Increasing ICU Nurses' Knowledge About Post-Anesthesia Patient Care

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Abstract

Patients are admitted directly from the operating room to the intensive care unit (ICU). It is estimated that major complications occur in 3-17% of inpatient surgical procedures (Preston & Gregor, 2015). Therefore, it is important that ICU nurses caring for the patients directly from the operating room are knowledgeable about the standards of care expected in the immediate postoperative period, different anesthetic agents, and how to identify and manage potential complications (Kaplow, 2010). This project consisted of an educational session for ICU nurses who recover patients from anesthesia in a community hospital in central New Jersey. In addition to the educational session, participants were asked to complete a pre-test, post-test, and follow up test to assess if ICU nurses' knowledge changed as a result of the educational session.

This project yielded statistically significant results. A Friedman test was done on the data from the pretest, posttest, and follow up test to see if there was a significant change in scores. The Friedman test yielded a statistically significant result $\chi 2(2) = 15.200$, $p = 0.001$ indicating there was a significant change in scores from the pretest, posttest, and follow-up test. . Further analysis using the Wilcoxon test showed that there was a significant change in test scores for the pretest compared to the posttest ($Z = -2.805$, $p = .005$) and the pretest compared to the follow up test($Z = -2.803$, $p = .005$). These findings indicate that ICU nurses needed formal education to feel that they are providing safe and competent care to patients in the immediate post-operative period.

Keywords: anesthesia, post-operative, recovering from anesthesia, nurses, intensive care unit, critical care, anesthetics, anesthesia complications

Table of Contents

Increasing ICU Nurses' Knowledge About how to Care for the Post-Anesthesia Patient

Introduction

Often, patients are admitted directly from the operating room to the intensive care unit (ICU). A provider may make the decision to bypass the post anesthesia care unit (PACU) due to a complicated intraoperative course or provider preference. It is estimated that major complications occur in 3-17% of inpatient surgical procedures (Preston & Gregor, 2015). It is important that ICU nurses are knowledgeable about the standards of care expected in the immediate postoperative period, different anesthetic agents, and how to identify and manage potential complications when providing care to patients transferred directly from the operating room (Kaplow, 2010).

During and after anesthesia, many of the patients' life sustaining reflexes are subdued and the ICU nurse caring for these patients must ensure adequate and timely assessment to recognize any change in patient status (Odom-Forren & Drain, 2013). Nurses need to assess for airway management, reflexes, temperature, hemodynamic stability, and monitor for immediate post-operative complications including pain, nausea, and vomiting (Preston & Gregor, 2015). To ensure the best outcomes, patient safety, and nurse competency, it is crucial that ICU nurses receive the education about the post-operative patient care to ensure the same standards of care provided by nurses working in the PACU.

In a community hospital in Central New Jersey, practice changed to allow ICU nurses to recover patients directly from the operating room. Because this is a shift in practice, ICU nurses lacked knowledge about different types of anesthetics, management of the patient in the immediate postoperative period, and recognizing and responding to complications. This project

consisted of an educational intervention about care of the post-operative patient, to improve patient safety and ensure positive patient outcomes in the immediate post-operative period.

Background and Significance

The American Society of Anesthesiologists (2014) standards for post anesthesia care states that all patients who received general anesthesia should immediately go to a PACU or an area that provides the equivalent level of care. The *American Society of Anesthesiologists* recognizes that recovery from anesthesia is occurring more frequently outside of the traditional PACU setting. Throughout the Standards for Post Anesthesia Care (2014) published by the *American Society of Anesthesiologists*, it is clear that the same standards of care should be applied to recovering patients from anesthesia in both PACU and PACU equivalent locations. The standards state that a PACU equivalent location can be the Surgical Intensive Care Unit. As part of the educational session, ICU nurses were educated about caring for the patient in the immediate post-operative period.

It is considered negligence if a nurse is performing a task for which he or she does not have the knowledge or proper skillset, even if that task is within the nurse's scope of licensed practice (Brooke, 2011). The International Council of Nurses states,

> The scope of nursing practice communicates the roles, competencies, professional accountabilities and responsibilities of the nurse. It provides the foundation for establishing standards of nursing practice, nursing education, nursing roles and responsibilities and also communicates to the public the characteristics of who is qualified to provide particular nursing services. (International Council of Nurses, 2010)

A nurse must admit to their limitations and not provide care for a patient outside of their scope of practice. Failure to assess, monitor, and manage the patient appropriately can result in malpractice and negligence charges (Brooke 2011). To prevent this difficult situation, it is important to provide nurses with the knowledge and resources to care for patients emerging from anesthesia.

Needs Assessment

A needs assessment was conducted at the hospital to determine the feasibility of implementing an educational intervention about care of the post-operative patient for ICU nurses. The primary investigator (PI) reviewed the procedure for recovering a patient from anesthesia in the ICU and sought feedback from ICU staff nurses, professional development personnel, and nurse leaders of the ICU. Methods used to conduct this needs assessment included direct experience, observation, and informal interviews. Nurses in the ICU expressed a desire to have a better understanding of the care required for post-operative patients. Additionally, nurses identified that their knowledge about the pharmacology of different anesthetic agents and complications from these agents needed to be improved. Results of this needs assessment indicated that there was no formal education or guidelines regarding care of the patient in the immediate post-operative period provided to the ICU nurses. A SWOT analysis (Appendix A) base on the information gathered from interviews during the needs assessment identified the strengths, weaknesses, opportunities, and threats to this project.

Strengths. Strengths of this project included support from key stakeholders, including nurses who provide direct patient care, and nurse leaders. Additionally, this educational session required a minimal time commitment and nurses can attended while working.

Weaknesses. A major weakness identified was resistance from nurses who do not want to participate or do not feel this education is necessary. Additionally, this education was not mandatory; some nurses found it too time consuming to participate.

Opportunities. Many opportunities resulted from this project. Most importantly, there was an increase in ICU nurses' knowledge about caring for the post-operative patient. By increasing the ICU nurses' knowledge patients can receive the same care as if they were in PACU. In the future, this educational session can be provided to other ICU nurses throughout the system and as part of the orientation for new nurses.

Threats. A potential threat to the project was scheduling the educational session only one time because nurses were unwilling to attend on their day off or had prior commitments during that time. To address this threat, the educational session was offered several times in a two-week period, so all ICU nurses had the opportunity to attend.

The SWOT analysis indicated benefits of this project outweighed the risks. After discussion with the key stakeholders, including the ICU nurses caring for patients in the immediate post-operative period, personnel in the professional development department, and management of the ICU unit it was determined that an educational session for the ICU nurses was fundamental to help ensure that patients receive competent, safe, and effective care.

Problem Statement

Recently, in a community hospital in Central New Jersey practice changed to allow patients from the operating room to be recovered by ICU nurses in the ICU. Protocols or guidelines were not provided to the ICU nurses who recover these patients. A patient who

emerges from anesthesia can have complications that are different from the typical ICU patient; the ICU nurse needed to be familiar with these different complications. To address this issue, meetings consisting of staff from the ICU and surgical services attempted to develop protocols for the patient recovering from anesthesia in the ICU, but no concrete protocol was established and education was not provided to the ICU nurses expected to care for post anesthesia patients.

Aims and Objectives

The primary aim of this project was to improve ICU nurses' knowledge about recovering a patient from anesthesia, thereby ensuring that patients who are recovered from anesthesia in a community hospital ICU receive safe, effective, and competent care. Objectives to accomplish this aim included:

- Identifying the current gaps in knowledge of ICU nurses caring for the postoperative patient.
- Developing an educational session about the care of the patient in the immediate postoperative period.
- Implementing this educational session.
- Evaluating the change in nurses' knowledge as a result of the educational session by the change in results of a pre-test, posttest, and a test one month after the intervention.

Clinical Question

This project answered the question, "Among nurses in a community hospital in Central New Jersey (P), does an educational session (I) increase nurses' knowledge of different

anesthetics, post-operative complications, and the care of the post-operative patient (C) compared to the current standard of no formal education (O)?"

Review of Literature

A literature search of the databases CINAHL, OVID, MEDLINE, PubMed, Joanna Briggs, and Google Scholar determined that there was no research conducted about critical care nurses in the ICU recovering patients from anesthesia. As a result of this lack of research about anesthesia recovery by critical care nurses, the search was expanded to include anesthetic agents and their potential side effects, common complications as a result of anesthesia, guidelines about caring for the patient in the immediate post-operative period, and nurses recovering patients from anesthesia.

Using the expanded parameters, CINAHL, OVID, MEDLINE, PubMed, and Joanna Briggs databases were searched again with combinations of the key words *perioperative nursing,* or *postoperative nursing,* or *postoperative nursing care.* To limit the results, the keywords *post anesthetic, anesthesia, anesthesia recovery period, recovery room, post anesthesia care unit, standards of care, complications,* and *education* were applied. The search was limited to studies about the adult population only; neonatal and pediatric studies were excluded. This search yielded 50 results, however none of these met the search criteria. Initially, the search was limited to publication dates from 2014 – 2019, however, because this time period did not return pertinent results the range was expanded to 2000 - 2019. This search yielded 72 results. The filter "Full Text," "English," and "Available Online" were applied. No studies were found that specifically discussed recovering a patient from anesthesia in the ICU. A description of the studies used for this project can be found in the evidence table (Appendix B). The Prismflow diagram for this search method can be found in Appendix C.

Types of Anesthesia

General anesthesia is the state of reversible unconsciousness. When a patient receives general anesthesia, protective reflexes are partially or completely lost and the patient is in a state of amnesia. In this state, intubation with assisted ventilation is necessary because the patient will not maintain their breathe on their own and interventions need to take place to ensure the patient has a patent airway. Additionally, the patient receiving general anesthesia is at risk for cardiovascular side effects including arrhythmia and hypotension.

Inhalational agents are widely used during the induction of anesthesia and during the maintenance phase of anesthesia and can have effects on the entire body but particularly the respiratory system, central nervous system, and cardiovascular system (Temple & Wiles, 2019). Common inhaled anesthetic agents include isoflurane, sevoflurane, and desflurane. Inhaled anesthetics are administered through the endotracheal tube and enter systemic circulation by crossing over the alveolar-capillary membrane. Inhaled anesthetics are central nervous system depressants. A nurse caring for the patient receiving general anesthesia should anticipate depressed reflexes, depressed respiratory drive, increased carbon dioxide production, and loss of the ability to respond to increased carbon dioxide levels decreased in blood pressure, decrease in myocardial contractility, depression of cerebral activity, decrease in gastric motility, and muscle relaxation (Khan, Hayes, & Buggy, 2014b).

Intravenous anesthetics are drugs administered directly into the intravascular system to produce anesthesia. Intravenous anesthetics work by crossing the blood brain barrier to lead produce a state of anesthesia. Common intravenous anesthetics include propofol, ketamine, and etomidate. Each of these drugs have very different effects on heart rate, contractility, systemic vascular resistance, mean arterial pressure, and changes in respiratory drive. Propofol has

minimal effect on heart rate, and decreases contractility, systemic vascular resistance, mean arterial pressure and respiratory drive. Ketamine increases heart rate, contractility, systemic vascular resistance, mean arterial pressure and causes bronchodilatation. Etomidate had no effect on hear rate and contractility, and minimal effect on systemic vascular resistance, mean arterial pressure, and respiratory drive (Khan et al., 2014a).

Complications from Anesthesia

The nurse recovering a patient from anesthesia needs to be knowledgeable about the different complications of anesthesia in order to readily identify and promptly treat any change in the patient's condition. Educating nurses about common complications from anesthesia may help nurses avert a detrimental complication.

Hypothermia. Burns, Piotrowski, Caraffa, & Wojnakowski (2010) found the incidence of postoperative hypothermia (defined as a core temperature less than 35° Celsius) was only 4% in a convince sample of 287 adult patients. Previous research studies found the incidence of postoperative hypothermia to be as high as 50% - 90%. The decrease in the incidence of postoperative hypothermia was attributed to heightened awareness of this complication by the perianesthesia team and new technologies such warming devices (Burns, Piotrowski, Caraffa, & Wojnakowski, 2010).

The researchers were unable to determine a correlation between use of cold solutions, non-humidified and non-heated anesthetic gases, type of surgery, type of anesthesia, length of anesthesia, preoperative core body temperature, patient age, and ambient operating room temperatures an post-operative hypothermia (Burns, Piotrowski, Caraffa, & Wojnakowski, 2010). A larger, more diverse sample is needed to determine if there is an actual decrease in the incidence of postoperative hypothermia (Burns, Piotrowski, Caraffa, & Wojnakowski, 2010).

Delayed Awakening. It is important for ICU nurses caring for this post anesthesia population to recognize when anesthesia lasts longer than expected, known as delayed recovery (Misal, Joshi, & Shaikh, 2016). The duration of anesthesia is a factor in delayed awakening; patients receiving anesthesia for a long period of time often take longer to wake up (Misal, Joshi, & Shaikh, 2016). Age increases sensitivity to analgesic and anesthetic agents. As people age there is a decreased distribution and clearance of medications, which leads to a higher free plasma concentration of medications (Misal, Joshi, & Shaikh, 2016).

Nurses must consider drug-drug interactions when there is a delayed recovery. Medications that patients receive prior to anesthesia, particularly opioids and benzodiazepines, may potentiate the effects of anesthesia. Comorbidities such as cardiac disease, respiratory disease, liver, and kidney disease affect how quickly a drug is distributed and eliminated from the body.

Respiratory and airway complications. Decreased oxygenation and respiratory complications in the postoperative period are common, even in healthy adults. Pulmonary atelectasis occurs in 85%-90% of healthy adults who undergo anesthesia (Karcz & Papadakos, 2013). Atelectasis and hypoventilation are often caused by anesthesia and analgesic medications can lead to hypoxemia. Surgical factors that can lead to respiratory complications include type, duration, emergency of, and anatomical location of surgery. Patient factors, such as obesity, age, sex, and comorbidities can contribute to respiratory complications. Anesthesia factors, such as the use of opioids and neuromuscular blocking agents during general anesthesia can cause respiratory complications (Karcz & Papadakos, 2013).

Peskett (1999) conducted a retrospective review to identify the most common respiratory complications from anesthesia such as arterial desaturation, airway obstruction, upper

airway complications (stridor, obstruction, laryngospasm), hypoventilation, bronchospasm, pulmonary edema, coughing, pneumothorax, and aspiration. In a sample of 13,266 postoperative patients, respiratory complications occurred in 1.5% of patients, or approximately 200 patients (Peskett, 1999). The most common respiratory complications were desaturation (0.8%), airway obstruction (0.6%), and hypoventilation and bronchospasm (0.3%) (Peskett, 1999).

Recognizing symptoms of hypoxemia early can lead to prompt intervention and can prevent serious complications such as reintubation. A retrospective review of PACU incident reports over a 2-year period, 701 critical incidents were identified (Bruins, Leong, & Ng, 2017). Of these 701 incidents, 22.1% were respiratory related and 4.9% were airway related. Of all the respiratory incidents, 66.5% of patients had complications from hypoxia. Reintubation was required in 0.05% of PACU (Bruins et al., 2017).

Risk factors for reintubation in the PACU include chronic pulmonary disease, preoperative hypoalbuminemia and renal insufficiency, head and neck surgery, cardiac catheterization, emergency surgery, duration of case longer than three hours, and use of certain neuromuscular blocking agents increased the risk of reintubation in PACU (Rujirojindakul et al., 2012). Surgery on the airway can cause airway edema and those patients who had surgery on their airway accounted for 18.9% of reintubations (Odds Ratio 32.2, CI 13.6 - 76.1) (Rujirojindakul et al., 2012). Cardiothoracic surgery disturbs the cardiopulmonary system potentially leading to reintubation because of impaired respiratory muscle capacity and airway protection leading to cardiac dysfunction (Odds Ratio 6.26, CI 1.85 - 21.2) (Rujirojindakul et al., 2012). Patients with renal failure (Odds ratio 4.08, CI 1.24 - 13.4) and hypoalbuminemia (Odds Ratio 4.86, CI 2.36 - 10.0) have difficulty metabolizing and eliminating anesthetic agents; these patients may continue to have effects from the anesthesia and require reintubation for airway

protection, hypoventilation, and decreased level of consciousness (Rujirojindakul et al., 2012). The data about risk for reintubation was collected over ten years in order to get an adequate sample. Education, skills, and practice guidelines can change drastically over a ten-year period (Rujirojindakul et al., 2012). Therefore, patients who may have needed to be reintubated ten years ago may have other interventions available today. A multisite study with an adequate sample size over a shorter amount of time may yield different results.

Delirium. Delirium can be a sign of hypoxia but can also occur with emergence from general anesthesia (Card et al., 2015). A prospective observational study of 400 participants determined the number of patients affected by delirium (defined as inattention, restlessness, agitation, fluctuating mental status, and lethargy) as they emerge from anesthesia. The Confusion Assessment Method for Intensive Care Unit (CAM-ICU) was used to assess the patients immediately on arrival to PACU, 30 minutes later, 1 hour later, and at discharge from PACU. The CAM-ICU is a delirium screening tool that identifies if delirium is present of absent. The patient is screened for fluctuation in mental status, inattention, altered level of consciousness, and disorganized thinking. Delirium is present when there is a fluctuation in mental status, inattentions, and either alerted level of consciousness or disorganized thinking. The study concluded that agitated emergence was present in 75 (19%) of patients, of these 75 patients, 45 (60%) were also CAM-ICU positive at PACU arrival, with 25 (33%), 12 (16%), and six (8%) continuing to be CAM-ICU positive at 30 min, at 1 hour, and at PACU discharge respectively (Card et al., 2015).

The most common form of delirium observed was hypoactive delirium, accounting for 56% of the patients at PACU admission and 92% of the patients during their PACU stay (Card et al., 2015). In this study, multivariable regression analysis indicated that perioperative opioid

administration and duration of anesthetic were independently associated with delirium signs during PACU stay (P = 0.02); (p <0.001). However, age and benzodiazepine use before surgery did not have a significant association with delirium in the post-operative phase (Card et al., 2015).

Cardiovascular complications. A three-year retrospective review of 13,266 cases found that cardiovascular complications were identified as the leading cause of complications in patients in the immediate postoperative period (Peskett, 1999). Cardiovascular complications including hypotension, hypertension, bradycardia, tachycardia, and cardiac arrhythmia occurred in 2.5% of the cases. Hypotension occurred in 1.2% of all cases, hypertension occurred in 0.6% of all patients, bradycardia occurred in 0.4% of all patients, arrhythmia occurred in 0.14% of all patients, and tachycardia occurred in 0.13% of all patients (Peskett, 1999). This study occurred nearly twenty years ago; technology, education, and standards of care have changed and improved which may affect the incidence of these cardiovascular side effects.

Malignant hyperthermia. Malignant hyperthermia, triggered by drugs and gasses that induce anesthesia, is a genetically inherited condition that many patients do not know they possess (Long & Ross, 2017). Interestingly, 51% of patients who had malignant hyperthermia had at least 2 previous encounters with anesthesia with no adverse effects (Larach, Gronert, Allen, Brandom, & Lehman, 2010). Malignant hyperthermia causes skeletal muscle to contract and leads to a hypermetabolic state, which may result in a cascade of events that lead to end organ damage and can result in death of the patient if this condition goes unrecognized (Long & Ross, 2017). Malignant hyperthermia can present very similar to respiratory and cardiovascular such as increased carbon dioxide levels, tachycardia, tachypnea and acidosis (Larach et al., 2010). In one study, death resulted in 34.8% of patients who were diagnosed with malignant

hyperthermia; the most common presenting symptoms were hypercarbia, sinus tachycardia, or masseter spasm with an increase in temperature being a later sign (Larach et al., 2010). The recommended antidote for malignant hyperthermia is 2.5mg/kg of Dantrolene every five minutes until symptoms are reversed (Long & Ross, 2017). In addition, active cooling measures are required (Long & Ross, 2017).

Caring for the Post-operative Patient

There are few research articles that evaluate how to care for the post-operative patient. A systematic review about postoperative recovery protocols found that that there was lack of research on this topic, particularly research conducted by nurses (Oliveira, Peniche, Costa, & Poveda, 2017). The research found only 13 articles about caring for the postoperative patient. These articles were primarily authored by physicians and lacked input from nurses. This demonstrates that more research needs to be done about caring for the postoperative patient, particularly by nurses.

The Perianesthesia Nursing Standards, Practice Recommendations and Interpretive Statements (2019) has no definitive statement regarding the standard of patient monitoring. However, it suggested that vital sign assessment occur at least every fifteen minutes or more often as the patient condition warrants. Vital sign assessment should include assessment of the airway, blood pressure, pulse, cardiac monitor, temperature, pain, sedation level, skin assessment, dressing or incision assessment, neurologic function, and other hemodynamic monitoring that may be necessary for that patient. More research is needed in this area to ensure a consistent standard of monitoring patients as they emerge from anesthesia.

Didactic Teaching for PACU Training

Classroom education gives participants the opportunity to ask questions and seek clarification (Elliotte, 2009). Georgetown University Hospital created a perianesthesia orientation program that consisted of twenty-two hours of classroom instruction. Topics covered in the classroom sessions included information about the American Society of Perianesthesia Nurses (ASPAN) standards, physical assessment of the PACU patient, pre-anesthesia pharmacology, airway management, pain and comfort measures, fluid management, and resuscitation (Elliotte, 2009).

Online education, while convenient, often does not give the learner the opportunity to ask questions or clarify topics, which is a disadvantage to the participant. The developers of Georgetown University Hospital's paranesthesia orientation program also had participants complete sixty-nine hours of online learning, known as the *Essentials of Critical Care Nursing Orientation Program*. Although the developers felt that the online program would be more convenient for the participants because they could complete the program at their own pace and at their convenience, feedback from the participants of the online program resulted in supplementing the online classes with additional in-person classroom sessions that reviewed hospital policies and discussed case studies (Elliotte, 2009).

More research is needed regarding care of the post-anesthesia patient and to determine the risks or benefits of recovering a patient in the ICU instead of the traditional PACU setting. There is a limited number of research studies about this topic and many are more than five years old. The lack of recent research is limitation of this project. Additionally, there were no research studies found that discussed recovering a patient from anesthesia in the ICU. More research is needed to determine the risks or benefits of recovering a patient in the ICU instead of the traditional PACU setting.

Theoretical Framework

The theoretical framework for this project is *Plan – Do – Study – Act* (PDSA). This four-stage cycle is used to foster change that leads to solutions to a problem and has been used frequently in healthcare to improve quality and safety (Taylor et al., 2013). In the *Plan* stage the investigator identifies the problem needs to be improved or made more efficient. Then, the investigator formulates a plan to improve the problem. In the *Do* phase, the investigator executes the plan and data is collected. As part of the *Study* phase, data is analyzed and results are interpreted and summarized. The investigator can now determine if the original plan needs to be changed or if their desired outcome, resolution of the problem, was met. During the *Act* phase, the investigator can make changes to their original plan, chose to adopt the plan, or completely abandon the plan. The cycle would then start all over incorporating any changes that were made (Taylor, et al., 2013).

The PDSA framework was used to implement an educational program for ICU nurses about different anesthetics, common complications from anesthesia, and guidelines to recovering a patient from anesthesia (Appendix B). As part of the *Plan* phase, the investigator identified the problem: ICU nurses were receiving patients directly from the operating room without formal education about how to care for these patients as they emerge from anesthesia and potential complications from different anesthetic agents. The investigator gathered information on these topics, assembled the educational program, and created a pre, post, and follow up test. In the *Do* phase the investigator conducted the educational program for the ICU nurses and had those nurses who participated in the program complete a pre- and post-test. One month after the educational session participants were asked to complete a follow up test. In the *Study* phase the investigator analyzed the differences in scores from the pre, post, and follow up tests and

evaluated if the educational program was effective. Feedback from the staff was gathered and questions were asked such as "Did this educational program meet your learning needs?," "Was this educational program easy to follow?," and "Did the educational program improve your knowledge on how to care for the patient immediately out of anesthesia?". In the *Act* phase, the results of the project were shared with key stakeholders and the feedback from participants will be addressed.

Methodology

This project was a one group pre-test and a post-test interventional design using a convenience sample. The post-tests were conducted at two points in time. This intervention consisted of a one-hour classroom session about care of the post-operative patient for ICU nurses. At the start of the educational session, participants were asked to review information sheet for participation and take a 10-question pre-test on care of the post-operative patient. The didactic educational session was presented by the primary investigator and lasted approximately 50 minutes; a copy of the PowerPoint slides that coordinated with the presentation were provided for the participants. At the conclusion of the classroom session, participants were asked to take a post-test with the same 10 questions as the pre-test. In addition, participants were asked to complete an evaluation survey of the educational session. One month after the classroom session, participants took the 10-question test again to determine if the information in the educational session was retained. Increases in knowledge were assessed by comparing the mean score of the pre-test, post-test, and one month follow up test.

Setting

This setting for this project was a 14 bed ICU of a community hospital in a suburban town in Central New Jersey. It was a mixed ICU, caring for surgical, medical, and cardiac

patients. The ICU was equipped with a classroom that has a projector and screen for the PowerPoint presentation.

Study Population

The convenience sample was drawn from critical care nurses who cared for the post-operative patient, the sample included full-time, part-time, per diem, and agency nurses who worked in the ICU of the community hospital. There were 26 staff nurses who work in this ICU at the time the educational session took place. All of the ICU nurses were ACLS and BLS certified, approximately 70% had a bachelor's degrees, 30% had an associates degree, and 84% were nationally certified. The goal was to achieve a sample size of 20 ICU staff nurses who participated in the project, which was 85% of the total population. Inclusion criteria for this project was limited to staff that provided direct patient care to patients recovering from anesthesia in the ICU. Staff nurses who did not work in in the ICU or registered nurses who were not critical care nurses were excluded from participation.

Subject Recruitment

Once IRB approval was obtained, project participants were recruited by flyers posted in the ICU staff lounge, the ICU staff locker room, and the ICU bulletin board. The flyers (Appendix D) included the topic of the educational session, location, and the various dates and times of the educational session.

Consent Procedure

The site did not require written consent for participation in this project. Participants were asked to read the information sheet for participation in research, which was the hospital's suggested IRB template customized to fit the objective of this project (Appendix E). Participants were able to keep a copy of the information sheet for participation in research. Participants were

given the opportunity to ask questions about the study, the information collected, how it was stored, and what was done with the data. Participants were able to leave the educational session at any time.

Risks/Harms

The risks to participants in this project were minimal. No personal or identifying information was collected from participants. Minimal anxiety could have been experienced when learning new material, but it is insignificant. Participants had the opportunity to gain new knowledge, but this could not be guaranteed.

The project proposal was presented at the sites nursing research council for approval. After the nursing research council approved of the project, the project was submitted to the site's IRB with all required documents for an expedited review. After approval from the site's IRB, the project was submitted to Rutgers IRB for an administrative review. After IRB approvals from both organizations were obtained, the educational session was scheduled.

Subject Costs and Compensation

There were no costs to participants for attending this educational session. During the educational session, light refreshments were served. The participants were given a copy of the power point slides to keep.

Study Intervention

This education session was developed by the primary investigator. The nurse manager and educator of the ICU were given the opportunity to provide input. The education was a didactic classroom session with a PowerPoint presentation. The educational session lasted approximately 50 minutes and include the following information:

1. Overview of the different anesthetic agents used during surgery and their basic pharmacologic properties
2. Common complications in the immediate post-operative period
3. Guidelines for caring for the patient in the immediate post-operative period

There was an opportunity for participants to ask questions at the end of the presentation. Multiple sessions were provided over a two-week period at varying times of day in order to ensure as many as possible of the 25 potential participants attended a session.

At the start of the educational session the participants were asked to read the informed consent. Next, the pre-test (Appendix I) was administered, approximately five minutes was allotted for participants to complete the 10-question test. The test was returned to the primary investigator before the educational session began.

Outcomes Measured

This project measured changes in the dependent variable, knowledge, as result of the independent variable, the educational session. The 10-question knowledge test (Appendix I) was be created by the primary investigator. Participants were asked to complete the test and return it to the primary investigator without writing any personal identifiers on it. The average total score of the pre-test, post-test, and follow up test was calculated. These averages were compared and analyzed to assess the effectiveness of the educational session.

Project Timeline

From January 2019 to April 2019 the primary investigator developed the project proposal and created the educational module. In April 2019 the primary investigators presented to site's Nursing Research Council and approval was obtained. The Primary Investigator applied to site's IRB in July 2019 and the site's IRB approval was obtained. The Primary Investigator applied to

Rutgers IRB in August 2019 and approval was obtained in November 2019. Flyers with the dates and times of the educational sessions was posted in November 2019. In December 2019 the educational sessions occurred and data collection and analysis from the pre and post-tests began. In January 2020 the one month follow up tests were distributed and data collection from the follow up tests began. In January 2020 data analysis occurred and compared the results of the pre-test, post-test, and one month follow up test. From January 2020 to February 2020 the final write-up will occurred. In April 2020 the primary investigator presented the final project and disseminated the of results to the site, committee, and professional organizations. See Appendix E for GANTT chart of project timeline.

Resources Needed

All costs associated with this project were the sole responsibility of the primary investigator. Costs included materials for recruitment flyers, educational handouts, and refreshments provided during the educational session. The site provided the classroom where the educational session occurred, which is equipped with a projector and large screen to display the PowerPoint presentation. Data collection and analysis occurred during the primary investigator's personal time and using the personal computer. The budget is located in Appendix G. The primary investigator had the flyers, surveys, consents, and handouts printed at local print shop 13¢ a page. The primary investigator also provided light refreshments for each session and budget about $15 per session. The total cost estimated for this project is $245.

Evaluation Plan

Participants were asked to complete a short survey at the completion of the educational session (Appendix F). The survey consisted of five questions on a Likert scale ranging from "not satisfied" to "very satisfied". The feedback received from the survey was used to tweak the

educational session to better meet the needs of the participants. These questions were made to give participants the opportunity to provide feedback on the quality of the education session and the information provided in the educational session. The survey was created to gauge if the ICU nurses report feeling more knowledge about caring for the post-operative patient, which is the problem being addressed by this project.

Data Analysis, Maintenance & Security

No personal identifying information was collected. Results are reported in the aggregate. The total score of each test was calculated, each correct question equaled ten points for a total score between 0 and 100. This total score was entered into an Excel spread sheet as ordinal data.

Descriptive statistics were used to analyze the results of this project. The mean of the pre-test, post-test, and follow up test were calculated as well as the standard deviation for each test. For each question, the PI calculated the percentage of participants that answered that question correctly in order to compare how the results of each question changed from the pre-test, post-test, and follow up test. A Friedman test was used to determine if there was a significant change in scores from the pretest, posttest, and follow up test. Finally, a Wilcoxon test was used to see if the change in scores from the pretest to the post test, the pretest to follow up test, and posttest to the follow up test were significant.

No personal identifying data was collected. The tests were collected by the PI and stored in a filing cabinet that only the PI was able to access. Data analysis was done on a password protected computer that only the primary investigator knew the password for. Once data analysis was completed all the tests were shredded and disposed.

Results

The population of nurses working in the ICU at the time of this project implementation was 26. Seventeen of the 26 nurses participated in this project, this was 65% of the total population. The intervention took place on several dates in the two-week period between December 12 and December 20. During the intervention participants completed the pre-test and post-test, the results of these tests were entered into an excel spreadsheet on December 22. The one month follow up test was distributed to participants the week of January 5 – January 12, the data from the results of the one month follow up test was entered into excel on January 12. For each question, the PI calculated the percentage of participants that answered that question correctly in order to compare how the results of each question changed from the pre-test, post-test, and follow up test. There was no identifying information reported on any of the tests, results were only tracked and analyzed in the aggregate. Individual scores were not tracked in order to protect participants' privacy.

Results Pre-Test, Post-Test, and One Month Follow-Up Test

Seventeen participants completed the pre-test and post-test. Ten participants completed the one month follow up test. The same ten questions were in the pre-test, post-test, and follow up test in order to compare how participant's knowledge changed as a result of the intervention. The pre-test was given in order to assess participant's baseline knowledge prior to any intervention. Results of the post-test showed an improvement of knowledge from the pre-test, as the percentage of people answering each question correctly improved for all 10 questions.

The lowest score on the pre-test was 30%, the highest score was 70%, the average score on the pre-test was 50%% and the standard deviation was 16.3. The lowest score on the post-test was 50%, the highest score was 100%, the average score was 86.6%, and the standard deviation was 15.7. The lowest score on the follow up test was 60%, the highest score was 100%, the

average score was 80%, and the standard deviation was 12.9. Both the post-test and one month follow up test had better average scores than the pre-test. The pre-test was the baseline knowledge assessment before any education intervention occurred. See table 2 for the descriptive statistics for each test.

The results of all ten multiple-choice questions successfully demonstrated that knowledge did improve over the baseline on the post-test and the one month follow up test after the educational session (Table 3). For question one which asked about respiratory effects after anesthesia, 76% of participants answered the question correctly on the pre test, 100% of participants answered correctly on the post test, and 90% of participants answered correctly on the follow up test. For question two which asked about the goal of neurological assessment post-surgery, 35% of participants answered correctly on the pre-test, 82% of participants answered correctly on the posttest and 80% of participants answered correctly on the follow up test. For question three which asked about causes of arrythmias postoperatively, 59% of participants answered correctly on the pretest, 88% of patients answered correctly on the post test, and 100% answered correctly on the follow up test. For question four which asked about the definition of general anesthesia, 76% of participants answered correctly on the pretest, 88% of participants answered correctly on the posttest, and 100% of participants answered correctly on the follow up test. For question five which asked about the cause of malignant hyperthermia, 29% of participants answered correctly on the pretest, 65% of participants answered correctly on the posttest, and 80% of participants answered correctly on the follow up test. For question six which asked about symptoms of malignant hypothermia, 41% of participants answered correctly on the pretest, 100% of patients answered correctly on the posttest, and 80% of patients answered correctly on the follow up test. For question seven which asked about temperature

regulation after anesthesia, 53% of participants answered correctly on the pretest, 82% of participants answered correctly on the posttest, and 60% of participants answered correctly on the follow up test. For question eight which asked about post-operative shivering, 47% of participants answered correctly on the pretest, 65% answered correctly on the posttest, and 90% of participants answered correctly on the follow up test. For question nine which asked about frequency of vital signs in the post-operative period, 24% of participants answered correctly on the pretest, 88% of participants answered correctly on the posttest, and 60% of participants answered correctly on the follow up test. For question ten which asked participants to identify inhaled anesthetics, 70% of participants answered correctly on the pretest, 100% of participants answered correctly on the posttest, and 90% of participants answered correctly on the follow up test.

A Friedman test was done on the data to see if the change in scores were significant. For the purpose of this project the significance level was set at 0.05. There was a statistically significant difference in test scores after the educational session $\chi2(2) = 15.200$, $p = 0.001$ (Table 5). Post hoc analysis with the Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied, resulting in a significant level set at $p < 0.017$. This test was conducted to see if there was a statistically significant change between pre-test and post-test scores, between pre-test and follow up test scores, and between post-test and follow up test scores. A Bonferroni adjustment was applied to the significance level because multiple comparisons were made which increased the likelihood of a Type I error. There was a significant difference between pre-test and post-test scores ($Z = -2.805$, $p = .005$). There was also a significant difference between pre-test and follow up test scores ($Z = -2.803$, $p = .005$). There was no significant change in test scores from the post-test scores compared to the follow up test scores ($Z = -.357$, $p = .721$)

(Table 6). These results indicate that as a whole, participants' knowledge did improve from their baseline knowledge as demonstrated by a significant improvement in scores from the pre-test to the post-test and the pre-test to the follow up test.

Results of the Intervention Evaluation

Participants were asked to complete a short feedback survey at the completion of the educational session. The feedback survey consisted of five questions on a Likert scale ranging from "strongly disagree" to "strongly agree." These questions were created to give participants the opportunity to provide feedback on the information provided in the educational session and rate how they felt the educational session impacted their knowledge. The overall response rate on this survey was 100% (n = 17). All points of evaluation received "agree" or "strongly agree" ratings. The responses support that participants felt that their knowledge improved as a result of the educational session and the intervention met the learning objectives (Table3).

Discussion

The purpose of this DNP project was to educate ICU nurses about anesthesia, complications of anesthesia, and care of the patient in the immediate post-operative period to help ensure safe, effective, and competent care of this patient population. Nurses working in the ICU were receiving patients directly from the operating room and recovering the patients from anesthesia without any formal education or training. Prior to this DNP project, an informal needs assessment concluded that an educational session on care of the post-operative patient for ICU nurses would be beneficial. It is important that ICU nurses are knowledgeable about the standards of care expected in the immediate postoperative period, different anesthetic agents, and how to identify and manage potential complications when providing care to patients transferred

directly from the operating room as it is estimated that major complications occur in 3-17% of inpatient surgical procedures (Kaplow, 2010; Preston & Gregor, 2015).

The results of the Friedman test indicate that there was a significant change in test scores after the educational session $\chi 2(2) = 15.200$, $p = 0.001(p < .05)$. It can be concluded from this result that the educational session had a substantial impact on knowledge of the participants. Additionally, a Wilcoxon signed-rank tests was done to see if there was a statistically significant change between pre-test and post-test scores, between pre-test and follow up test scores, and between post-test and follow up test scores. This test showed a statistically significant change in test scores from the pre-test to the post-test ($Z = -2.805$, $p = .005$), a statically significant change in test scores for the pre-test to the follow up test ($Z = -2.803$, $p = .005$) , and no significant change in test scores from the post-test to the follow up test($Z = -.357$, $p = .721$). The significant change in scores from the pre-test to the post-test and follow up test show that knowledge changed as a result of the educational session. There was not a significant change in test scores from the post-test to the follow up test indicating that knowledge did not change significantly, thus that the knowledge was retained.

Facilitators and Barriers

The high participation rate in this project can directly be attributed to the dates and time the educational sessions were provided. The educational sessions were offered immediately after ICU Competency Classes that all nurses working in the ICU are required to attend. The ICU nurses were already present for the Competency Class and did not have to come in to work on another day in order to participate. Participants were not required to attend in this educational session and were given the option to leave, as participation was voluntary. Some potential participants did leave, 17 participants were able to stay for this education session about care of

the post-operative patient. If the educational sessions were not offered at this time, the PI believes participation would have been much lower. This project was initially designed to be an online module that would have been mandatory for all ICU nurses to complete. While planning this project, management at the hospital announced that the online learning system was going to change. The PI decided it was best to offer in person classroom sessions instead of an online module and risk the module or results getting lost in the transition to the new online learning system.

Process Evaluation

The feedback survey consisted of questions asking participants to rate their knowledge after completing the educational session including their ability to identify common anesthetics used during surgery, knowledge of complications that occur in the post-operative period, and understanding of guidelines about caring for the post-operative patient. The feedback survey was an helped the PI to gauge if the educational session met the needs of participants and if participants felt the education session met its' objectives. All participants selected "agree" or "strongly agree" on questions about their knowledge as a result of the educational session. See Table 4 for results of the feedback survey. Results of the feedback survey showed that 75% of participants strongly agreed that there was a need for this education, 59% of participants strongly agreed that this educational session will help them identify common anesthetics used during surgery, 75% of participants strongly agreed that this educational session will help them identify complications after a patient received anesthesia, and 59% of participants strongly agreed that they are knowledgeable about guidelines for caring for the postoperative patient after receiving this education.

Unintended Consequences

The most surprising finding while implementing this project was the amount of staff interested in more information about an advanced nursing degree. Many participants asked the PI about different programs and different degrees. Also, many participants were interested in the PI's experience in her current DNP program at Rutgers University School of Nursing. This conversation was not necessarily about the project, it did facilitate conversation about the importance of advanced practice nursing and continuing education.

Implications and Recommendations

This project was successful and highlights that more research needs to be done about ICU nurses caring for post-operative patients. This small project can potentially be the foundation for future projects. This project called attention to the fact ICU nurses are recovering patients from anesthesia in some institutions. There are many potential benefits to ICU nurses caring for postoperative patients, however, this topic needs to be examined on larger level. In the future, more research on this topic may lead to ICU nurses caring for the postoperative patient recovering from anesthesia more institutions.

Quality and Safety

Nurses who recover patients from anesthesia are usually on call weekends, nights, holidays, and any time there are not routine surgical cases scheduled. These on call hours are usually in addition to the nurses' regular full-time scheduled hours for the week. This can disrupt the on-call nurses' sleep schedule, potentially leading to sleep deprivation. The fatigue caused by sleep deprivation can hinder nursing performance and potentially lead to errors, endangering the safety of the patient (Wallis, 2014). In fact, in a study of anesthetists, who often work similar on-call hours as nurses, 86% of those surveyed reported fatigue related errors (Nicol & Botterill, 2004). These errors can potentially put patients in danger. However, nurses

working their regular scheduled hours, whether it be night shift, weekends, or holidays, are likely to develop a better sleeping routine and be better rested than their on-call counter parts (Wallis, 2014). Therefore, having ICU nurses recover patients from anesthesia, particularly when PACU nurses are on call, can impact patient safety. Patients will be cared for by a nurse who is routinely used to these hours and not working additional hours to their already hectic schedule. Additionally, patients will not have a nurse caring for them who may have been woken up in the middle of the night to come care for a sick patient.

Economic

Training the ICU staff to recover patients can help reduce the amount of money the hospital spends having PACU nurses come in on-call. At this institution between the hours of 11pm to 7am, PACU nurses are not regularly scheduled; instead two nurses are on-call should PACU staff be needed. When nurses who are on-call have to come into work they are paid time and a half, this can be upwards of $60 an hour for each nurse and get compensated for four hours even if they spend less time caring for the patient. Patients are emergently taken to the operating room during off hours frequently and operating room cases often get backed up in the day requiring the on-call team to come care for the patients late in the night and early morning hours. Should the on-call team have to come in to care for a patient at least three times a week this can cost the hospital over $1,500 weekly and over $75,000 yearly. Instead of this extra expense, ICU nurses can be trained to recover patients and the hospital does not need to pay extra people to come care for a patient in the PACU. Educating ICU nurses to care for PACU provides flexibility to the hospital's workforce. Increasing the number of nurses able to recover patients from anesthesia and essentially cross training these nurses to care for PACU patients can prevent

PACU staff from having to come in frequently during non-scheduled hours, thereby reducing costs of the hospital (Paul & Macdonald 2014).

Clinical Practice

As a result of implementing this project, nurses can practice safer and avoid negligence and malpractice claims. Nurses should not provide care for a patient outside of their scope of practice. Failure to assess, monitor, and manage the patient appropriately can result in malpractice and negligence charges (Brooke 2011). Nurses can be sued for malpractice can be sued individually, with an average paid indemnity of over $100,000 (Nurses Service Organization, 2015). According to a 2015 claim report from the Nurses Service Organization, over $90 million was paid in nurses' malpractice claims between 2010 and 2014 (Frank & Danks, 2019). This education can broaden nurses' knowledge and help them practice within their scope of practice. Additionally, as part of the educational session, the hospital's policy for patients in the recovery phase of anesthesia was reviewed, which many nurses did not know existed. This can be a problem in more locations than just the site of this project. Policies and procedures are what nurses use to adhere to professional practices, promote compliance, reduce risk, standardize practice, and serve as a resource (Frank & Danks, 2019). Liability claims can be made if the nursing staff failed to follow the institutions policy and procedure (Frank & Danks, 2019). Mandating an education on care of the postoperative patient, which includes information about the institution's policy for caring for these patients, can help reduce the risk to the nurse for a liability claim.

Healthcare Policy

Research of the American Nurses Association, New Jersey Nurses Association, American Association of Critical Care Nurses, and American Society of Paranesthesia Nurses revealed that

there are no formal position statements about recovering a patient from anesthesia in ICU. This project may be the foundation for future projects about post-anesthesia recovery by ICU nurses, which may ultimately result in a national position statement. More research will need to be done in the future about the pros and cons of ICU nurses recovering patients from anesthesia. This small project has shed light on the fact that ICU nurses are recovering patients from anesthesia and this is a topic that needs to be investigated more. Once these studies are completed, these different agencies may be able to take an official stance about ICU nurses recovering patients from anesthesia.

On a smaller scale, this project may change the policy at the site. The results of this project are evidence that ICU nurses in this location expected to care for the patient immediately out of anesthesia benefited from receiving formal education about this topic. Surgical nursing requires skills and specialized training that generally isn't offered to ICU nurses during their training (Ball, Doyle, & Oocumma, 2015). After discussing the results with key stakeholders, it may be mandated that new hires into the ICU are required to complete some type of education or training about recovering patients from anesthesia before caring for these patients. This education can include online modules, in classroom sessions, or even spending a few days of orientation in the PACU.

Education

Nursing is a career that requires lifelong learning. Continuing education is important to nurses, it allows them to increase their knowledge and allows them to gain and refine skills (Price and Reichert, 2017). Many nurses feel that continuing education improves the care they give to patients (Price & Reichert, 2017). Best practices and patient care standards are constantly changing and can be difficult for nurses to keep up with if they are not formally

educated about it (Price & Reichert, 2017). Mandating that nurses in the ICU who care for post-operative patients receive a yearly education about caring for this population of patients can help ensure that patients receive the most up to date care. Additionally, mandating a yearly competency give the ICU nurse the opportunity to refresh their knowledge on the different policies and procedures used when caring for the post-operative patient. Finally, it gives the nurse to ask questions, discuss issues they may have had, and clarify difficult topics in order to better care for the patient. Ongoing education and professional development throughout nurses careers help to ensure competency and quality patient care (Price & Reichert 2017). For patient safety, it is necessary to ensure that nurses caring for them are up to date on the most recent information and standards of care. Mandating yearly education can help ensure that nurses stay current on all new information about caring for this patient population.

Sustainability

This project was effective, nurses benefited for the information shared in this educational session. In the near future, the educational session can be converted into an online educational module to be viewed by new hires into the ICU during their orientation period. The information used to construct the presentation can be shared with educators at the site to incorporate into yearly ICU nurses' competency. On a slightly larger scale, if other ICUs throughout the hospital network are interested in educating ICU nurses about recovering a patient from anesthesia in the ICU, this online module can be made available for nurses in these units.

This project is the steppingstone for future projects on this topic. Should future research provide evidence that ICU nurses recovering patients from anesthesia is beneficial, national organizations such as the American Nurses Association, New Jersey Nurses Association, American Association of Critical Care Nurses, and American Society of Paranesthesia Nurses,

can use the information from this educational session to create CEUs, lectures at seminars, and online education modules for its members to complete.

Translation and Dissemination

The participants have been notified via email about the results of this project. The PI has made a presentation to the leaders at the site and the site's nursing research council about the results of this project. In the near future the PI will have a poster presentation at the hospital network's annual research day in June 2020. A presentation about the results of this intervention has been made to the PI's DNP committee and a poster presentation will be made at Rutgers DNP poster day in April 2020. This project is eligible for submission to scholarly publications such as Critical Care Nurse, published by The American Association for Critical Care Nurses (AACN). Additionally, results of this project are eligible to be presented at conferences throughout the country such as The National Teaching Institute that is given by the AACN annually.

Summary

Patients are admitted directly from the operating room to the intensive care unit (ICU). A provider may make the decision to bypass the post anesthesia care unit (PACU) due to a complicated intraoperative course or provider preference. It is estimated that major complications occur in 3-17% of inpatient surgical procedures (Preston & Gregor, 2015). Therefore, it is important that ICU nurses caring for the patients directly from the operating room are knowledgeable about the standards of care expected in the immediate postoperative period, different anesthetic agents, and how to identify and manage potential complications (Kaplow, 2010). During the recovery period, nurses need to assess for adequate airway management, adequate reflexes, temperature, hemodynamic stability, and immediate post-operative

complications including pain management, nausea, and vomiting (Preston & Gregor, 2015). During and after anesthesia, many of the patients' life sustaining reflexes are subdued and the critical care nurse caring for these patients must ensure adequate and timely assessment to recognize any change in patient status (Odom-Forren & Drain, 2013). It is important to provide nurses with the knowledge and resources to care for patients emerging from anesthesia. To ensure the best outcomes, patient safety, and nurse competency, it is crucial that the ICU nurses receive the education about the care of the post-operative patient so that they can perform at the same standards of care as nurses working in the PACU.

This project yielded statistically significant results. A Friedman test was done on the data from the pretest, posttest, and follow up test and yielded a statistically significant result $\chi 2(2) = 15.200$, $p = 0.001$ indicating that the change in scores between the pretest, posttest, and follow up test were significant. Additionally, further data analysis with the Wilcoxon test showed there was a significant change in test scores for the pretest compared to the posttest ($Z = -2.805$, $p = .005$) and the pretest compared to the follow up test($Z = -2.803$, $p = .005$).

The clinical question was answered. In summary, in a community hospital in Central New Jersey (P), the results of an educational session (I) increased ICU nurses' knowledge of different anesthetics, post-operative complications, and the care of the post-operative patient (C) compared to the current standard (O). These findings validate that ICU nurses needed formal education to feel that they are providing safe, effective, and competent care to patients in the immediate post-operative period. It is necessary to continue to educate current and new staff about caring for the patient in the immediate post-operative period. Since the project was successful, this topic could be incorporated into ICU nurses' yearly competency or provided as an online learning module for new hires into the ICU.

References

ASPAN. (2016). 2017-2018 Perianesthesia nursing standards, practice recommendations and interpretive statements (1st ed.). Cherry Hill, NJ: American Society of PeriAnesthesia Nurses.

Brooke, P. (2011). Legally speaking ... when can staff say no? *Nursing Management, 42*(1), 40. doi:10.1097/01.NUMA.0000391673.35403.4b

Bruins, S. D., Leong, P. M. C., Ng, S. Y., & Bruins, S. D. (2017). *Retrospective review of critical incidents in the post-anesthesia care unit at a major tertiary hospital* doi:10.11622/smedj.2016126

Burns, S. M., Piotrowski, K., Caraffa, G., & Wojnakowski, M. (2010). Incidence of postoperative hypothermia and the relationship to clinical variables. *Journal of PeriAnesthesia Nursing, 25*(5), 286-289. doi:10.1016/j.jopan.2010.07.001

Card, E., Pandharipande, P., Tomes, C., Lee, C., Wood, J., Nelson, D., Hughes, C. (2015). *Emergence from general anesthesia and evolution of delirium signs in the post-anesthesia care unit*. Oxford] : Oxford University Press. doi:10.1093/bja/aeu442

Curatolo, C. J., McCormick, P. J., Hyman, J. B., & Beilin, Y. (2018). *Preventable anesthesia-related adverse events at a large tertiary care center: A nine-year retrospective analysis* doi://doi.org/10.1016/j.jcjq.2018.03.013

Elliotte, L. E. (2009). Creating successful PACU nurses: Georgetown university hospital perianesthesia orientation program. *British Journal of Anaesthetic and Recovery Nursing;*

British Journal of Anaesthetic and Recovery Nursing, 10(4), 70-74. doi:10.1017/S1742645609990180

International Council of Nurses. (2010). Scope of Nursing Practice and Decision-Making Framework TOOLKIT. Retrieved March 9, 2019, from https://www.icn.ch/sites/default/files/inline-files/2010_ICN Scope of Nursing and Decision making Toolkit_eng.pdf

Kaplow R. Ask the experts. *Critical Care Nurse*. 2010;30(1):60-62. http://ccn.aacnjournals.org/.

Khan, K. S., Hayes, I., & Buggy, D. J. (2014a). *Pharmacology of anaesthetic agents I: Intravenous anaesthetic agents*doi://doi.org/10.1093/bjaceaccp/mkt039

Khan, K. S., Hayes, I., & Buggy, D. J. (2014b). *Pharmacology of anaesthetic agents II: Inhalation anaesthetic agents*doi://doi.org/10.1093/bjaceaccp/mkt038

Kohn, L., Corrigan, J., & Donaldson, M. (2000). *To err is human building a safer health system* . Washington, D.C: National Academy Press.

Larach, G., Marilyn, Gronert, A., G., Allen, C., G., Brandom, W., B., & Lehman, B., E. (2010). Clinical presentation, treatment, and complications of malignant hyperthermia in north america from 1987 to 2006. *Anesthesia & Analgesia, 110*(2), 498-507. doi:10.1213/ANE.0b013e3181c6b9b2

Long, M., & Ross, J. (2017). Malignant hyperthermia. *Journal of Radiology Nursing; Journal of Radiology Nursing, 36*(3), 152-157. doi:10.1016/j.jradnu.2017.07.005

Misal, U., Joshi, S., & Shaikh, M. (2016). Delayed recovery from anesthesia: A postgraduate educational review. *Anesthesia: Essays and Researches, 10*(2), 164-172. doi:10.4103/0259-1162.165506

Nurses Service Organization. (2015, October). Nurse Professional Liability Exposures: 2015 Claim Report Update. Retrieved April 1, 2019, from https://aonaffinity.blob.core.windows.net/affinitytemplate-dev/media/nso/images/documents/cna-nurse-claim-report-101615.pdf

Odom-Forren, J., & Drain, C. B. (2013). Drains perianesthesia nursing: A critical care approach. St. Louis, MO: Elsevier/Saunders.

Oliveira, R. A., Guatura, Gabrielle Meriche GalvÃo Bento da Silva, Peniche, Aparecida de Cássia Giani, Costa, A. L. S., & Poveda, V. d. B. (2017). *An integrative review of postoperative accelerated recovery protocols*. Denver, Colo., etc.] : Association of Operating Room Nurses. doi:10.1016/j.aorn.2017.08.005

Peskett, M. J. (1999). Clinical indicators and other complications in the recovery room or postanaesthetic care unit.*Anaesthesia, 54*(12), 1143-1149. doi:10.1046/j.1365-2044.1999.01077.x

Preston, N., & Gregory, M. (2015). Patient recovery and the post-anesthesia care unit (PACU). *Anesthesia & Intensive Care Medicine, 16*(9), 443-445. doi:10.1016/j.mpaic.2015.06.015

Rujirojindakul, P., Geater, A. F., McNeil, E. B., Vasinanukorn, P., Prathep, S., Asim, W., & Naklongdee, J. (2012). Risk factors for reintubation in the post-anaesthetic care unit: A case–control study. *British Journal of Anaesthesia, 109*(4), 636-642. doi:10.1093/bja/aes226

Sewell, A., & Young, P. (2003). Recovery and post-anesthetic care. *Anesthesia & Intensive Care Medicine; Anaesthesia & Intensive Care Medicine, 4*(10), 329-332. doi:10.1383/anes.4.10.329.27315

Taylor, M., McNicholas, C., Nicolay, C., Darzi, A., Bell, D., & Reed, J. (2013). Taylor MJ, McNicholas C, Nicolay C, et al Systematic review of the application of the plan–do–study–act method to improve quality in healthcare BMJ Qual Saf 2014;23:290-298. BMJ Quality & Safety, 23(4).

Temple, E., & Wiles, M. (2019). *Inhalational anaesthetic agents* doi://doi.org/10.1016/j.mpaic. 2018.12.011

2019-2020 perianesthesia nursing standards, practice recommendations and interpretive statements. (2018). Cherry Hill, NJ: American Society of PeriAnesthesia Nurses

Appendix A – SWOT Analysis

Appendix B – Evidence Table

Article #	Author & Date	Evidence Type	Sample, Sample Size, Setting	Study findings that help answer the EBP Question	Limitations	Evidence Level & Quality
1	Burns, Piotrowski, Caraffa, Wojnakowski 2010	Prospective quantitative correlational study	Data was collected from three tertiary care facilities in Arizona and Florida 287 adult, nonemergency patients scheduled for surgery. A convenience sample was used.	Patients included in the study were 287. Patients ranged in age from 16-97 with a mean age of 56.8. The mean OR ambient temperature was 18 degrees Celsius (65 degrees Fahrenheit). Surgical times ranged from four minutes to 525 minutes (mean 142 minutes). Surgeries were divided into two categories: major cases including open abdominal and thoracic and joint replacement procedures, generally exceeding two hours in length (N =154) and minor surgical procedures lasting less than two hours including tonsillectomy, closed abdomen, and arthroscopic procedures (N=133) Post-operative temperatures ranged from 35.6 to 39.0 Celsius (96.08-102.9F). The mean preoperative temperature was 36.6 degrees Celsius. The mean post-operative temperature was 36.8 degrees Celsius (98.2F). Hypothermia, defined as T < 36 degrees Celsius, was demonstrated in 4% of the sample.	Temperature measurements in ORs varied based on the institutional engineering methods of temperature measurement. Some ORs did not have a thermostat and individual units were displayed Reliability of thermostats remains in question. Data regarding ambient temperatures were missing in some cases.	Level III Quality: Good

				Warming devices were used for 96.2% of the sample. The incidence of postoperative hypothermia has reduced significantly, as older studies listed the incidence of hypothermia ranging from 50-90%.		
2	Misal, Joshi, Shaikh 2016	Comprehensive review of the literature	N/A	Risk factors for delayed awakening include: 1. Age: Elderly patients have increased sensitivity toward general anesthetics, benzodiazepines, and slow return of consciousness due to progressive decline in CNS function. They have a high free plasma concentration of drugs. 2. Genetic factors: unexpected responses and prolonged somnolence after specific anesthetic are commonly associated with a genetic defect of the metabolic pathway of the agent or its receptor. 3. Gender: Men are 1.4 times more likely to have delayed recovery. 4. Body habitus: obesity requires higher doses to attain same peak plasma concentration of a drug than a smaller person. Drug dosing should be based on weight. 5. Comorbidities: Lung disease causes decreased ability to wash out inhalational agents. Decreased cardiac output can prolong somnolence. Renal or hepatic disease can prolong action of anesthetic	N/A	Level V Quality: Good

				agents and alter metabolism and excretion. 6. Drug factors: Drug interactions or prior ingestion of drugs may lead to a relative overdose and delayed awakening. The length of time the patient receives anesthesia can directly relate to the length of time it takes someone to wake up. 7. Metabolic causes: hyper and hypo glycemia can prolong the emergence from anesthesia. Electrolyte imbalances can affect the emergence from anesthesia. Core temperatures less than 33 degrees Celsius can delay metabolism of anesthesia leaking to increased time to emerge from anesthesia.		
3	Preston and Gregory 2015	Expert opinion	N/A	The PACU needs trained staff, capable of managing airways and postoperative complications. Regular team training should take place and include management of emergencies. Major complications occur in 3-17% of inpatient surgical procedures. Purpose of PACU is to allow patient to regain full control of airway, reflexes, manage any immediate postoperative complications such as nausea vomiting, airway obstruction and analgesia to be managed.	N/A	Level V Quality: Good

				Minimum standards of monitor should include pulse ox, noninvasive BP, EKG, nerve stimulator, temperature management, capnography, and invasive pressure monitoring if patient requires.		
4	Karcz and Papadakos 2013	Literature Review	N/A	Large variation in the incidence of critical respiratory events in the PACU with several prospective observational studies reports an incidence between 0.8% and 6.9%. Factors for respiratory complications include surgical risk factors such as emergency surgery, long duration of surgery and type of surgery. Anesthetic causes include the use of opioids, neuromuscular blocking drugs and general anesthesia. Patient risk factors include COPD, diabetes, obesity, age and male sex. There is significant atelectasis found in anesthetized adults and marked increase in alveolar hypoventilation, V/Q mismatch, and pulmonary shunt in some adults upon initiation of anesthesia. Anatomical site of surgery can cause a change in lung mechanics, hemodynamic impairment and respiratory depression from residual effects of anesthetic drugs.	N/A	Level V Quality: High

				Ongoing assessment must occur in PACU for signs of hypoxemia. These signs include tachypnea with increased minute ventilation, dyspnea, tachycardia, and altered mental status. New onset delirium or agitation may be signs of hypoxemia.		
5	Oliveira, Peniche, Costa, Poveda 2017	Systematic review	A total of 13 studies were identified	There is a lack of research on this topic by nursing professionals. Most of the studies found were done by professionals from other knowledge areas who described what nursing actions should take place. Interventions in the post-anesthesia phase include recovery of normothermia, assessment of vital signs, symptom assessment (pain, nausea, vomiting), oral administration of fluids and carbohydrates and avoidance of the use of urinary catheters. The review found that perioperative nurses make the success of patient care. The importance of a specialized nurse is highlighted.	There was a lack of articles written by nurses which may affect the description of nursing care delivered. Small number of studies were identified.	Level III Quality: Good
6	Peskett 1999	Retrospective review	13,266 patients receiving general, IV or local anesthesia	Discusses common complications seen in PACU 1. Cardiovascular: hypotension, hypertension, tachycardia, arrhythmia, angina, ischemia, cardiac arrest 2. Respiratory: Arterial desaturation, airway obstruction, upper airway complication (stridor, obstruction, laryngospasm), hypoventilation,	The complications were gathered via voluntary reporting and not objective	Level III Quality: Good

				bronchospasm, pulmonary edema, coughing, pneumothorax, aspiration 3. Other: hypothermia, excessive pain, prolonged sedation, hypoglycemia The most common complication was hypotension (1.2% of all patients), followed by hypertension and airway obstruction (0.6% of all patients), then bradycardia (0.4% of all patients), then hypoventilation (0.3% of all patients).		
7	Bruins, Leong, Ng 2017	Retrospective review	364 patients in a tertiary care hospital's PACU in Singapore	There were 701 critical incidents in 364 patients over a 26-month period. Cardiovascular complications were the most common (41.8%). The most common cardiovascular related complication was tachycardia (38.6%), hypotension (29%), and arrhythmia (10.6%). The second most common types of complications were respiratory (22.1%). Hypoxia accounted for 66.5% of these complications and carbon dioxide retention accounted for 26.5% of these complications. There were 25 reintubations, this was 0.05% of all patients in the PACU during the 2-year period.	Not all data was uniformly available. Not all incidents were uniformly recorded. Critical incidents were recorded in prose form and investigators used clinical judgement to translate reports into data.	Level III, Quality: Good

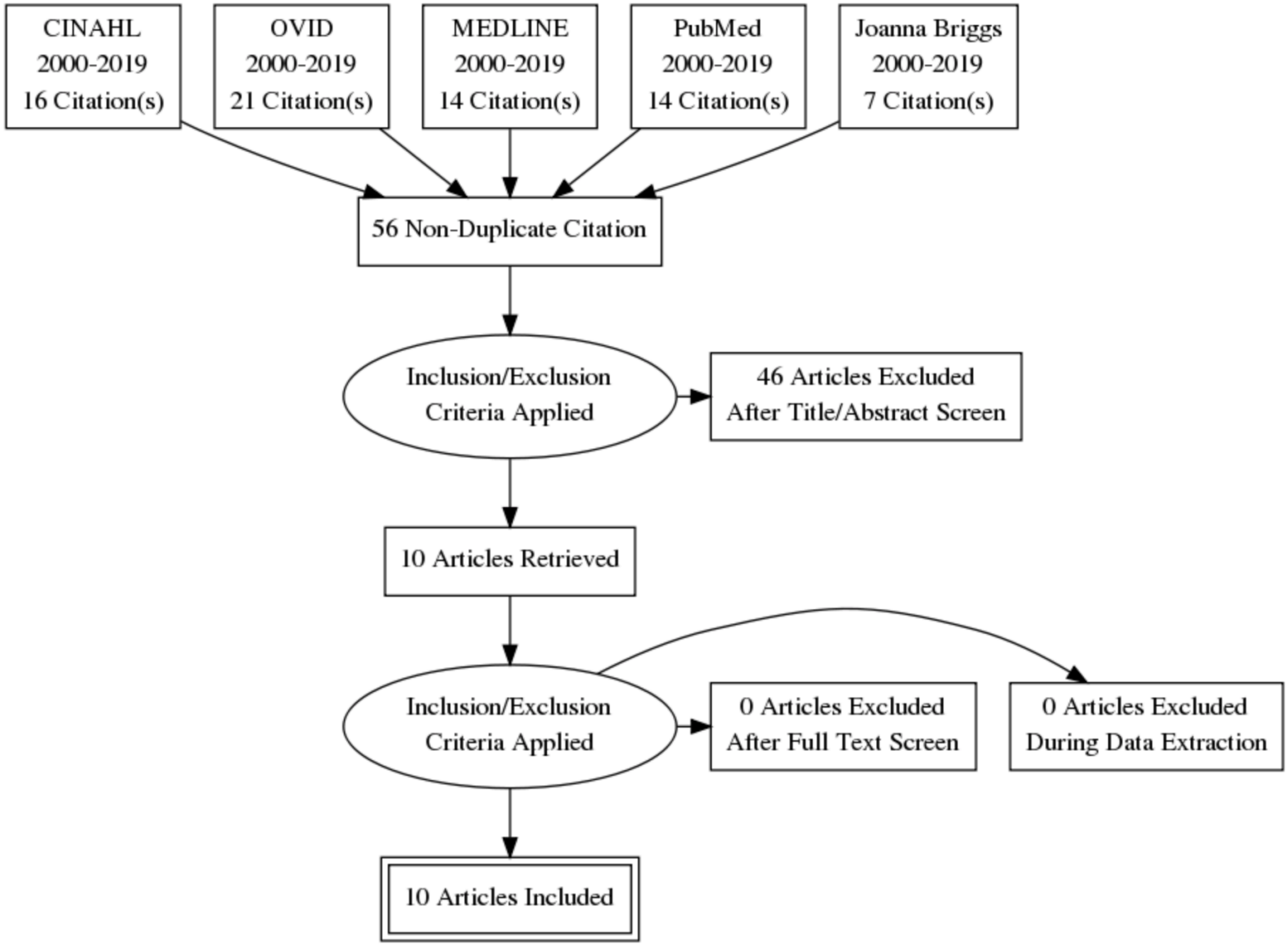
				The most frequent surgery related critical incident (which accounted for 6.7% of complications) was bleeding. The study suggested that the majority of patients experiencing complications were ASA level II suggesting that had had relatively few comorbidities (55.8%)		
8	Rujirojindakul, Feater, McNeil, Casinanukorn, Prathep, Asim, Nakongdee 2012	Case control study	[redacted] an 853 bed tertiary care hospital in southern Thailand	The results showed that chronic pulmonary disease, preoperative hypoalbuminemia and renal insufficiency, head and neck surgery, cardiac catheterization, emergency case, duration of case longer than three hours, and use of certain neuromuscular blocking agents increased the risk of reintubation in PACU. Surgery on the airway can cause airway edema leading to reintubation (OR 32.2, CI 13.6 - 76.1). Cardiothoracic surgery disturbs the cardiopulmonary system leading to reintubation by impairing the respiratory muscle capacity and airway protection and causing cardiac dysfunction (OR 6.26, CI 1.85 - 21.2). Patients with renal failure (Odds ratio 4.08, CI 1.24 - 13.4) and hypoalbuminemia (OR 4.86, CI 2.36 -	Confounding factors might not have been identified. Some variables had missing values because they were not required on young, healthy patients. Sample size may not have been large enough to test for differences in some subgroups.	Level III Quality: High

				10.0) have difficulty metabolizing and eliminating anesthetic agents. Neuromuscular blocking agents, particularly aminosteroid derivatives with and odds ratio of 7.26 (CI 2.67 - 19.8).		
9	Card, Pandharipande, Tomes, Lee, Wood, Nelson, Graves, Shintani, Ely, Hughes 2015	Prospective observational study	PACU at [redacted]	The incidence of delirium was highest on arrival to PACU and decreasing over PACU stay. Hypoactive features of delirium were more common than hyperactive features. Agitated emergence was present in 75 (19%) of patients. Of these 75 patients, 45 (60%) were also CAM-ICU positive at PACU admission, with 25 (33%), 12 (16%), and six (8%) continuing to be CAM-ICU positive at 30 min, at 1 hour, and at PACU discharge respectively. 124 (31%) of patients had delirium signs (positive CAM-ICU) at PACU admission, 56% of whom had hypoactive features. During multivariable regression model found total perioperative opioid administration to be independently associated with delirium signs during PACU stay (P = 0.02) Sensitivity analysis showed that anesthetic duration was independently associated	Single academic center study. Delirium assessments were not done preoperatively, therefore, patients may have been delirious prior to surgery. Delirium assessments were done by the same bedside nurses caring for the patient, so delirium assessments were not blinded.	Level III Quality: Good

				with deli rum signs during PACU stay (P < 0.001).		
10	Larach, Gronert, Allen, Brandom, & Lehman 2010	Retro-spective review	Cases in the North American MH registry were reviewed from January 1, 1987 to December 31, 2006 This included United States and Canadian cases A total of 286 cases were found.	Muscular presentation was defined as masseter spasm, generalized muscular rigidity, dark colored urine, peak creatine kinase 10,000 U/L, or peak potassium 6.0 mEq/L. A respiratory acidosis presentation was defined as inappropriate hypercarbia, inappropriate tachypnea, maximum end-tidal carbon dioxide 55 mm Hg, or arterial Pco 60 mm Hg. A metabolic acidosis presentation was defined as an arterial base excess more negative than 8 mEq/L. Complications were defined as a change in consciousness level and/or coma; disseminated intravascular coagulation; pulmonary edema; cardiac, renal, or hepatic dysfunction; or “other” complication as specified by the reporting clinician Only 6.5% of cases had a known family history of MH prior to anesthesia. Because 45% of MH cases involved the administration of volatile anesthetics without concomitant succinylcholine, it is	Limited by incomplete patient data, underreporting, or biased reporting.	Level III Quality: Good

				likely that MH cases will continue to occur even without succinylcholine use. The most frequent initial MH sign was hypercarbia, sinus tachycardia, or masseter spasm with temperature abnormalities as a further relatively early sign. 77 of 152 patients with MH reported 2 prior unremarkable general anesthetics. Complications not including recrudescence, cardiac arrest, or death occurred in 63 of 181 patients (34.8%) with MH. Twenty-one experienced hematologic and/or neurologic complications with a temperature 41.6°C (human critical thermal maximum). The likelihood of any complication increased 2.9 times per 2°C increase in maximum temperature and 1.6 times per 30-minute delay in dantrolene use.		

Appendix C – Prismaflow Diagram



Appendix D – Theoretical Framework

PLAN

- Identify gaps in knowledge among ICU nurses caring for the patient directly out of anesthesia via interviews with stakeholders.
- Research and identify what current protocols are in place and what education has been provided.
- Review the literature regarding evidenced based practice.
- Assemble an educational session for ICU nurses to attend.
-Create pre and post-test to evaluate participants knowledge.

DO

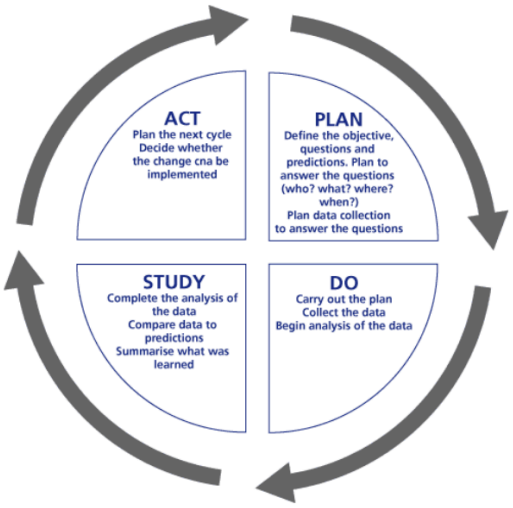
- Provide educational session to ICU nurses.
- Have ICU nurses complete a pre-test and post-test before and after educational session.

STUDY

- Analyze Data
- Compare results to pre and post-tests that were provided to ICU nurses before and after the educational session.
- Get feedback from staff participating in educational session.

ACT

- Share results with key stakeholders.
- Continue to use education for future new ICU nurses at this hospital.
- Address feedback or concerns with staff who participated in educational session.



Appendix E – Recruitment Flyers

[redacted]

Improving ICU Nurses' Knowledge about Caring for the Post-Operative Patient

Purpose of the Study

This quality improvement project is to improve ICU nurses' knowledge on care of the post-operative patient. All nurses working in ICU will be asked to participate in a one-hour classroom educational session.

Topics Presented

1. Overview of the different anesthetic agents used during surgery and their basic pharmacologic properties
2. Common complications in the immediate post-operative period
3. Guidelines for caring for the patient in the immediate post-operative period

This project is conducted under the direction of Kaitlin Burns.

Where and When

The educational session will be held in the ICU classroom on the following dates and times

December 5 – 10 am
December 5 - 1pm
December 5 – 5pm
December 12 – 10am
December 12 – 1pm
December 12 – 5pm
December 13 – 8am
December 13 – 1pm
December 13 – 5pm

Please email the Primary Investigator, Kaitlin Burns, at [redacted] to sign up for a class.

Appendix F – Informed Consent

INFORMATION SHEET FOR PARTICIPATION IN RESEARCH

You are being asked to participate in a research study conducted by Kaitlin Burns BSN, from the ICU at [redacted]. You are being asked to participate in this study because you are a registered nurse working in the ICU at [redacted]. The purpose of this study is to improve ICU nurses' knowledge on care of the post-operative patient.

Please read the information below and ask questions about anything you do not understand before deciding whether or not to participate. Your participation in this research study is completely voluntary.

If you decide to participate, you will be asked If you agree to participate in this project, you will be asked to attend a one-hour educational session. Topics will include:

1. Overview of the different anesthetic agents used during surgery and their basic pharmacologic properties
2. Common complications in the immediate post-operative period
3. Guidelines for caring for the patient in the immediate post-operative period

Participants will be asked to complete a 10-question pre-test, post-test, and one month follow up test. These tests will take approximately five minutes to complete. These tests will be anonymous; scores will in no way affect employment.

By completing the educational session, you are agreeing to participate in this research study. There are no other alternatives to the study other than not participating. Participation is voluntary and whether you participate or not will not affect your employment in any way. You have the right to decide not to participate in the educational session or complete the pre-test, post-test, and follow-up test.

Your answers to the tests are anonymous and cannot be linked back to you in anyway. Please do not print your name on the test if you decide to participate. If you do not want to answer a question for any reason you are free to skip it.

There is no foreseeable risk since the test is anonymous and there will be no way to link your responses to you.

The results of the project will be used as part of a Doctor of Nursing Practice project. The results will be presented to Rutgers University.

If you have any questions, concerns, or complaints about the research please contact Kaitlin Burns. She will be glad to answer any of your questions. Kaitlin Burns' number is [redacted]

If you have questions about your rights as a research participant, or concerns or complaints about the research, you may contact the [redacted] You may also call this number in the event the research staff cannot be reached, or you wish to talk to someone else.

In addition, you may also call the [redacted] to anonymously report any concerns you have related to the Study or research.

Thank you for considering participating in this study. If you decide to participate, please keep this sheet and retain for your records.

Kaitlin Burns
Principal Investigator

Appendix G – Feedback Survey

1. I felt a need for this education before attending the educational session.

   Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree □

2. After completing this education, I am able to identify the common anesthetics used during surgery.

   Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree □

3. After completing this education, I am able to identify common complications that occur in the post-operative period.

   Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree □

4. After completing this education, I am knowledgeable on the guidelines of caring for the post-operative patient.

   Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree □

5. The presenter presented the topics in an efficient and easy to understand manner.

   Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree □

Appendix H – Budget

Expense	Cost	Total Cost
Recruitment Flyers	10 flyers x .13 cents each	$1.30
Educational Materials (PowerPoint slide handouts)	10 pages per handout x .13 cents per page x 35 handouts	$45.50
Surveys	30 pages at .13 cents each	$3.90
Light Refreshments	$15 x 8 sessions	$120
Dissemination Poster	$75.00	$75
Total Budget		**$245.70**

Appendix I – Gantt Chart

	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20
Development of Project Proposal																
Present to Nursing Reasearch Council																
Apply to Site's IRB																
Obtain Site's IRB Approval																
Apply to Rutgers IRB																
Obtain Rutgers IRB Approval																
Post Flyers																
Intervention																
Data Collection from Pre-Test																
Data collection from Post-Test																
Distribute One Month Follow-up test																
Data collection from Follow-up Test																
Data Analysis																
Final Write Up																
Presentation of Final Project																
Dissemination of Results																

Appendix J – Pre-test, Post-test, Follow-up test

Please select the correct answer:

1. Patients at higher risk for respiratory problems include:

    1. Those receiving general anesthesia
    2. Those who smoke heavily or have lung disease
    3. Obese patients
    4. Patients undergoing thoracic, airway, or abdominal surgery

    Select the correct combination:
    A. 1, 2, and 4
    B. 2, 3, and 4
    C. 2 and 4
    D. All of the above

2. What is the goal of a neurological assessment post-surgery?

    A. Ensure the patient can move all 4 extremities
    B. Ensure the patient returns to level of consciousness they were before surgery
    C. Ensure the patient has appropriate cough and gag reflex
    D. Ensure the patient can vocalize they're in pain

3. The most common causes of ventricular tachycardia in PACU are:
    A. hypoxia, heart disease, or drug toxicity.
    B. pain and anxiety.
    C. Nausea and vomiting.
    D. Hypovolemia and decreased kidney function.

4. What is General Anesthesia?
    A. relaxed, non-paralyzed state of analgesia
    B. loss of body sensation to region
    C. state of reversible unconsciousness where protective reflexes are partially or completely lost, muscle relaxation, sedation, and amnesia obtained
    D. the individual can respond to verbal directions, but he or she feels little to no pain and has an altered level of consciousness.

5. Which drug can cause malignant hyperthermia?
    A. Inhaled nitric oxide
    B. Etomidate
    C. Succinylcholine

D. Propofol

6. If you suspect your patient has malignant hyperthermia, what should you evaluate for?
    1. Muscle rigidity
    2. Increased serum potassium
    3. Increased core temperature
    4. Increased ETCO2
    5. Tachycardia

    Select the correct combination

    A. 1, 3, & 5
    B. 1, 2, 4, & 5
    C. 2, 4, & 5,
    D. All of the above

7. After receiving an inhaled anesthetic, a patient should be monitored for hypothermia or hyperthermia. As the nurse, you are aware that anesthesia effects temperature regulation because it causes a
    A. depressant effect on the hypothalamus
    B. stimulating effect on the cerebral cortex
    C. depressant effect on the cerebral cortex
    D. stimulating effect on the hypothalamus

8. Which is correct regarding post-operative shivering?
    A. Increased O2 consumption, increased ventilatory requirements
    B. Decreased O2 consumption, increased ventilatory requirements
    C. Minor mechanism of heat production, prolongs recovery time
    D. Need for close monitoring for hypotension and diffuse muscle aches

9. According to the Perianesthesia Nursing Society, how often should vital signs be checked in the immediate post- operative period?
    A. Every 5 minutes or more frequently as patient condition warrants
    B. Every 10 minutes or more frequently as patient condition warrants
    C. Every 15 minutes or more frequently as patient condition warrants
    D. Every 5 minutes for the first half hour and then every 15 minutes, or more frequently as patient condition warrants

10. Which of these anesthetics are inhaled anesthetics?
    A. Ketamine and Etomidate
    B. Halothane and isoflurane
    C. Rocuronium and Vecuronium
    D. Diazepam and Propofol

Table 1 – Average Test Scores

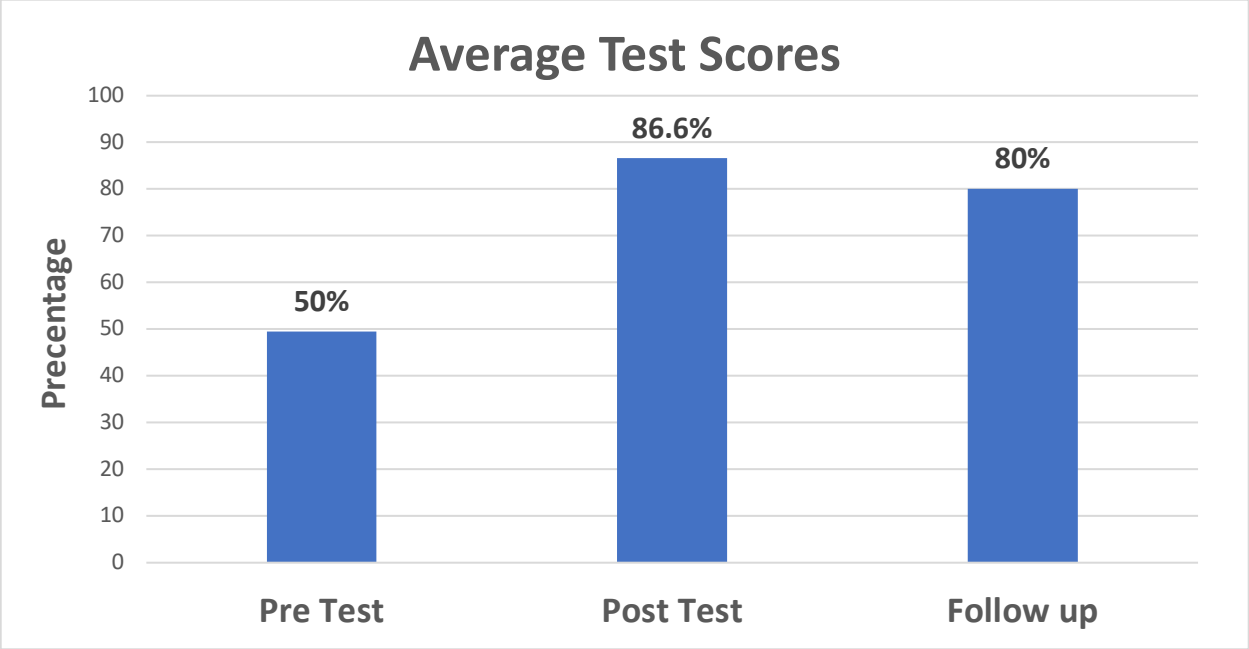


Table 2 – Descriptive Statistics

Pre-test Descriptive Statistics	
Mean	50
Standard Error	4.529108137
Median	50
Mode	30
Standard Deviation	16.32993162
Sample Variance	266.6666667
Kurtosis	-1.678125
Skewness	-0.135696165
Range	40
Minimum	30
Maximum	70
Count	17
Confidence Level(95.0%)	9.868078915

Post-test Descriptive Statistics	
Mean	86.66666667
Standard Error	4.49466575
Median	90
Mode	100
Standard Deviation	15.56997888
Sample Variance	242.4242424
Kurtosis	1.46025
Skewness	-1.239564944
Range	50
Minimum	50
Maximum	100
Count	17
Confidence Level(95.0%)	9.892692615

Follow Up Descriptive Statistics	
Mean	80
Standard Error	4.879500365
Median	80
Mode	80
Standard Deviation	12.90994449
Sample Variance	166.6666667
Kurtosis	0.312
Skewness	0
Range	40
Minimum	60
Maximum	100
Count	10
Confidence Level(95.0%)	11.93970727

Table 3
Correct Responses for Care of the Post-Operative Patient

Question (Short Description)	% Correct *Pre-Test* (n = 17)	% Correct *Post-Test* (n = 17)	% Correct *Follow Up* (n = 10)
1. Respiratory Problems	76%	100%	90%
2. Neurological Assessment	35%	82%	80%
3. Ventricular tachycardia	59%	88%	100%
4. General Anesthesia	76%	88%	100%
5. Cause of malignant hyperthermia	29%	65%	80%
6. Symptoms of malignant hyperthermia	41%	100%	80%
7. Temperature Regulation	53%	82%	60%
8. Post-op Shivering	47%	65%	90%
9. Vital Signs	24%	88%	60%
10. Inhaled Anesthetics	70%	100%	90%

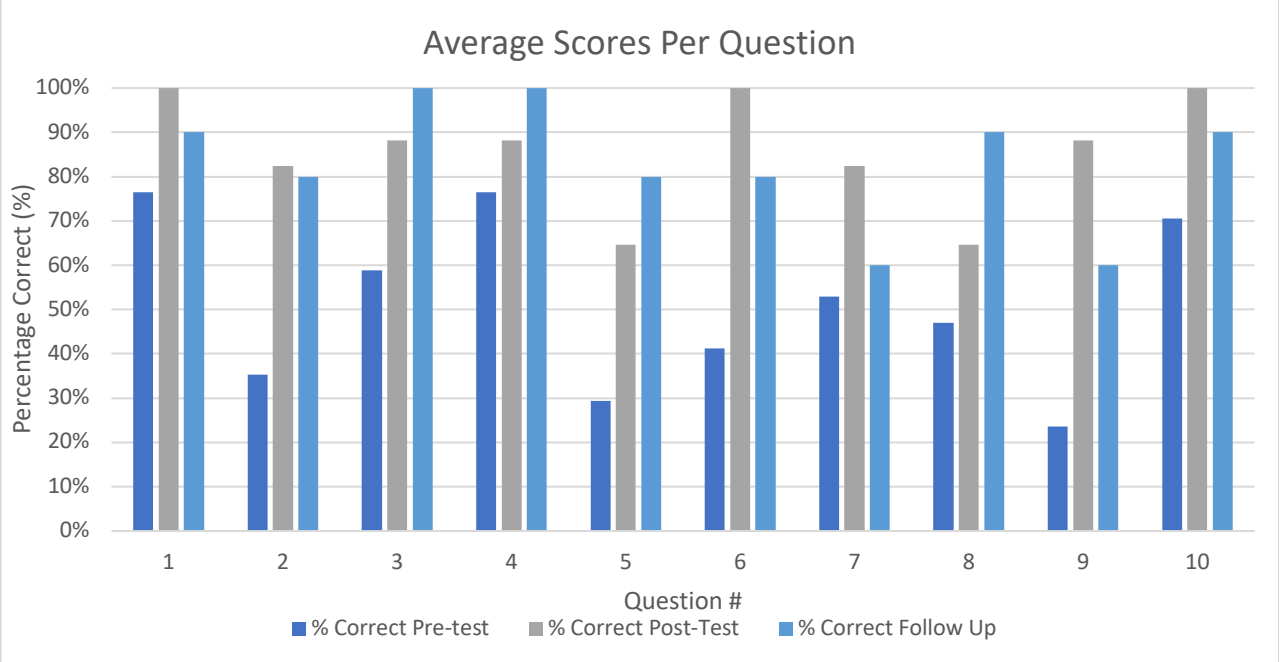


Table 4

Feedback Survey

Point of Evaluation	Agree Frequency	%	Strongly Agree Frequency	%
Need of education	6	(35%)	11	(75%)
Identification of anesthetics	7	(41%)	10	(59%)
Identification of complication	6	(35%)	11	(75%)
Guidelines	7	(41%)	10	(59%)
Instructor presentation	5	(30%)	12	(70%)
Overall Response Rate on Survey = 100% (n = 17)				

Note: the survey had the options of "strongly disagree," "disagree," and "neutral" but these were not selected on any survey.

Table 5 – Friedman Test

Test Statistics[a]

N	10
Chi-Square	15.200
df	2
Asymp. Sig.	.001

a. Friedman Test

Table 6 – Wilcoxon Test

Test Statistics[a]

	PostTest – PreTest	FollowupTest – PreTest	FollowupTest – PostTest
Z	-2.805[b]	-2.803[b]	-.357[c]
Asymp. Sig. (2-tailed)	.005	.005	.721

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. Based on positive ranks.