. *Nurse Education Today, 35*(1), 176-182.

Slutsky, A. S. (2015). History of mechanical ventilation. From Vesalius to ventilator-induced lung injury. *American Journal of Respiratory and Critical Care Medicine, 191*(10), 1106-1115.

Spadaro, S., Karbing, D. S., Fogagnolo, A., Ragazzi, R., Mojoli, F., Astolfi, L. ... & Volta, C. A. (2017). Simulation training for residents focused on mechanical ventilation: A randomized trial using mannequin-based versus computer-based simulation. *Simulation in Healthcare*, *12*(6), 349.

Steckler, A., & Linnan, L. (2002). In A. Steckler & L. Linnan (Eds.), Process evaluation for public health interventions and research (pp. 1-24). San Francisco: JosseyBass

Sudsawad, P. (2007). Knowledge translation: Introduction to models, strategies, and measures. Austin, TX: Southwest Educational Development Laboratory, *National Center for the Dissemination of Disability Research*.

Torpy, J. M., Campbell, A. D., & Glass, R. M. (2010). Mechanical ventilation. *JAMA*, *303*(9), 902-902.

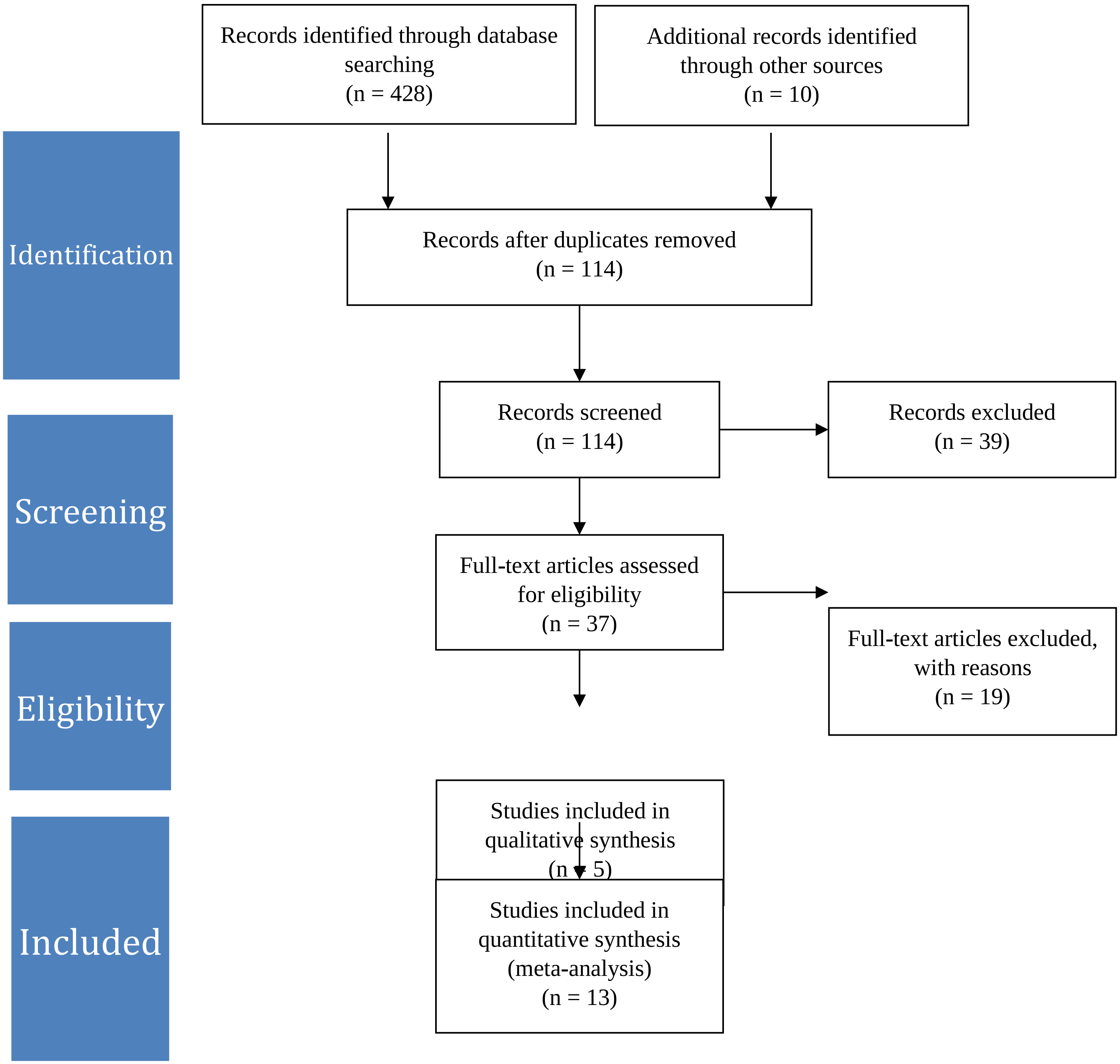
White, K. M., Dudley-Brown, S., & Terhaar, M. F. (Eds.). (2016). *Translation of evidence into nursing and health care*. Springer Publishing Company.

World Health Organization. (WHO). (2012). Knowledge translation framework for ageing and health. Retrieved from https://www.who.int/ageing/publications/knowledge_translation.pdf

Yee, J., Fuenning, C., George, R., Hejal, R., Haines, N., Dunn, D. ... & Ahmed, R. A. (2016). Mechanical ventilation boot camp: A simulation-based pilot study. *Critical Care Research and Practice, 2016*.

Appendix A

PRISMA Flow Diagram



Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009).

Appendix B

Table of Evidence

Article #	Author & Date	Evidence Type	Sample, Sample Size, Setting	Study findings that help answer the EBP Question	Limitations	Evide Level Quali
1	Adib-Hajbaghery, M., & Sharifi, N. (2017).	Systematic literature review (experimental and quasi-experimental studies)	787 potential papers, 16 included according to the inclusion criteria	Simulation-based learning results in improvements in nursing students' clinical judgment, self-efficacy, clinical abilities, and self-confidence	Varied sample sizes (range: 26 – 237) Different critical thinking scales used (cannot compare or generalize)	Level Good
2	Ballangrud, R., Hall-Lord, M. L., Hedelin, B., & Persenius, M. (2014).	Cohort cross-sectional design (article calls it "questionnaire evaluation design")	A convenience sample of 63 registered nurses: RNs who wanted to participate signed up on a list.	RNs with prior simulation experience (*n*=27) (mean=4·13, SD=0·43) scored significantly higher on 'self-confidence in learning' than those with no prior simulation experience (*n*=36) (mean=3·80, SD=0·47) (*Z*=2·72, *p*=0·007).	Small sample size, lack of control group, all in one country, difficult to generalize findings	Level Low
3	Berger, J. D., Kuszajewski, M., Borghese, C., & Muckler, V. C. (2018).	Quality improvement project - pretest, posttest, repeated-measures design	Sample of 52 nurses in the critical care transport department at a level 1 university medical center in the Southeast United States – 10 RNs participated in the study	Despite excellent clinical performance by all participants in the simulation scenarios, mean scores on the pre-, post-, and three-month posttests reflected discrepant knowledge deficiencies that were not detected during the scenarios. Knowledge was not sustained after three months.	Lack of baseline knowledge evaluation Small sample size	Level Good
4	Bliss, M., & Aitken, L. M. (2018).	A qualitative study (use	Eight nurses from an acute care setting	All participants reported that the simulation had improved their knowledge	Limited sample size	Level Good

		of structured interviews)		and they perceived they could transfer both knowledge and skills to the practice environment. Participants all felt that simulation had enhanced their ability in practice to assess and take appropriate action with an acutely ill patient. Simulation offered the participants the ability to repeat skills; this has previously been noted as not always practical in the clinical situation The simulated environment offered a non-threatening learning environment for nurses to develop away from the clinical setting with its daily pressures	Participants were volunteers, not a true representation Interviews evaluated by one researcher	
5	Boling, B., Hardin-Pierce, M., Jensen, L., & Hassan, Z. U. (2016).	Pre-course post-course program evaluation	10 nurse interns in the cardiothoracic intensive care unit	No correlation was shown between the improvement in learning and improvement in confidence	Small sample, Limited to one setting,	Level Good
6	Bultas, M. W., Hassler, M., Ercole, P. M., & Rea, G. (2014).	Randomized Control Trial	66 nurses from a large metropolitan Magnet® hospital were recruited; 33 completed the study	HFS was effective as a teaching method in recognizing and treating the deteriorating patient. HFS group scenario scores are significantly higher than the control group at post-test. HFS group performed better at recognizing and intervening in deteriorating patient scenarios. Respiratory skills significantly improved 6	Researcher-modified non-validated assessment tools Participants not blinded to study group Scenario performance scored as teams, not individual participants	Level Good

				months after for the HFS group.	Scenarios repeated at 6-month follow up; Participants had potential for remembering answers	
7	Connell, C. J., Endacott, R., Jackman, J. A., Kiprillis, N. R., Sparkes, L. M., & Cooper, S. J. (2016).	A systematic review (mix of RCTs and other studies)	6908 potential articles identified, 23 studies met inclusion criteria	Improved learner outcomes when incorporating medium to high-fidelity simulation. High-fidelity simulation has demonstrated effectiveness when delivered in brief sessions lasting only forty minutes. In situ simulation has demonstrated sustained positive impact upon the real-world implementation of rapid response systems.	Inconsistent education interventions ranged from 25 min to 45 h with a mean time of eight hour Small participant size (mean sample size = 73) Use of indirect outcome measures.	Level Good
8	Crowe, S., Ewart, L., & Derman, S. (2018).	Pretest – post-test comparative experimental design	331 nurses from various medical inpatient units attended the simulation education sessions. 161 nurses participated in the research study completing the confidence and knowledge questionnaire at baseline (pre-	Overall improvement in confidence was measured immediately post and maintained at the 3-month follow-up overall improvement in knowledge was measured immediately post and maintained at the 3-month follow-up	Small sample Use of a non-validated questionnaire 48% return rate of questionnaires Only 42 nurses completed all courses	Level Good

			intervention), 161 nurses completed the questionnaire immediately post-intervention, and 79 nurses (49%) completed the questionnaire at the 3-month follow-up. Of these, a matched sub-sample (42 nurses) provided a personal code that enabled matching their surveys across all three-time points.			
9	Goldsworthy, S. (2016).	Quasi-Experimental Pre-Test Post-Test Design	363 critical care nurses from hospitals in central Canada	Critical care self-efficacy correlated positively with general self-efficacy (r = 0.24). Top 3 competencies novice nurses rated as feeling most confident with after simulation intervention were arterial blood gas interpretation, arterial line management, prioritization of a critical care patient; least confident competencies were wedging pulmonary artery catheter, performing cardiac output, mechanical ventilation.	No information regarding experience and demographic information of participants No information regarding settings of studies	Level Good

10	Jansson, M. M., Ala-Kokko, T. I., Ohtonen, P. P., Meriläinen, M. H., Syrjälä, H. P., & Kyngäs, H. A. (2014).	Randomized controlled trial	30 critical care nurses divided evenly into control (n =15) and intervention (n = 15) groups	Identified transfer of learned skills to clinical practice post-human patient simulation (HPS) education. No improvement in factual knowledge. No significant change in knowledge scores over time.	Small sample size May not be applicable to physicians or nursing students. No relationship between HPS education and clinical outcomes.	Level Quali Gooc
11	Joyce, M. F., Berg, S., & Bittner, E. A. (2017).	Informal review	n/a	Support for advanced educational-based programs in critical care. Identification of teaching strategies for efficient and effective critical care education.		Level Quali Good
12	Mariani, B., Zazyczny, K. A., Decina, P., Waraksa, L., Snyder, P., Gallagher, E., & Hand, C. (2019).	Pretest-posttest comparative Experimental design	18 registered nurses from a mid-Atlantic five-hospital health system who had current PALS certification and cared for pediatric patients in the emergency department, the inpatient pediatric unit, the ambulatory care center, or the post-anesthesia care unit.	Nurses in the intervention group did have statistically significantly higher scores on the knowledge test	Small sample size Lack of follow-up from participants Numerous instruments to complete, potential participant fatigue	Level Good
13	McRae, M. E., Chan, A., Hulett, R., Lee, A. J., &	Descriptive pre- and post-test study	60 nurses (25 PICU, 35 CSICU) at a university-	Self-confidence to perform all 12 CS resuscitation skills were significantly higher	Single-center descriptive study	Level Good

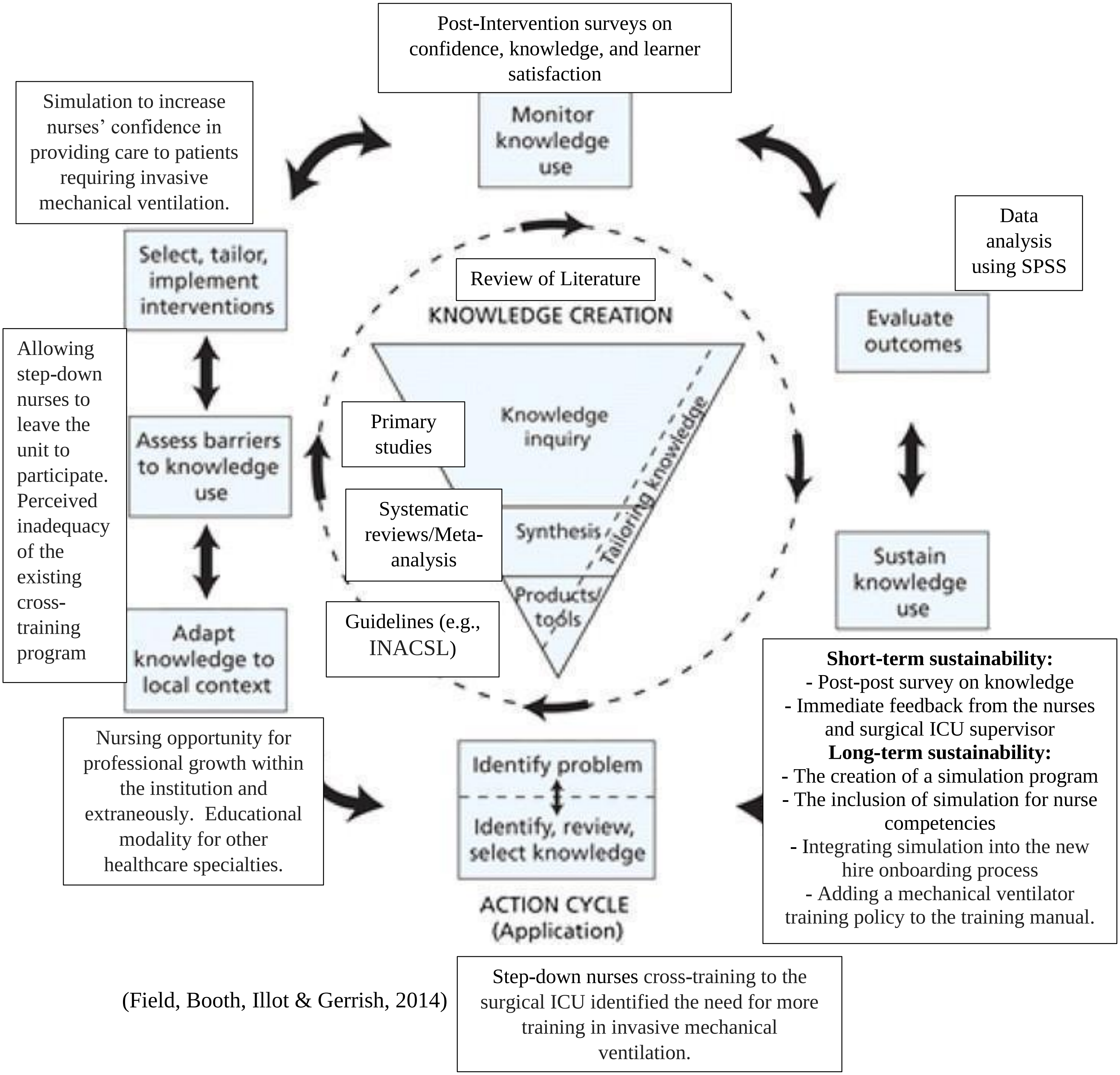
	Coleman, B. (2017).		affiliated medical center in a large urban center in the western United States	after the simulation versus before the simulation. HFS as an effective method to increase self-confidence to perform CS resuscitation skills Nurses in this study were highly satisfied with the HFS experience regardless of age group or years of CS work experience.	Presence of investigator in the room Use of a convenience sample Lack of established validity and reliability for investigator developed questionnaires No information regarding the impact on patient outcomes	
14	National League for Nursing (NLN). (2015).	Organization Consensus Statement	n/a	NLN support for simulation learning Identification of existing guidelines and quality measures for simulation programs	Statistics regarding the current use of simulation programs	Level High
15	O'Leary, J., Nash, R., & Lewis, P. (2016).	Quasi-experimental pre-test/post-test control-group design	30 nurses from the [redacted] Paediactric Critical Care Unit in Brisbane Australia during the period of June 2013 – January 2014	Participants allocated to high-fidelity stimulation were found to demonstrate significant increases in both knowledge and self-efficacy scores following the learning intervention whilst no significant change was noted amongst nurses in the control group	Lack of randomization Use of self-report assessments Use of a small sample	Level High qualit
16	Shin, S., Park, J. H., & Kim, J. H. (2015).	A meta-analysis (experime	2503 potential articles, 20 included	Simulation education could improve learning outcomes with medium-to-large effect	Use of self-report for	Level Good

		ntal and quasi-experimental)	according to the inclusion criteria	size, compared with no intervention or traditional education. The improvement was greater in the acquisition of psychomotor, affective, and cognitive skills than in reaction to learning and learning environment patient simulation education could motivate clinical nurses	measuring confidence Specific inclusion criteria for studies	
17	Spadaro, S., Karbing, D. S., Fogagnolo, A., Ragazzi, R., Mojoli, F., Astolfi, L., ... & Volta, C. A. (2017).	Randomized trial	The prospective randomized single-blind trial of 53 anesthesiology residents at the Simulation Centre of the [redacted] (Italy) from January 2013 to April 2013; 50 residents participated and were randomized into one of two groups	Mannequin-based simulation seemed more effective than computer-based simulation for improving knowledge and skills related to MV. The relationship between experience level and performance during simulation training indicates that traditional didactic lectures alone do not sufficiently raise skill levels of less experienced residents. In contrast, mannequin-based simulation seemed to improve the skills of residents of all experience levels in managing a complex MV scenario	Evaluation of skills in the final assessment, the scenario may not predict performance in other scenarios; scenario more complex and not reflective of prior training scenarios. The use of a single-center limited the generalizability of results.	Level High
18	Yee, J., Fuenning, C., George, R., Hejal, R., Haines, N., Dunn, D., ... & Ahmed, R. A. (2016).	Program development (curriculum)	17 medical residents at a tertiary-care university-affiliated teaching hospital simulation lab	Cognitive knowledge between the identical pre- and post-intervention multiple-choice tests increased significantly Participants felt more confident with ventilator management based on their	Small sample One location Use of non-validated surveys	Level Good

			during July of 2015	pre- and post-intervention confidence surveys.		

Appendix C

Knowledge-to-Action Model



(Field, Booth, Illot & Gerrish, 2014)

Appendix D

Recruitment via Email

Hello Step-Down Nurses,

My name is Samantha Ruszkowski and I am currently a DNP student at Rutgers University in the Adult-Gerontology Acute Care Program as well as a full-time registered nurse at the [redacted] For my doctoral project, I want to see if step-down nurses who wish to cross-train to the surgical ICU would be interested in participating in simulated scenarios related to invasive mechanical ventilation. Attached to this email is the recruitment flyer that outlines the eligibility criteria.

The anticipation of this project is that step-down nurse cross-training to the ICU become more confident and knowledgeable in providing care for patients requiring invasive mechanical ventilation after participation in the simulated scenarios. Other benefits include potential professional growth by supporting nursing guided research. With your feedback from the pre- and post-intervention assessments, a thorough analysis will be conducted to see if simulation should be added as an adjunct to mechanical ventilation education.

Your time is valuable and by participating in this study it will take an estimated 65-70 minutes split between two days that will be coordinated with your scheduled days of work. A brief 15-minute survey a month later would be requested.

YOU WILL NOT HAVE TO COME IN ON YOUR DAYS OFF!

If you have any questions or concerns, please feel free to contact me via phone or email.

Best,

Samantha Ruszkowski [redacted]

This research is being conducted at the [redacted] on the 5th floor in the ICU

Page 1, Verison #1 4/20/19

Appendix E

Recruitment Flyer

RUTGERS
School of Nursing

Interested in Cross-Training to the Surgical ICU?

Join Hands-On Research to Cross-Train Using Simulation

- Are you currently a full-time employed step-down nurse who has not officially been trained in the ICU but has an advanced cardiovascular life support (ACLS) certification?
- Do you have less than 1-year experience providing care to a patient requiring invasive mechanical ventilation?

If you answered YES to both of these questions, you may be eligible to participate in simulation research.

The anticipation of this project is that step-down nurse cross-training to the ICU become more confident and knowledgeable in providing care for patients requiring invasive mechanical ventilation. Other benefits include potential professional growth and will promote nursing guided research.

Time commitment:

- You will not have to come in on our days off! All parts of the research will be completed during your scheduled work hours.
- It will take an estimated 65-70 minutes to be part of this research entirely and will be held over two days, no more than 35 minutes at a time. A brief 15-minute survey would be requested one-month later.

This research is being conducted at the [redacted] on the 5th floor in the ICU

Please call Samantha Ruszkowski [redacted] for more information

Page 1, Verison #1 4/20/19

Rutgers, The State University of New Jersey

[redacted]

Appendix F

CONSENT TO TAKE PART IN A RESEARCH STUDY

TITLE OF STUDY: Mechanical Ventilation Simulation for Cross-Training Step-Down Nurses to the Surgical ICU: A Quality Improvement Study

Principal Investigator: Samantha Ruszkowski, BSN, RN, ONC

STUDY SUMMARY: This consent form is part of an informed consent process for a research study and it will provide information that will help you decide whether you want to take part in this study. It is your choice to take part or not. The purpose of the research is to establish a simulation program for the use of cross-training step-down nurses to the surgical ICU to provide care for patients requiring mechanical ventilation. If you take part in the research, you will be asked to fill out a demographic questionnaire and a self-assessment on satisfaction and confidence in learning, in addition to a knowledge assessment of mechanical ventilation and then participate in simulated scenarios. After the simulation you will be asked to complete post-intervention surveys. Your time in the study will take approximately 65-70 minutes. A one-month follow-up survey is requested that will take no more than fifteen minutes. Possible harm or burden of taking part in the study may be feelings of anxiety while learning new material or responding to surveys and the possible benefit of taking part may be gaining confidence in caring for patients who are invasively mechanically ventilated. Your alternative to taking part in the research study is not to take part in it.

The information in this consent form will provide more details about the research study and what will be asked of you if you choose to take part in it. If you have any questions now or during the study, if you choose to take part, you should feel free to ask them and should expect to be given answers you completely understand. After all of your questions have been answered and you wish to take part in the research study, you will be asked to sign this consent form. You are not giving up any of your legal rights by agreeing to take part in this research or by signing this consent form.

Who is conducting this research study?

Samantha Ruszkowski, BSN, RN, ONC is the Principal Investigator of this research study. A Principal Investigator has the overall responsibility for the conduct of the research. However, there are often other individuals who are part of the research team.

Samantha Ruszkowski, BSN, RN, ONC may be reached at [redacted]

[redacted]

The Principal investigator or another member of the study team will also be asked to sign this informed consent. You will be given a copy of the signed consent form to keep.

Why is this study being done?

The purpose of the research is to establish a simulation program for the use of cross-training step-down nurses to the surgical ICU to provide care for patients requiring mechanical ventilation.

Who may take part in this study and who may not?

The sample will be determined using inclusion and exclusion criteria. Inclusion criteria will include nurses who work full time, have an active state nursing license, advanced cardiovascular life support (ACLS) certification, have zero to minimal (1 year) experience with mechanical ventilation, and are currently working in the step-down unit. Exclusion criteria will include nurses who have been working in the institution's surgical ICU for > 1-year, advanced practice nurses, nurses who are not hired to the step-down unit, and nurses who wish to not participate. There will be no limit for the number of candidates in each demographic category and will only be used for characteristics of the population.

Why have I been asked to take part in this study?

You have been invited to take part in the study to evaluate if using simulation to cross-train step-down nurses to the surgical ICU increases confidence in providing care for invasively mechanically ventilated patients.

How long will the study take and how many subjects will take part?

Because this is a project on step-down nurses' confidence in providing care for patients requiring mechanical ventilation in the surgical ICU, the study will be limited to how many participants can join. The study will begin by taking five minutes to complete the demographic questionnaire. Next, it will take five minutes to complete the pre-surveys on confidence and knowledge. These will be done on a separate day before the start of the project. After all surveys and questionnaires are returned, participants will be given fifteen minutes for the project's introductory objectives, twenty minutes to participate in the simulation and five minutes to complete the post-intervention surveys. In two months, the participants will be asked to take a post-post intervention survey that will be no more than fifteen minutes, totaling an anticipated 65-70 minutes of the participant's time. The length of time that this project will last overall is approximately three months.

What will I be asked to do if I take part in this study?

First, you will fill out a questionnaire on demographics and a survey on learner satisfaction on simulation, confidence in providing care to invasively mechanically ventilated patients, and knowledge in the evidence-based essentials of nursing care for ventilated patients. Once the pre-assessments are completed, you will be assigned an hour during your regular work week to participate in a fifteen-minute session regarding learning objectives followed by a few simulated experiences. At the completion of the simulation, you will complete post-intervention surveys and project evaluation. It is asked that you complete a two-month follow-up survey that will take no more than fifteen minutes.

What are the risks and/or discomforts I might experience if I take part in this study?

The risks to participate in this study are minimal but include potential feelings of anxiety with individual performance in simulation. All responses from the pre and post surveys will not have identifiable information and will be kept confidential.

Are there any benefits to me if I choose to take part in this study?

The benefits of taking part in this study may be an increase in confidence and knowledge when providing care to a patient requiring invasive mechanical ventilation. However, it is possible that you may not receive any direct benefit from taking part in this study.

What are my alternatives if I do not want to take part in this study?

There are no alternatives available. Your alternative is not to take part in this study.

How will I know if new information is learned that may affect whether I am willing to stay in the study?

During the course of the study, you will be updated about any new information that may affect whether you are willing to continue taking part in the study. If new information is learned that may affect you after the study or your follow-up is completed, you will be contacted.

Will I receive the results of the research?

You will not receive individual results from this study but the results will be disseminated through unit huddles, staff meetings and possibly nurse competency days.

Will there be any cost to me to take part in this study?

There will be no cost to participate in this study.

Will I be paid to take part in this study?

You will not be paid to take part in this study.

Who might benefit financially from this research?

There is a chance the hospital may benefit financially by retaining nurses.

How will information about me be kept private or confidential?

All efforts will be made to keep your personal information in your research record confidential, but total confidentiality cannot be guaranteed. Participants will be provided with a randomized ID number by the co-investigator to use on the demographic questionnaire and pre and post surveys; no individual demographics will be discussed in the results. Only the co-investigator and project team member will have access to the list with participant's names linking the project to the participants and will stay in a locked cabinet in the project team member's office. Once all data has been coded, all data will be de-identified. Upon the completion of the project, closure of the IRB, and final writing of the manuscript, all data will be destroyed in accordance with Rutgers University guidelines.

What will happen if I do not wish to take part in the study or if I later decide not to stay in the study?

It is your choice whether to take part in the research. You may choose to take part, not to take part or you may change your mind and withdraw from the study at any time.

If you do not want to enter the study or decide to stop taking part, your relationship with the nurses will not change, and you may do so without penalty and without loss of benefits to which you are otherwise entitled.

You may also withdraw your consent for the use of data already collected about you, but you must do this in writing to:

Samantha Ruszkowski, BSN, RN, ONC

[redacted]

Who can I call if I have questions?

If you have questions about taking part in this study or if you feel you may have suffered a research-related injury, you can call the primary investigator:

Samantha Ruszkowski, [redacted], 5th floor Step-Down Unit, [redacted]

If you have questions about your rights as a research subject, you can call the IRB Director at:

Newark HealthSci (973)-972-3608 or the Rutgers Human Subjects Protection Program at (973) 972-1149.

Appendix G

Demographic Data

Instructions:

- Please complete the demographic data prior to completing the simulated experience
- This information is required for data analysis and is strictly confidential. For those reasons please fill in this questionnaire without your name
- If you do not feel comfortable answering a question or do not wish to provide a response, you do not have an obligation to do so
- Thank you for your participation in this project!

A) What is your age?

1. 21-25 2. 26-30 3. 31-35 4. 36+

B) What is the gender you associate it?

1. Male 2. Female 3. Other __________

C) How many years have you been a registered nurse?

1. 1-2 years 2. 3-5 years 3. 5-6 years 4. 6 years +

D) How many years have you been employed as an RN in the step-down unit?

1. 1-2 years 2. 3-5 years 3. 5-6 years 4. 6 years +

E) What is your highest degree?

1. Associates 2. Bachelors 3. Masters 4. Doctoral

F) Do you have any experience with simulation?

1. Yes, watched 2. Yes, partook 3. No

Appendix H

Pre-Survey: Student Satisfaction and Self-Confidence in Learning

Instructions: This questionnaire is a series of statements about your personal attitudes about the instruction you receive during your simulation activity. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the instruction you need. There are no right or wrong answers. You will probably agree with some of the statements and disagree with others. Please indicate your own personal feelings about each statement below by marking the numbers that best describe your attitude or beliefs. Please be truthful and describe your attitude as it really is, not what you would like for it to be. This is anonymous with the results being compiled as a group, not individually.

Mark:
1 = STRONGLY DISAGREE with the statement
2 = DISAGREE with the statement
3 = UNDECIDED - you neither agree or disagree with the statement
4 = AGREE with the statement
5 = STRONGLY AGREE with the statement

Satisfaction with Current Learning	**SD**	**D**	**UN**	**A**	**SA**
1 The teaching methods currently used for caring for mechanically ventilated patients are helpful and effective.	O 1	O 2	O 3	O 4	O 5
2. Simulation might help me with a variety of learning materials and activities to promote my learning with caring for a mechanically ventilated patient.	O 1	O 2	O 3	O 4	O 5
3. I might enjoy how primary investigator will run the simulation.	O 1	O 2	O 3	O 4	O 5
4. The teaching materials to be used during simulation might motivate and helped me to learn.	O 1	O 2	O 3	O 4	O 5
5. The way the primary investigator will run the simulation might be suitable to the way I learn.	O 1	O 2	O 3	O 4	O 5
Self – confidence in Learning	**SD**	**D**	**UN**	**A**	**SA**
6. I am confident that I am currently mastering caring for mechanically ventilated patients.	O 1	O 2	O 3	O 4	O 5
7. I am confident that the simulation will cover critical content necessary for the mastery of caring for a mechanically ventilated patient.	O 1	O 2	O 3	O 4	O 5
8. I am confident that I am currently developing the skills and obtaining the required knowledge in order to perform necessary tasks when caring for a mechanically ventilated patient.	O 1	O 2	O 3	O 4	O 5

9. The primary investigator will use helpful resources to run the simulation.	O 1	O 2	O 3	O 4	O 5
10. It is my responsibility as the learner to absorb what I need to know from this simulation activity.	O 1	O 2	O 3	O 4	O 5
11. I know how to use simulation activities to learn critical aspects of the skills required for care of a mechanically ventilated patient.	O 1	O 2	O 3	O 4	O 5
12. I know how to get help when I do not understand the concepts for caring for mechanically ventilated patients.	O 1	O 2	O 3	O 4	O 5

(National League of Nursing, 2004; modified).

Appendix I

Knowledge Assessment of Invasive Mechanical Ventilation

1. While caring for a patient receiving mechanical ventilation, the critical care nurse notices that the patient suddenly becomes hypoxic and the ventilator begins to alarm. The nurse is unable to identify quickly why the ventilator is alarming. Which of the following is the priority action for the nurse to take to prevent further complications?
   a. Press the "Alarm Silence" button on the ventilator and continue troubleshooting
   b. Administer 100% oxygen via the ventilator
   c. Detach the patient from the ventilator and deliver manual ventilations
   d. Call for a respiratory therapist to evaluate the problem

2. The critical care nurse hears a ventilator alarm coming from a patient's room. The nurse sees that the screen reads low volume. Which of the following is a likely cause of a low volume ventilator alarm?
   a. The ventilator circuit has a kink in it
   b. The patient is biting down on the ET tube
   c. The ventilator circuit has become disconnected
   d. The patient has copious secretions

3. A 75-year-old male is admitted to the ICU with a diagnosis of COPD exacerbation. His respiratory status declines, and he requires endotracheal intubation and mechanical ventilation. A few minutes after the patient is intubated, he becomes tachycardic and severely hypotensive. Pulse oximetry readings also decrease significantly. Which of the following conditions must be identified?
   a. The patient is agitated and needs sedation
   b. The ventilator settings are inappropriate and need to be adjusted
   c. The patient is exhibiting signs of potential tension pneumothorax
   d. The patient is experiencing increased preload due to positive pressure ventilation

4. A patient is admitted to the ICU and is mechanically ventilated on volume control. The family is at the bedside and is curious as to what this means. Which of the following correctly explains the nature of the volume control ventilation?
   a. The ventilator prevents the patients from taking in too much volume
   b. The ventilator controls the amount of tidal volume delivered to the patient in each breath
   c. The ventilator has a set volume to deliver in a day and will stop after this volume has been administered to allow the patient to breathe on his own
   d. The patient controls the amount of tidal volume in each breath, but the ventilator controls the IPAP and EPAP

5. The ICU nurse is concerned with ventilator-associated pneumonia (VAP) and wants to learn ways to minimize the chance the patient develops it while on endotracheal ventilation. It would be necessary for her to perform all of the following except:
    a. Provide frequent mouth care and suctioning
    b. Keep HOB elevated > 45 unless contraindicated
    c. Monitor feeding-tube placement by checking residuals
    d. Use sterile technique to perform oral suctioning

6. How does Synchronized Intermittent Mandatory Ventilation (SIMV) differ from Assist Control (A/C) in relation to the patient's spontaneous breaths?
    a. A/C allows the patient to control the tidal volume of spontaneous breaths
    b. A/C is a spontaneous mode that the patient initiates every breath
    c. SIMV allows the patient to breathe at their own tidal volume between mechanical breaths
    d. SIMV is only used with spontaneously breathing patients

7. Which statement about PEEP and tidal volume are correct?
    a. PEEP recruit alveoli and increases compliance. Tidal volume is the amount of air delivered with each breath
    b. PEEP is usually set between 20 and 30 cm H2O and tidal volume is the volume of gas delivered in a single breath
    c. PEEP can increase cardiac output and venous return and tidal volume is the volume of gas delivered in a single breath
    d. PEEP can decrease lung volumes and compliance and tidal volume is the amount of oxygen delivered with each breath

8. If the monitor is alarming high peak inspiratory pressure (PIP) what intervention is NOT appropriate to address this alarm?
    a. Locate leak in ventilator system
    b. Assess breath sounds for wheezing, bronchospasm or crackles
    c. Suction airway for secretions
    d. Check tubing for excess water

9. You are receiving a ventilated patient from the OR and the provider puts in orders for the ventilator. They tell you that this setting has a predetermined tidal volume and respiratory rate that the patient is guaranteed to get each minute. Patients can initiate their own breaths; patient-initiated breaths are delivered at the full tidal volume that has been set. What setting do you expect to see the ventilator in?
    a. Assist Control Ventilation (ACV)
    b. Synchronized Intermittent Mechanical Ventilation (SIMV)
    c. Pressure Support Ventilation (PSV)
    d. Pressure Control Ventilation (PCV)

10. Which of the following is **not** an intervention for high respiratory rate alarm?
    a. Assess the need to increase sedation
    b. Assess if ventilator tubing is connected
    c. Assess for secretions and suction as needed
    d. Assesses the patient for pain and/or anxiety

True answers are reported in bold.

Appendix J

Learner's Objective

- Purpose of mechanical ventilation
- Risks associated with mechanical ventilation and how to prevent it
- How to perform a ventilator check
- Types of alarms and how to correct them
- Evaluate the effectiveness of interventions
- Emergency preparedness in the event of ventilation failure

American Association for Respiratory Care & University Health System Consortium. (2016).

Appendix K

Post Survey: Student Satisfaction and Self-Confidence in Learning

Instructions: This questionnaire is a series of statements about your personal attitudes about the instruction you receive during your simulation activity. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the instruction you need. There are no right or wrong answers. You will probably agree with some of the statements and disagree with others. Please indicate your own personal feelings about each statement below by marking the numbers that best describe your attitude or beliefs. Please be truthful and describe your attitude as it really is, not what you would like for it to be. This is anonymous with the results being compiled as a group, not individually.

Mark:
1 = STRONGLY DISAGREE with the statement
2 = DISAGREE with the statement
3 = UNDECIDED - you neither agree or disagree with the statement
4 = AGREE with the statement
5 = STRONGLY AGREE with the statement

Satisfaction with Current Learning	**SD**	**D**	**UN**	**A**	**SA**
1. The teaching methods used in this simulation were helpful and effective.	○ 1	○ 2	○ 3	○ 4	○ 5
2. The simulation provided me with a variety of learning materials and activities to promote my learning the mechanical ventilator.	○ 1	○ 2	○ 3	○ 4	○ 5
3. I enjoyed how my instructor taught the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
4. The teaching materials used in this simulation were motivating and helped me to learn.	○ 1	○ 2	○ 3	○ 4	○ 5
5. The way my instructor(s) taught the simulation was suitable to the way I learn.	○ 1	○ 2	○ 3	○ 4	○ 5
Self-confidence in Learning	**SD**	**D**	**UN**	**A**	**SA**
6. I am confident that I am mastering the content of the simulation activity that my instructors presented to me.	○ 1	○ 2	○ 3	○ 4	○ 5
7. I am confident that this simulation covered critical content necessary for the mastery of mechanical ventilation.	○ 1	○ 2	○ 3	○ 4	○ 5
8. I am confident that I am developing the skills and obtaining the required knowledge from this simulation to perform necessary tasks in a clinical setting.	○ 1	○ 2	○ 3	○ 4	○ 5
9. My instructors used helpful resources to teach the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
10. It is my responsibility as the student to learn what I need to know from this simulation activity.	○ 1	○ 2	○ 3	○ 4	○ 5
11. I know how to get help when I do not understand the concepts covered in the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5

12.I know how to use simulation activities to learn critical aspects of these skills.	○ 1	○ 2	○ 3	○ 4	○ 5
13. It is the instructor's responsibility to tell me what I need to learn about the simulation activity content during class time.	○ 1	○ 2	○ 3	○ 4	○ 5

(National League of Nursing, 2004; modified).

Appendix L

Gantt Chart of Project's Timeline

Activity	Plan/Start	Plan Duration in months	May-19	Jun-19	July-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20
Presentation of Proposal to Team	May-19	1													
IRB Submission	May-19	3													
Participant Recruitment	July-19	1													
Project Implementation (Education)	Sep-19	2													
Data Collection	Nov-19	2													
Data Analysis	Jan-20	1													
Evaluation/Writing	Feb-20	2													
Presentation of Final Project	Apr-20	1													
Graduation	May-20	1													

Appendix M

Budget

Expense	**Cost**	**Total Cost**
Recruitment Flyers	5 @.15	$0.75
Demographic Questionnaires	10 @.15	$1.50
Pre and Post Survey Papers	10@.15	$1.50
Light Refreshments	$20 x 8 sessions	$160.00
Statistician Consultation	$50/hr x 2hrs.	$100.00
Dissemination Posters	$75	$75
TOTAL BUDGET		**$338.75**

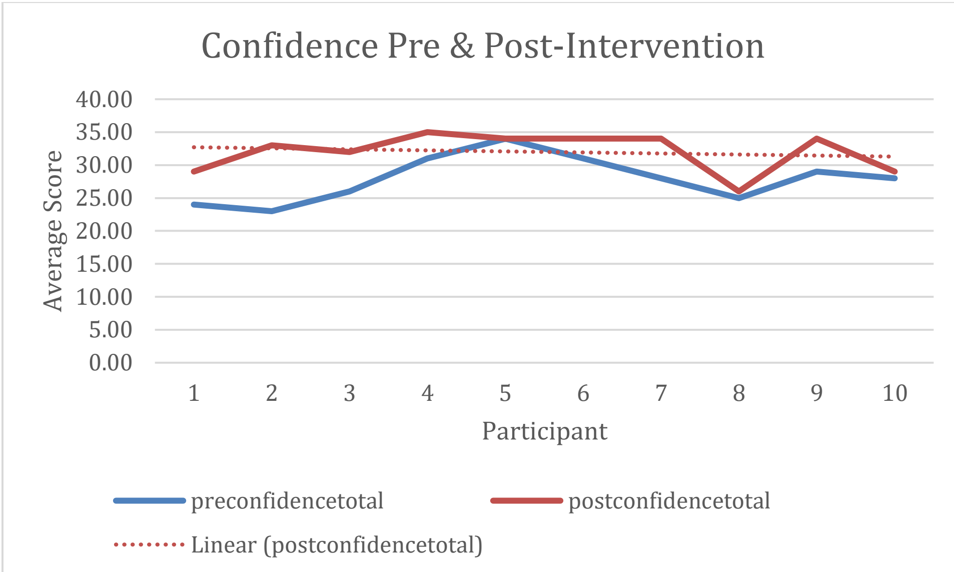
Appendix N

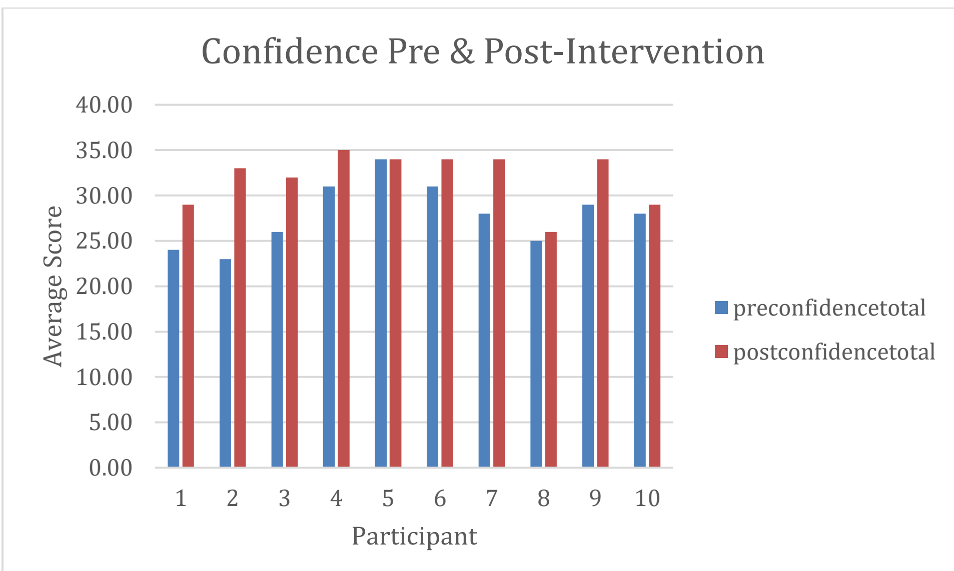
Demographic Results

Descriptive Statistics	
Factor	N
Participants	10
Age	
21-25	2
26-30	4
31-35	3
36+	1
Gender	
Male	6
Female	4
Highest Degree	
Associates	1
Bachelors	8
Masters	1
Years as RN	
1-2	1
3-5	6
5-6	1
6+	2
Step-down years	
1-2	4
3-5	6
Simulation Experience	
Yes	7
No	3

Appendix O

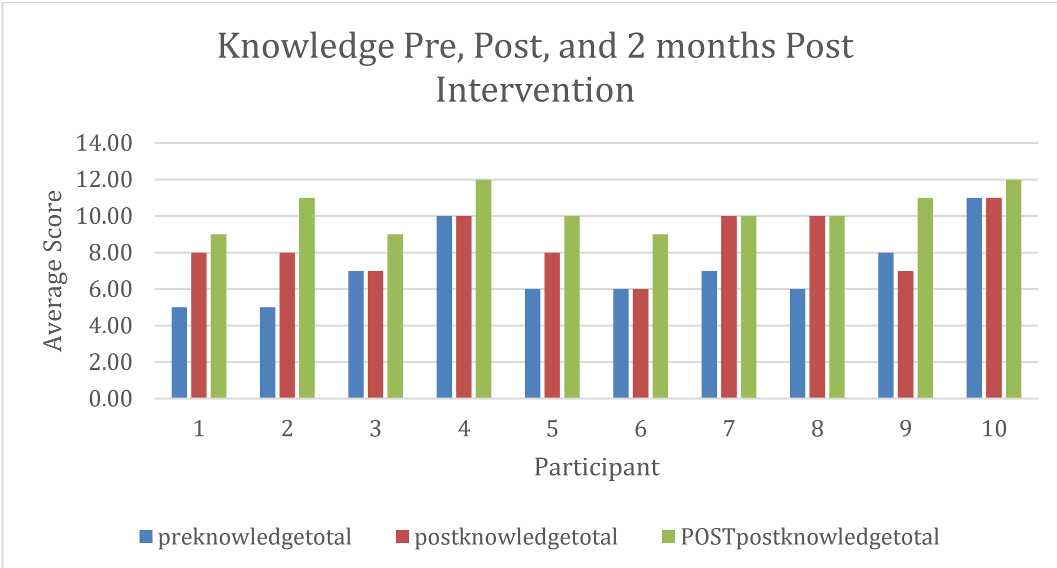
Pre- and Post-Intervention Confidence Scores

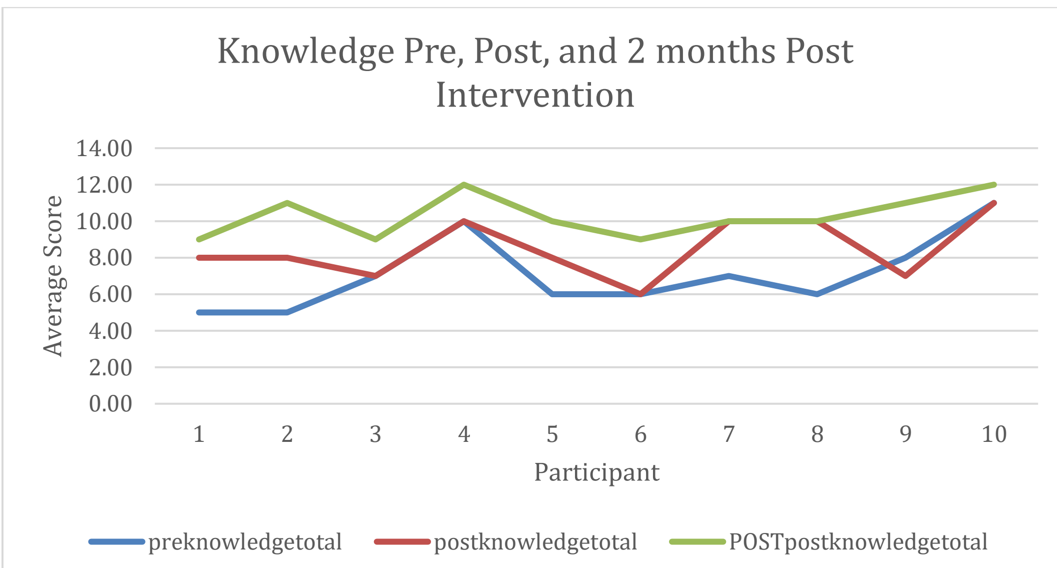




Appendix P

Pre, Post, and 2 months Post-Intervention Knowledge Scores





Appendix Q

Pre- and Post-Intervention Learner Satisfaction Scores