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Multidisciplinary Simulation Training to Improve Nursing Knowledge of Intraoperative Malignant Hyperthermia

Heather Burrell
Walden University

Walden University

College of Health Sciences

This is to certify that the doctoral study by

Heather Burrell

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
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Review Committee
Dr. Patricia Schweickert, Committee Chairperson, Nursing Faculty
Dr. Robert McWhirt, Committee Member, Nursing Faculty
Dr. Mirella Brooks, University Reviewer, Nursing Faculty

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2019

Abstract

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MSN, South University, 2011

BSN, Florida Hospital College of Health Sciences, 2009

Project Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Nursing Practice

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Abstract

Malignant hyperthermia (MH) is a rare but severe reaction that can occur in the operating room. Due to the low volume of these reactions, nurses are often unprepared to handle the event; however, not recognizing the event and intervening can lead to the death of the patient. This is a practice problem that can be addressed through a nursing staff education simulation training program. The purpose for this doctoral project was to develop a multidisciplinary MH simulation program that could improve nursing knowledge when caring for patients experiencing an MH crisis in the operating room. The practice-focused question for this project asked whether MH multidisciplinary simulation education improves the knowledge of nurses in the operating room setting. Utilizing Kolb's theory of experiential learning, nurses were developed through the four stages of learning. Sources of evidence for this project included a review of the literature. Data were also collected pre- and post-intervention on the reliability of simulation training to improve operating room nurses' knowledge of caring for the patient experiencing an MH crisis. Descriptive statistics via percent difference evaluated pre- and post-test evaluations. Results revealed a 16.4% increase knowledge scores from pretest to posttest following participation in the MH simulation. Improving patient outcomes creates significant social impact by developing community confidence in the surgical care provided by local hospitals.

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Dedication

This project is dedicated to improving patient outcomes through enhancing patient care. Developing our nurses through well effective education. May we never lose our desire to learn more.

Acknowledgments

A huge thank you to my family that never stopped believing in me when I took this large leap of fate. To that same family that put up with my endless computer time and whining, pushing me to just get it done.

Thank you to my faculty, especially my mentor, Dr. Schweickert for never giving up on me as I pulled this project together. Thank you for always answering my endless questions with a smile and kind word.

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Section 1: Nature of the Problem

Introduction

Malignant hyperthermia (MH) is a rare but severe disorder that can occur after administration of volatile anesthetic gases and depolarizing muscle relaxants in the intraoperative setting (Seifert, Wahr, Pace, Cochrane, & Bagnola, 2014). MH occurs in approximately one out of every 100,000 adult surgical procedures and approximately one out of every 30,000 pediatric surgeries (Malignant Hyperthermia Association of the United States [MHAUS], 2018). Even with advanced recognition and early treatment fatality rates from this disorder remain to be just under 5% (In, Ahn, Lee, & Kang, 2017) Although rare, this event, if not identified and treated appropriately, can result in the death of the patient because of the extreme hypermetabolic state. Because MH is a rarely occurring problem, operating room nurses may never see an actual case and may not be knowledgeable and confident in their care of the patient.

This DNP project was developed to seek out a method of training operating room nurses to help them retain knowledge in caring for a patient experiencing this high risk, infrequently occurring event. A mock MH crisis patient scenario was developed for perioperative nurses to participate in, with nurses completing a short pretest before and participating in debriefing after to identify strengths and weaknesses of the entire team. Walden University's vision for 2020 is to make a positive impact on society and create benefits for the public (Walden University, 2017). This DNP project creates positive social change in educating nurses in the emergency care of patients experiencing an MH crisis. Additionally, this project helped to develop a nursing unit into one that the

community can trust for their surgical needs. An unrelated outcome of this project is the development and support of a method of educating nurses in managing other emergency situations.

Problem Statement

The occurrence rates of an MH crisis are low, so operating room managers must seek out methods of training their nurses that keep recognition, diagnosis, and treatment of an MH crisis at the forefront of the nurses' practice. MH is a fatal reaction if not recognized and treated in a timely manner. MH requires immediate recognition and intervention to prevent a negative outcome (Cain, Riess, Gettrust, & Novalija, 2014). Despite efforts to maintain training techniques for operating room nurses, a reported 1 to 2 patients die each year from MH (DeJohn, 2008). Simulation training for MH crisis gives operating nurses an opportunity to practice and refine their skills of caring for these patients (Hershey Dirksen, Van Wicklin, Mashman, Neiderer, & Merritt, 2013).

When conducting informal surveys at the local facility, I discovered that operating room nurses were not able to identify the signs and symptoms associated with an MH crisis or the proper interventions. Facility management expressed a desire to have MH education provided in a new way. The focus of this DNP project was to provide a method to assist in educating operating room nurses in MH management and allow them a safe environment to practice this gained knowledge.

This doctoral project is significant for the field of nursing. Development of the simulation training provided operating room nurses an opportunity to practice a replicated MH crisis in an environment that does not put patients at risk (Mullen & Byrd,

2013). Kolb's theory of experiential learning suggests that learning takes place in four steps: concrete experience, reflection, conceptualization, and experimentation (Fewster-Thuente & Batteson, 2018). Through simulation, operating room nurses had the opportunity to experience caring for a patient exhibiting the signs and symptoms of an MH crisis. Through debriefing, they could reflect on and conceptualize their actions. Allowing the nurses to repeat the scenario after the debriefing gave them the opportunity to experiment with their newly acquired skills and knowledge.

Purpose

An actual MH crisis is a rare event to witness in the operating room (Cain et al., 2014). MH occurs in approximately one out of every 100,000 adult surgical procedures and approximately one out of every 30,000 pediatric surgeries (MHAUS, 2018). Nurses require a specialized level of knowledge when caring for a patient experiencing this crisis. Knowledge-to-practice gaps exists in almost every area of nursing practice such as documentation gaps (Haslam, Hackett & Deriet, 2015) and gaps in hands-on care of the patient (Mullen & Byrd, 2013). This project was designed to eliminate the existing knowledge to gap in practice that exists in managing MH medical emergencies. This project involved simulation to close this gap. Simulation was originally developed for training employees in high-risk industries (Galloway, 2009). Simple simulation methods have been used in health care education. In more recent years, the development of high-tech simulators has allowed this method of training to be adapted to high-risk patient situations such as MH.

The practice-focused question for this project was whether MH multidisciplinary simulation education improves the knowledge of MH management by operating room nurses in the operating room setting. Through the development of a simulation scenario, this doctoral project addressed the gap from knowledge to practice. Operating room nurses had the opportunity to translate their knowledge of identification and treatment of a patient experiencing an MH crisis to hands-on practice of caring for a simulated patient experiencing the crisis. This entire event occurred in a setting conducive to learning and free of patient harm.

Nature of the Doctoral Project

A literature review was conducted using various search engines providing up-to-date evidence. Evidence in the literature along with practice standards such as the Association of periOperative Registered Nurses (AORN) Guidelines for Perioperative Practice and information from the MHAUS guided the simulation training (MHAUS, 2018). The project relied on a predeveloped simulation scenario on caring for a patient experiencing an MH crisis from AORN (2018). The project was developed to collect data on the efficiency of simulation training on the education of operating room nurses. Objective data included the use of pre- and post-knowledge testing of the nurses using a written exam and an observation of demonstrated skills.

As a staff education project, this project fulfilled the Walden definition as an in-service education for professional nurses to meet a clinical practice need to improve patient care. This project was submitted for Institutional Board (IRB) approval per the requirement of Walden University, and facility approval was also be obtained. The

project approach included development of an 11-question pre- and post-test, which were developed utilizing MHAUS and AORN guidelines for perioperative practice when caring for a patient experiencing an MH crisis. The pre- and post-test tested basic MH knowledge levels. Posteducation follow-up was completed utilizing the same posttest at a time frame of approximately six months after the education to see if the knowledge was retained. This assessment gathered data to determine whether nursing knowledge improved after the participation in the simulation training, which was developed and implemented as part of this project. Evidence was organized and kept confidential via a password-protected computer by me. Additionally, information collected was coded by a computer randomization program and deidentified. The analysis of the evidence was based on pre- and post-test results using descripting statistics via percent difference to assess project outcomes.

The purpose of this doctoral project was to provide MH education to operating room nurses to improve their knowledge of caring for a patient experiencing an MH crisis. Findings included 16.4% improvement in knowledge scores postsimulation as demonstrated by analyzing pre- to post-test results.

Significance

Stakeholders for this project included the patient, the nurse, the surgical technician, the surgeon, and the anesthesiologist. As a patient, potential impact from addressing the local problem includes improvement of outcomes in emergency situations. For the nurse, potential impact includes increased confidence and knowledge on how to care for the MH patient. For the rest of the surgical team, including the surgical

technician, the surgeon, and the anesthesiologist, the potential impact is improved teamwork leading to improved patient outcomes.

Nursing practice is constantly being improved through evidence-based practice, which occurs through nursing research. Through the development of this doctoral project, research was added to the growing evidence supporting the use of simulation training. Additional contributions to nursing practice include building the knowledge of operating room nurses to provide optimal patient care. The Institute of Medicine (2010) 2020 future of nursing report advocates for nurses to engage in lifelong learning. This project fosters nurses to enhance their education in caring for patients in an MH crisis.

The demonstration of success in simulation training can be transferred to similar practice areas. MH has been identified in various stages of patient care, from the operating room to the recovery room or in any location where triggering anesthetic agents are being used (Cain et al., 2014). This project could be transferred to nurses working in those other locations such as recovery room nurses, emergency room nurses, intensive care nurses, or office nurses. Additionally, this method of training can be transferred to any other emergency situations such as cardiac arrest or drug overdose by utilizing the basic framework of simulation.

Creating positive social change is a major goal of every Walden University DNP project. This doctoral project has implications for positive social change through the improved nursing knowledge of caring for patients experiencing an MH crisis. This improved knowledge leads to positive patient outcomes in these emergency situations by reducing the rates of fatality from lack of recognition or treatment of the crisis situation.

These improved outcomes can also lead to improved community confidence in the care they receive locally. This aligns with Walden's goal of social change by impacting the care provided by the nurses working in the operating room.

Summary

MH is a rare, potentially deadly, reaction to anesthetic agents. Using Kolb's experiential theory of learning, the purpose of this DNP project was to provide a method of educating operating room nurses in the appropriate recognition and treatment of an MH crisis. The knowledge-to-practice gap was addressed through the development of an evidence-based simulation scenario. This project contributed to nursing practice by adding to the growing body of evidence supporting simulation training. Additionally, it added a template providing staff education for emergency situations. This doctoral project supports Walden's desire to make a positive impact on society and create benefits for the public. This project directly impacts future patient care received in the operating room setting. The next section will include a discussion of the application of theory to the project and the relevance to nursing practice.

Section 2: Background and Context

Introduction

MH is a rare but severe reaction that can occur after administration of anesthetic gases and muscle relaxants in the intraoperative setting (Seifert et al., 2014). In an emergency like this, it is important that a nurse is knowledgeable in the correct actions to take, but it is difficult to keep nurses knowledgeable in the recognition and treatment of the MH crisis. The practice-focused question for this project asked whether MH multidisciplinary simulation education improves the knowledge of nurses in the operating room setting. The purpose for this doctoral project was to develop a multidisciplinary MH simulation program that would improve nursing knowledge of how to care for patients experiencing an MH crisis in the operating room.

Concepts, Models, and Theories

This doctoral project was developed based on two theoretical works. The first theory was Kolb's experiential learning theory. Kolb's theory proposes that students learn in a four-part process: concrete experience, reflection, conceptualization, and experimentation (Fewster-Thuente & Batteson, 2018). Concrete experiences allow the learners to participate in a group activity, such as a simulation, and perform their role. (Fewster-Thuente & Batteson, 2018). Core learning requires changes in cognitive processes (i.e., metacognition or thinking about thinking), scaffolding (building on previously obtained knowledge), and reflection. Simulation training can help foster this learning.

The second theory used was Benner's model of novice to expert. Benner's novice to expert model identifies five stages to a person's learning process (Thomas & Kellgren, 2017). At the beginning, we have novice or beginner nurses. Those are nurses with no practical experience. The next step is an advanced beginner. That nurse is one that is starting to be able to use previous experience to make judgement calls. The third level is a competent level. A competent nurse can prioritize and think abstractly. Fourth stage is the proficient stage. A proficient nurse can look at situations holistically and can recognize the importance of change as the situation unfolds. The final stage is the expert stage. An expert nurse has highly developed experience and intuition. Benner's model is an experiential model (Thomas & Kellgren, 2017).

Both theories supported the use of simulation training. Experiential learning creates an environment that allows for development of knowledge through the transformation of experience into knowledge, thus altering the way that a person thinks and acts (Sewchuk, 2005). With active participation in simulated MH scenarios, learners can experience this emergency situation and perform actions based on their preexisting knowledge. Through the post-scenario debriefing process, learners can reflect on their actions and discuss areas for improvement. Further, Benner's novice to expert theory pushes the thoughts that knowledge alone is not enough to handle complex situations. Learners require experience and practice to move their skill to a higher level of performance (Dumchin, 2010). Benner's theory supports the use of simulation, allowing learners to practice that level of knowledge and move their skills through the levels of novice to expert.

For purposes of this doctoral project, the term *participant* refers to the circulating nurses in the operating room. *Patient* or *client* will refer to the factious surgical patient experiencing an MH crisis.

Relevance to Nursing Practice

MH is a rare but severe disorder that can occur in the intraoperative setting (Seifert et al., 2014) and requires immediate intervention to prevent patient mortality (Cain et al., 2014). Although mortality rates have dropped significantly since use of dantrolene sodium and initiation of capnography, operating room nurses may not have experienced such an emergency to gain knowledge for best management (DeJohn, 2008). Educating operating room nurses to recognize the signs of MH and intervene with appropriate treatments has been shown to lower mortality rates from 80% down to less than 5% (Hirshey Dirksen et al., 2013). Utilizing effective methods of educating nurses, such as simulation, can help better prepare nurses for action in these emergency situations.

Annual education for perioperative nurses is common practice in all facilities. Common practice for educating nurses is either via an article to read followed by a posttest or a PowerPoint/lecture for nurses to sit through. These methods of teaching have been around for a long time, but the practice is outdated. However, simulation is an active learning method of teaching. Active learning has been shown to result in higher gains of academic learning than traditional lecture methods (Mello & Less, 2014).

Local Background and Context

Historically, the practicum site had never experienced an actual MH crisis in their operating room. Regardless, the nurses are required to complete annual training about it. Although operating room nurses are educated via a yearly module on MH, this has not been effective at providing adequate education for this serious surgical complication. Therefore, nurses need an improved educational experience for these surgical emergencies.

The institutional context is a 186-bed rural community hospital. The hospital provides care to a service area with more than 160,000 individuals in Southwestern New York state and Northwestern Pennsylvania. The project hospital's current surgical suite includes nine surgical rooms. Surgical members include 21 surgeons, eight anesthesiologists, 43 nurses, and 13 technicians. Operating room nurses will be invited to participate. The mission of the hospital is to provide excellent care in response to the health care needs of the community.

Role of the DNP Student

As a DNP student, we have a responsibility to translate evidence-based research into practice as well as a responsibility to lead quality improvement and safety initiatives in our organizations (America Association of Colleges of Nurses, 2006). From a professional (and personal) context, this writer has been a practicing operating room nurse since 1998. Care of surgical patients requires a unique set of skills. Some of those skills are used daily, like in cleansing the patient's skin or putting a dressing on, some of those skills are rarely used, like in caring for a patient experiencing an MH crisis.

Regardless of the frequency of these skills, an operating room nurse must be ready to perform these tasks on a moment's notice.

My role in this doctoral project has been as a leader since inception. After speaking to the director of the department and reviewing the literature for key topics the decision was made to focus on MH. As an operating room nurse since 1998, I have never personally experienced caring for a patient with an MH crisis. Regardless, the importance of the knowledge is well known. The participants in the project are peer nurses, with a variety of operating room experience. The institution is my practicum site as well as current work site. Institutional research shows no documented cases at the organization, but with the frequency of crises occurring in approximately one out of every 100,000 adult surgical procedures and approximately one out of every 30,000 pediatric surgeries operating room nurses must be knowledgeable in this care (MHAUS, 2018).

When a patient enters the surgical suite undergoing a procedure requiring anesthesia they are put into a vulnerable position. They entrust the operating room team to care for their every need. As an operating room nurse, this writer takes this role very seriously. The motivation behind this project was to provide a way to elevate the care provided to patients entering a small community hospital. Choosing this avenue of staff development may open up other opportunities to enhance nurses' knowledge in caring for patients experiencing emergency situations.

As an employee of the surgical services department, potential biases may exist in the writer's expectation of outcomes. While I do not have any authority over staff in the facility, I do informally hold a role as a content expert or mentor to the staff. Being one of

the few staff members that are certified in the operating room, nurses often turn to me when seeking guidance or clarification of new polices or procedures.

Role of the Project Team

Stakeholder identification is important in any evidence-based project. Stakeholder involvement in project planning, development, and implementation can aid in a much smoother transition in the practice change. In this DNP project the primary stakeholders are the surgical nurses. Secondary stakeholders are the surgical technicians, anesthesiologist, surgeons, recovery room nurses, and the operating room director.

Summary

MH is a rare emergency situation that occurs in the operating room. Despite the infrequency of its occurrence, operating room nurses must be constantly alert and aware of the signs and symptoms that it may be occurring. Additionally, they must be comfortable and confident in their skills to care for the patient experiencing this crisis. Addressing this gap in knowledge to action will be discussed in detail in the next section. The next section will focus primarily on the sources of evidence that support this doctoral project.

Section 3: Collection and Analysis of Evidence

Introduction

MH is a rare, potentially lethal reaction to inhaled anesthetic gases that a patient undergoing general anesthesia can experience. A nurse working in the operating room caring for any patient must be aware of this potential reaction, be able to recognize the signs and symptoms, and be able to perform appropriate interventions in a timely manner (Cain et al, 2014). The purpose of this DNP project was to develop a method of educating operating room nurses so that the knowledge of the signs/symptoms of an MH crisis along with the treatment interventions is retained longer and easier to recall when needed. Educating operating room nurses to recognize the signs of MH and intervene with appropriate treatments has been shown to lower mortality rates from 80% down to less than 5% (Hirshey Dirksen et al., 2013).

Locally, the organization had never experienced a true case of MH. There have been several reactions mimicking the signs and symptoms of MH that staff have struggled to perform appropriately in. Debriefing of nurses after those incidences has led to the discovery that they feel unprepared and unskilled to perform in an MH crisis. Following America Association of Colleges of Nurses (2006) Essentials of Doctoral Education for Nursing Practice, this project aimed to translate evidence-based research into practice as well as lead quality improvement and safety initiatives in the organization. Based on the theoretical works of Kolb and Benner, nurses learned through the repeated exposure to and practice of caring for a patient experiencing an MH crisis.

Section 3 will reframe the practice-focused question and identify the sources of evidence. It will further explain tools and techniques used to collect the project data and address the ethical protection of the participants in the project. The section concludes with a discussion regarding the analysis and synthesis of the collected data.

Practice-Focused Question

Locally, operating room nurses are taught on MH on an annual basis. Often this education comes in the form of a short (10 minutes or less) presentation or reading an article and taking a test. For some annual competencies, this method of education may be efficient, but this may not be enough for something as life-threatening as an MH crisis. Informally speaking to some of the nurses in the operating room has revealed that they do not feel confident to recognize and appropriately intervene should a crisis occur. Though the organization has never experienced a true crisis, training is required to address potential future occurrences. The practice-focused question for this project asked whether MH multidisciplinary simulation education improves the knowledge of nurses in the operating room setting.

The purpose for this doctoral project was to develop a multidisciplinary MH simulation program that would improve nursing knowledge of how to care for patients experiencing an MH crisis in the operating room. This approach aligns to the practice-focused question because defining competency in nurses has become more than having them fill out a piece of paper. The use of simulation in education has been shown to aid in developing confidence and competence in student learners (Alt-Gehrman, 2019).

Development of this confidence and competence will allow nurses to perform more efficiency in an MH crisis.

One operational definition to clarify for this project is *simulation*, which is an interactive, student centered, learning experience that is performed in a blame free environment (Alt-Gehrman, 2019). Another definition is *competence*, which is having the ability to translate knowledge into clinical skills (Fukada, 2018). Competency is important to fulfilling an individual's role in nursing.

Sources of Evidence

This DNP project was based on literature supporting the need for educating operating room nurses regarding the care of a patient experiencing an MH crisis. Various emergency situations, such as code blue and fire, were also considered prior to selection of MH. Various training methods, such as classroom training and self-study packets, were explored before selecting simulation. The following section details the literature review process.

The literature review was completed using an extensive search process through the Walden library. Search engines utilized included but were not limited to CINALHL, ProQuest, MEDLINE, Ovid, and PubMed. Search terms included but were not limited to various combinations of the following: *malignant hyperthermia, simulation, peri-operative education, teaching methods, competency* and *interdisciplinary*. Results from the various search combinations yielded approximately 75 articles. Articles were first narrowed down by publication years limited to 2010-2019 for the most current literature. Articles were further narrowed down by primary publications only to prevent dilution of

the data. The result was 28 usable articles. Articles were further sorted into the following main themes: MH, teaching methods, and simulation.

Evidence from Literature

MH is a rare patient reaction to volatile anesthetic gases and depolarizing muscle relaxants (Schaad, 2017). It results in the patient developing a hypermetabolic crisis, with extreme temperatures that can result in organ destruction. Early signs of an MH crisis include increased patient body temperature, increase end-tidal CO2 detection, spasms of the masseter muscle (preventing opening of the jaw), and increased heartrate (Seifert et al, 2014). Complications from an MH crisis include cardiac dysfunction, renal destruction, bleeding disorders (such as disseminated intravascular coagulation), respiratory complications, and even death (Riazi & Brandom, 2015). Occurrence is rare, with less than 1/10,000–1/220,000 cases happening yearly (In et al., 2017). Rates of occurrence vary with geographic location, gender, age, and occasionally race. MH fatality is preventable with early recognition and interventions, and advances in patient care have reduced fatality rates to less than 5% (In et al., 2017). MH happens most frequently in the operating room, but cases have been seen throughout the post-operative phase while patients are in the post-anesthesia care unit, intensive care unit, and even in the postsurgical care unit.

Because of the lack of exposure to patients experiencing this crisis, operating room nurses are not able to make the immediate connection to MH and provide appropriate interventions. Annual education aims to keep operating room nurses knowledgeable and competent in recognizing these symptoms. But there is debate

regarding the best way to teach students clinical content such as classroom education versus simulation education. For example, Herron, Powers, Mullen, and Burkhart (2019) compared the material presentation for 165 baccalaureate nursing students, with one group receiving the material as a written case study and the other participating in a video simulation of the same case study. Although there were no statistically significant differences in levels of satisfaction and self-confidence between the groups, the video simulation students correctly answered a higher number of posttest questions correct (Herron et al., 2019). This supports the use of simulation for a deeper understanding of the material and better engaging student learners.

A challenge with completing annual education for operating room nurses is keeping them engaged. In informal discussions with facility staff, they reported that the content is boring and uninteresting and admitted to sharing answers with each other just to complete the task. In a study on three methods of delivery—didactic lecture, engaged classroom, and simulation scenario—participants were given the same content with pre- and post-test questions as evaluation of knowledge retention. Results revealed a score increase of 6% in the didactic classroom, 11% in the engaged classroom, and 9% in the simulation (Raleigh et al., 2018). Compared to the didactic classroom, both the engaged classroom and simulation method of teaching resulted in statistically significant improvement, further supporting the use of simulation to enhance knowledge transfer. These findings support the need to enhance annual staff education in ways that engage and excite the nurses and allow for knowledge to be easily transferred into practice when facing an emergency.

Operating room nurses must also receive their annual training in a way that matches their learning style and appeals to their sense of understanding. Using simulation mannequins to train nurses allows for the development of creative, hands-on situations that resemble real-life situations such as in an MH crisis. Simulation has been shown to increase participants' critical thinking and improve patient safety (Erlinger, Bartlett, & Perez, 2019). Allowing operating room nurses to practice the skills of recognizing and treating MH in a safe environment like a simulation lab allows for learning to occur in a safe zone with no risk of harm to patients. Nurses can be exposed to situations like MH that rarely occur in real life and practice putting knowledge into practice.

Simulation started in the airline industry in the early 1930s. Over the years, medicine has slowly made the transition to health care starting early with anesthesiology training. The health care industry has been using modified simulation in aspects of code blue trainings. For the last fifty years, simulation has been used by the American Heart Association to train nurses and other responders to respond to cardiovascular emergency situations (Davis, Storjohann, Spiegel, Beiber, & Barletta, 2013). Using simulation as a method of educating staff in code blue situations has resulted in significantly increased staff confidence and improved staff reactions (Herbers & Heaser, 2016). Although there has been some debate over the effectiveness of simulation training, several studies have shown statistically significant evidence supporting the transfer of knowledge through simulation (Alt-Gehrman, 2019). However, there is a need for additional research in this area.

Simulation is currently being considered as a method of educating surgical teams such as the anesthesia team. Nurse anesthesia education programs, specifically certified registered nurse anesthetist, are using simulation to teach their students how to care for patients in emergency situations without putting an actual patient in danger. Simulation is used to train certified registered nurse anesthetist students to care for patients experiencing cardiac arrest, code blue and other emergency situations. Parsons, Kuszajewski, Merritt, and Muckler (2019) found that utilizing simulation training with new nurse anesthetists increased their knowledge and self-confidence when caring for an MH patient in the immediate time frame after the simulation.

Good simulation training transfers the learner from their physical location into the event being simulated. Students are emotionally transferred into the situation at hand, this requires some element of belief or pretend on the learner's part. Creating this altered level of reality requires the event to be created as close to real as possible with realistic equipment and patient responses (Muckler, 2016). Learners must feel comfortable in the learning environment and agree that the overall goal of the training is learning.

Developing the knowledge and skills to recognize and intervene in an MH crisis also requires the development of the nurses' confidence and competence. Creating a more confident and competent nurse increases the chances of the nurse recognizing the MH crisis and knowing the appropriate interventions. Marker, Mohr, and Ostergaard (2019) performed a qualitative approach explorative interview study of 20 first-year doctors at 6 months post 4-day simulation training. The focus of the interviews was to determine if the doctors felt improved confidence and competence in handling emergency situations

after attending the simulation-based training. Upon being interviewed, the doctors reported an overall feeling of being better prepared to handle emergency responses after attending the simulation training (Marker et al., 2019). The interviews further identified that the simulation experience needs to be as realistic as possible. Utilizing a high-fidelity mannequin in this project helps to create a more realistic environment for student learning.

It is important to examine whether realistic simulation education improves confidence and competence. Blum, Borglund, and Parcells (2010), performed a quasi-experimental, quantitative study looking for the relationship between simulation and learner self-confidence and clinical competence. The study included 53 BSN students enrolled in either a traditional lab or simulation-based lab. The student in the simulation lab reported a statistically significant improvement in self-confidence and competence from mid-term to final (Blum et al., 2010). These findings continue to support the use of developing confidence and competence, helping to support the use of Benner's theory of novice to expert in this project.

Preparing for a simulation training requires extra time on the educator's part, it is important to demonstrate effective transition of knowledge to practice when caring for a patient experiencing an MH crisis. Kirkman (2013) evaluated the transfer of knowledge and skills in students undergoing simulated education regarding respiratory assessment. Forty-two students underwent the simulation education. Students were evaluated prior to classroom content, after classroom content and after simulation training. Results of the study showed statistically significant difference in learning from the first exam to the last

(Kirkman, 2013). This project has been designed in a way follow suit in this research by testing the nurses both before and after their simulation experience. Further opportunity exists to do a follow-up test at a time frame of six months after the simulation to see if the knowledge and competency still remains.

Developing the skills to successfully care for a patient experiencing an MH crisis may not occur in one educational setting. Nurses may need to be exposed repeatedly to the content before that transfer of knowledge truly occurs. Simulation as a method of education also allows for that repeated exposure to the event. Nurses that do not meet the minimum knowledge level can be required to revisit the simulation lab at another time. The above discussed research has shown that simulation does aid the nurse in the transfer of knowledge into action. Hauber, Cormier, and Whyte (2010), used an observation study to evaluate the potential relationship between knowledge and skills performance during simulation. Results of the study found that knowledge was directly related to improved skills performance in the simulation setting. The more a nurse knows about an emergency situation the more likely he/she will be able to respond.

Simulation has also been shown to be an effect method of training in other emergency situations. Allowing for the recreation of rare (and stressful) emergency situations provides the ideal opportunity for nurses to practice until perfect. Morton, Powers, Jordan and Hatley (2019) used a quasi-experimental pilot study to exam the effectiveness of simulation training on medical surgical nurses responding to a code blue. Results showed significant improvements in skills and self-confidence. This research aids in supporting the use of this method of training for emergency situations like an MH

crisis or a code blue crisis. This project was developed in a way that the basis of training could be used with operating room nurses to train for those other emergency situations. Identifying these idea ways to education nurses helps to improve the overall outcomes of the patients we care for. This doctoral project was designed so that it can also be easily transitioned to train patients is other areas, such as post-anesthesia care unit and intensive care unit, how to care for a patient experiencing an MH crisis.

Analysis and Synthesis

Data collection is a vital component of doctoral project. The evidence collected supports the use of simulation as a method of nurses' education in emergency situations. Without the appropriate data to support this finding, the project is irrelevant. Data collection took place as described in the following paragraphs.

After achieving committee approval, the project was submitted for IRB approval per Walden guidelines. IRB approval assures that the rights and welfare of the participants in the project was protected. Following successful IRB approval the simulation was announced to the surgical nurses seeking willing voluntary participants. Participants in this doctoral project were focused primarily on the nursing staff. Because the function of the unit is heavily dependent on a multidisciplinary team, other members of the surgical team were invited to attend. Potential additional attendees included surgical technicians, anesthesiologists, certified registered nurse anesthetists, ambulatory surgery staff, recovery room staff, and anesthesia licensed practical nurses. Attendance was completely volunteer, and attendees were not compensated for their participation.

Per the feedback from the IRB committee, written consent was not obtained from participants, however they received a hand explaining their role in participating.

Prior to attendance at the simulation event, participants were asked to complete a short knowledge evaluating test on the care of a patient experiencing an MH crisis. This test was developed for this project as an 11-question test based on current evidence/standards regarding care of the patient experiencing an MH crisis. This test was developed by this author utilizing best practice guidelines on MH from the MHAUS and AORN and evaluated by project stakeholder group members including the nursing operating room director, operating room nurses, and nurse educators. Data collected from this pretest was used to compare with the results collected in the posttest phase for any improvement in knowledge. Participants then attended the simulated MH crisis event. The simulation scenario was based on current literature and evidence of the signs, symptoms and treatments required for patients experiencing an MH crisis. After the simulation crisis, participants participated in a debriefing of the events. Debriefing in simulation is important to allow the participants an opportunity to talk about the events that occurred and the actions that took place. Following the debriefing participants completed a short knowledge evaluating posttest. In this test, participants were retested on the same questions they saw pre-simulation. Results on the pretest were compared to those on the posttest to see if any knowledge was gained. Retention of knowledge could further be evaluated by having the same participants complete a follow-up test at a time frame of 6 months to a year after the simulation. In addition, the nurses were informally

questioned on their confidence in caring for a patient experiencing an MH crisis after participating in the simulation event.

All methods of ethical protection were provided to nurses participating in the doctoral project. Protections taken included keeping participants name/bio-graphical data anonymous and information collected coded by a computer randomization program and de-identified. Per IRB committee feedback, participants were not required to complete a written consent form prior to participating in the simulation; they instead received an informational handout. If at any time participants were uncomfortable or no longer willing to participate they were allowed to leave the event. Prior to implementation of this project, the IRB approval was requested from Walden University.

Participants were recruited from the pool of nurses currently working as staff in the perioperative services at the practicum site. A computerized system was utilized to analyze and de-identify the collected data. The access to the computerized system was password protected and limited to only the organizer of the project. Data will remain in the system for a period of seven years, at which at that time the data will be destroyed. At no time throughout the storage period will anyone else have access to the information.

Analysis of the data was based on descriptive statistics of percent difference between pre- and post-testing. Biographical data (such as educational level and years of experience) was only collected to characterize the project population. All collected data was kept secure and confidential. This project was completed in conjunction with the education department at the writer's place of employment. All collected pre- and post-tests were given to the education department at the facility for de-identification and

returned to the writer for a secondary data analysis. This additional step aided in keeping participants anonymous and confidential.

Because of time limitations posed by the clinical site, the simulation was only allowed once. Data to answer the project question was derived from nurses who completed the pre- and post-test and participated in the educational simulation project. Based on current staffing at the proposed time of the training, the participants included a pool of 15 interdisciplinary nurses from perioperative services. No nurses were allowed to provide data after the event was concluded.

Results on the pre- and post-test were compared to determine the effects of the educational methods. Results showed that 78.6% of nurses did increase their posttest results after participating in the MH simulation education. Nurses also indicated an increased confidence level of caring for a patient experiencing an MH crisis after attending the simulation event.

Summary

Identifying a meaningful way to educate nurses in the recognition and care of a patient experiencing an MH crisis is important to prevent potential patient deaths. Review of current literature supports the use of simulation as an effective method of education to improve the knowledge transfer in attendees. Nurses' willing consent to participate in the IRB approved study allowed collection of data from pre- and post-simulation tests on basic knowledge of MH. Data collected were protected and stored for a period of seven years prior to being destroyed. Data collected were analyzed for statistical significance in improvement of the nurses' knowledge. The next section will discuss the findings and

implications of the project. It further identifies strengths and limitations of the project and makes recommendations for future research.

Section 4: Findings and Recommendations

Introduction

Preventing adverse patient outcomes like an MH crisis is a goal of health care providers. The project organization has never experienced an actual MH crisis; however, the perioperative nurses need to be ready to recognize and respond to an MH crisis and there was a gap in nursing knowledge to care for MH emergencies. Therefore, the practice-focused question for this project asked whether MH multidisciplinary simulation education could improve the knowledge of MH management by operating room nurses in the operating room setting. The purpose of this doctoral project was to design a method of educating operating room nurses so that they gain that knowledge. To answer the project question, data were collected from the nurse participants in the MH simulation in the form of pre- and post-simulation tests. Nurses completed the pre- and post-test simulation questionnaire evaluating their knowledge of the signs and symptoms of MH and how to treat it. Collected data were analyzed utilizing descriptive statistics via percent difference in pre- and post-test test scores. The next section will detail the results found.

Findings and Implications

This simulation project was designed to transfer nurses into a rare MH crisis so that they could experience and practice caring for the patient, gaining knowledge of MH treatment. Simulation requires a realistic scenario and the thorough debriefing afterward. Careful planning allowed this simulation education project to provide appropriate learning. The simulation sessions were conducted in an unoccupied operating room

utilizing a mannequin as the patient. Time was taken to enhance the scenario with realistic surgical drapes, equipment, and sounds (see Figure 1). Providing an environment that was as close as possible to a real surgical case helped the learners be to immersed in the scenario.

Figure 1. Operating room set-up for simulation.

The design of this project was a one group pre- and post-test staff education via a simulation session. Participants gathered in an empty operating room that was transformed to represent a surgical case. Once inside, they completed a short pre-simulation test to assess their baseline knowledge on MH. After the pretest, nurses participated in the simulation scenario. The scenario started with a brief introduction to the selected case and patient history. Participant volunteers were called on to play the role of the different perioperative team members (anesthesiologist, surgeon, scrub technician, and circulating nurse). Another participant volunteer was designated the unit charge nurse. As the MH simulation unfolded, the nurses responded to the patient's MH signs and symptoms to the best of their abilities. After completion of the scenario, debriefing was conducted. Together, the participants were led back through the MH simulation

scenario, this time pausing to discuss areas for learning. When the debriefing was complete, participants had an opportunity to ask questions before completing the short post-simulation test. The posttest was a repeat of the pretest, designed to evaluate the participants' growth in knowledge of MH. The entire education session took approximately an hour from start to finish.

There were 15 nursing participants in the event; 14 completed both the pre- and post-simulation test, but data were not collected on one participant because of an unforeseen issue before taking the posttest. Therefore, project data from 14 nurse participants were collected and analyzed to answer the project question. To characterize the project participants, demographic information was collected with the pretest. The participants included a multidisciplinary array of staff nurses from the perioperative department. Demographic data collected with the pretest included age, education level, years in health care/perioperative and if the participant had ever experienced an MH crisis before. Results indicated that participants' ages ranged from 32 to 59 years old, with the median age of 47.6 years. Participants included an operating room director, an assistant nurse manager, multiple circulating nurses, an anesthesia licensed practical nurse, several post-anesthesia care unit nurses, and an ambulatory nurse. Education levels varied by participant (see Figure 2).

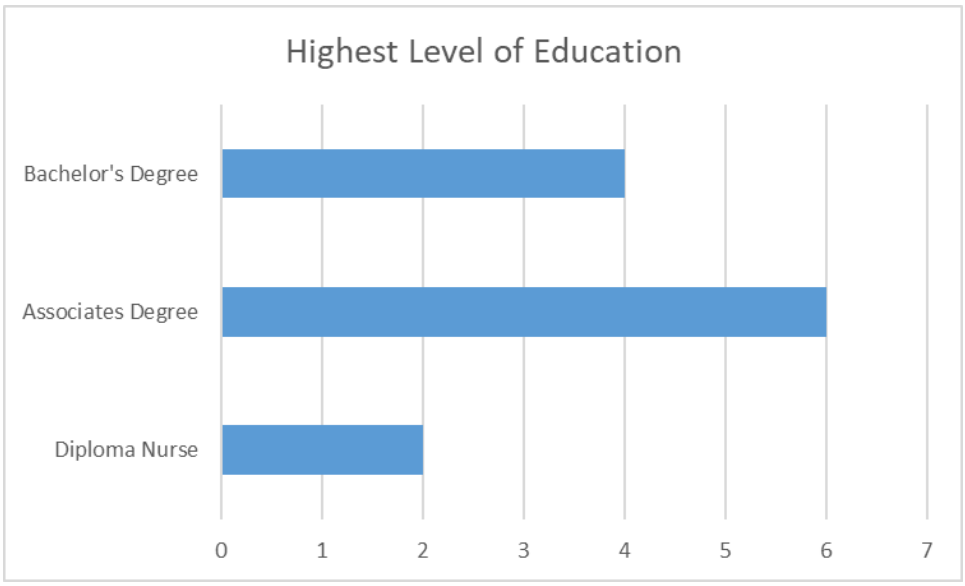

Figure 2. Nurses reported highest level of education.

Additional demographics showed that participants worked from 5 to 35 years in the health care setting, with the average length of time being 23.9 years. The years of experience in the perioperative setting was from 1 year to 24 years, with the average length of time being 9.5 years. When asked if they had ever experienced an MH crisis, 92.8% responded *no*, whereas only 7.2% responded *yes*.

To answer the project question, the 14 pre- and post-tests were analyzed using descriptive statistics for percent difference. The tests were comprised of 11 multiple-choice style questions via a project developed questionnaire. The questions were designed to test the key information associated with caring for a patient experiencing an MH crisis. The average prescore was 8.2 correct answers (74.5%), whereas the average postscore was 10.0 correct answers (90.9%). Analysis revealed that the MH simulation education program improved scores by 16.4% from pretest score to posttest score (see Figure 3).

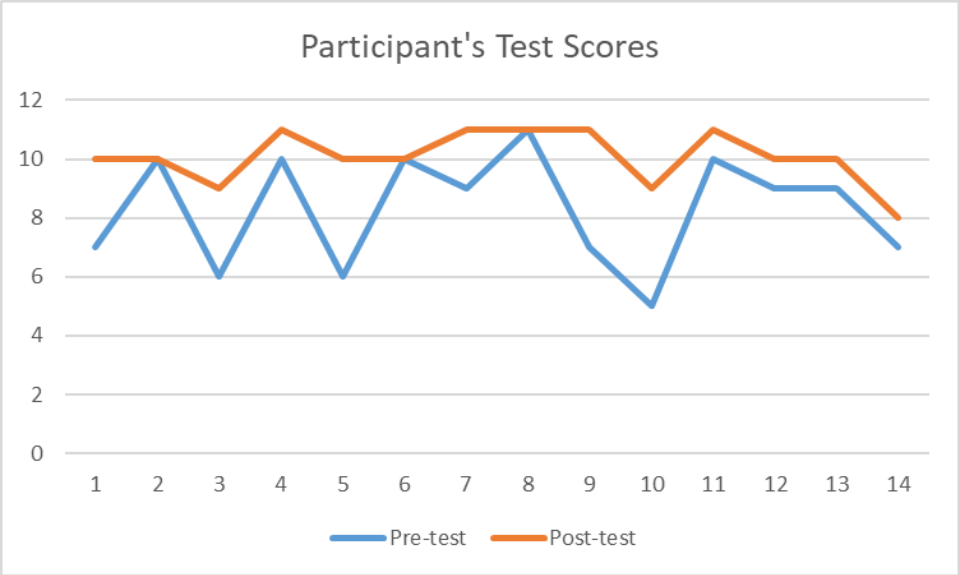

Figure 3. Nurses' pretest scores and posttest scores.

Additionally, individual test question analysis revealed that 63.6% of test questions had an improvement in the number of correct answers. The average of improvement in individual posttest question score was by 3.22 points (23 %; see Figure 4). Two questions remained the same (with 100% correct response pre and post), whereas two questions resulted in a negative change. One question that resulted in a negative change was related to whether an MH susceptible person could safely have surgery performed. This is a decision that is often made between the patient and the anesthesia care provider, prior to the patient meeting the perioperative nurse. The negative change was minor (7.1% or one participant less), although this question in the questionnaire could be reviewed for clarity if used in subsequent projects.

The second question that resulted in a negative change was one regarding the characteristics of an MH crisis. This negative change was also minor (7.1% or one participant less). In reflection upon this question, it became obvious the confusion

occurred during the actual simulation. When presenting the past medical history of the simulation patient, it was shared that the patient had an underlying neuromuscular disorder. It was later discussed in the debriefing that such a history could potentially predispose the client to an MH crisis. When repeating this education event, this patient detail should be removed from the patient history and the wording of the answer choice should be revised for clarity. Implications overall on patient care remained minimal as the nurses were still able to identify the key signs and symptoms of an MH crisis.

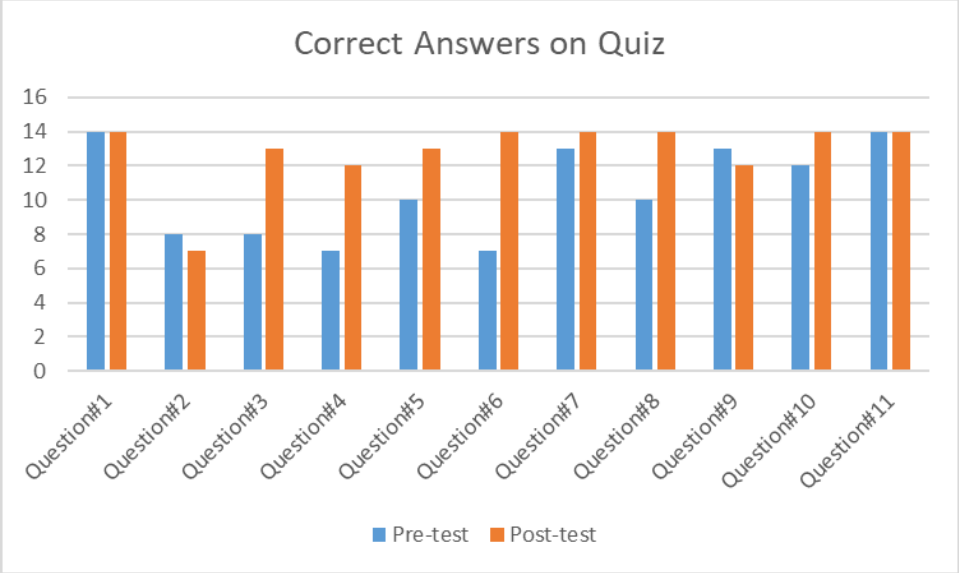

Figure 4. Nurses' individual question analysis pre/posttests.

Perioperative nurses, in general, tend to have longer lengths of service than some other areas of nursing. Results from this study found the average length of perioperative experience to be 9.5 years. A finding explored was whether length of perioperative service led to more knowledge around caring for patients experiencing an MH crisis. To answer this, years of perioperative service were compared to pretest scores. No apparent

relationship exists between the number of years worked in the perioperative environment and the pretest scores (see Figure 5).

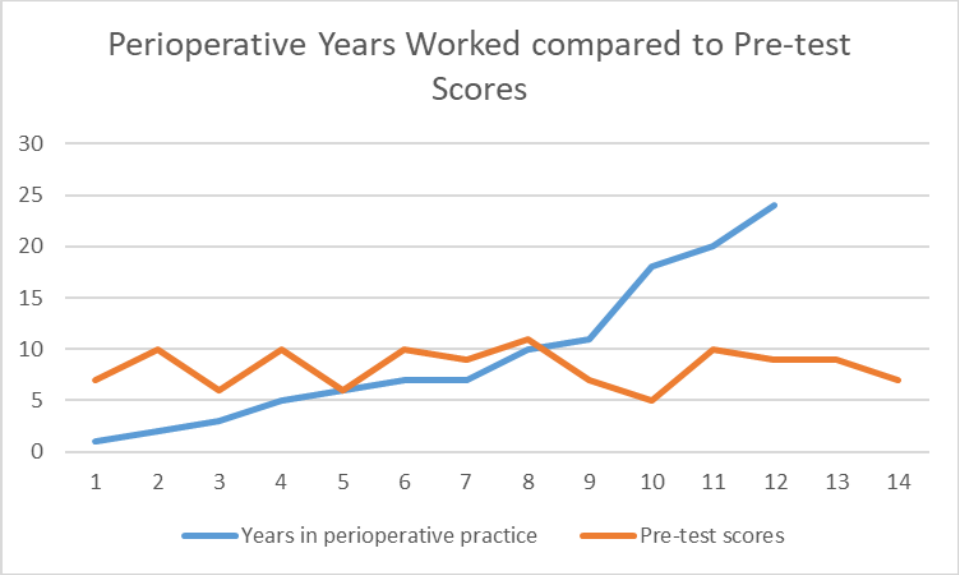

Figure 5. Nurses' years of perioperative service compared to pretest scores.

At posttest, participants were asked to rate their confidence level regarding caring for an MH event: comparing their post confidence to that before the scenario, and to rate the use of simulation in general. Answers were scored on a five-point Likert scale with one being the lowest rank, three being neutral and five being the highest. Overall the participants reported feeling more prepared to care for a patient experiencing an MH crisis after attending the simulation (see Figure 6). They reported strong feelings that simulation was a good way to learn about MH, and that given the choice for other trainings they would pick simulation. Results from these questions were gathered for information only and not used to validate the success of the project.

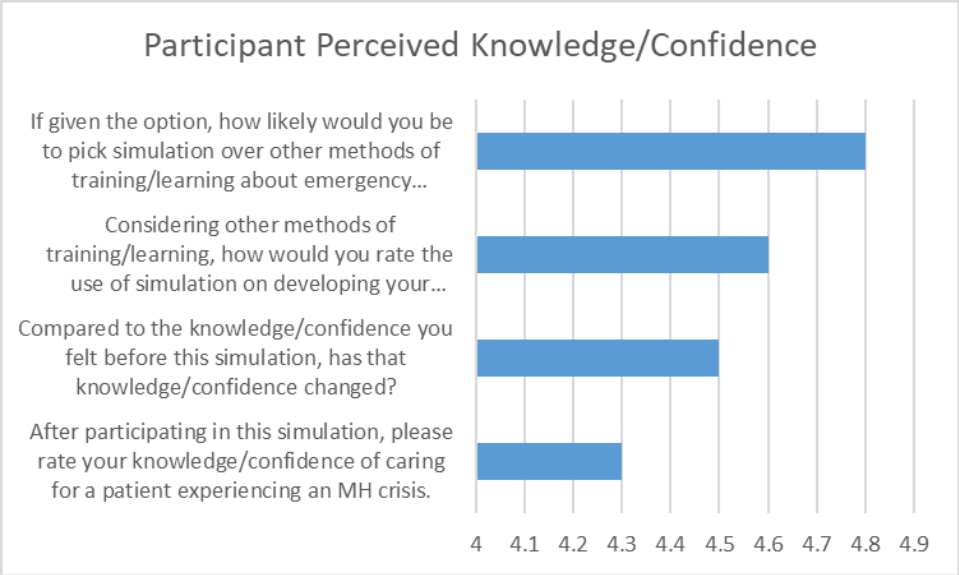

Figure 6. Nurses' perceived knowledge/confidence.

When nurses are faced with an MH crisis, one of the early steps in caring for the patient is retrieving and utilizing the MH cart (cart of potential supplies gathered together). An unanticipated finding during this project was the lack of staff cohesiveness when it came to utilizing that cart. The staff member that was sent to retrieve the cart initially had issues due to unawareness that the cart was plugged into the wall. When the cart arrived in the room, staff were unfamiliar with locating contents within it. They were unfamiliar with role cards located in the top drawer and the use of them to facilitate the emergency situation. Staff were even seen searching for the MHAUS emergency number although it was posted in clear sight on the front of the cart. Although these unanticipated findings seem daunting, they actually supported the need for a regular simulation training to prevent this type of chaos from happening in an actual emergency event.

Implications from the results of this project are far reaching. From an individual perspective this gave each nurse an opportunity to see how knowledgeable he/she was

when it came to an MH crisis. By completing the pre- and post-test, each nurse had an opportunity to reflect on their own preparedness in the event. From an institutional and system perspective, this project gave the hospital an opportunity to see a gap in knowledge to practice and take positive action towards correcting it. It also provided substantial support in utilizing simulation as a method for training for other emergency situations both inside and outside the operating room. These enlightenments to the current state of patient care also gives the organization and opportunity to improve and develop a better perspective from the community perspective.

The results of this project support positive social change in several ways. First, from a nursing perspective, this project's design demonstrated improved knowledge of patient care in an MH crisis for all participants resulting in improved patient outcomes. It fosters participants to continue lifelong learning, seeking knowledge to improve patient care. It also adds to the existing body of knowledge already supporting simulation in learning. From a community perspective, this project improves nursing knowledge and that knowledge will lead to improved patient outcomes during MH events. Improved patient outcomes results in increased community confidence of the local hospital and the care they received, creating positive social change.

Recommendations

This project has shown that a well-developed simulation program can enhance the knowledge and perceived confidence of participants in an MH crisis. Based on the results of this project, recommendations would be to further develop and continue using simulation as a method of educating nurses both inside and outside of the organization.

Recommendations to the organization would be to start by doing an analysis of their annual operating room education. Identify and select those that would best be administered in a simulated manner. The first to start with should be MH, since the results of this project has shown its effectiveness. Standards should be developed and put into place that define what educational activities the operating room staff complete on an annual basis and which ones are to be offered in a simulated manner. Offering these simulated educational events can be supported through AORN toolkits and already developed simulation packets found accessible on their website to any member. Scenarios such as MH and code blue would be cost effective to offer utilizing the organization's already owned simulation equipment.

MH occurs most frequently in the operating room but has also been seen in patients during their postoperative phase. Patients have experienced MH crisis in phase one recovery (post anesthesia care unit), phase two recovery (the nursing floor/ambulatory post-surgery/intensive care unit), as well as coming back in to the emergency room in a crisis. A proposed secondary recommendation would be to expand the simulation offering to nurses working outside the operating room. The organization already owns its own simulation equipment. If the education staff are not able to develop their own simulation scenarios there are numerous available on web both for free and for purchase. With a little education and staff training/practice, these simulation scenarios can be easily developed. Nursing staff also need the managerial support to get them to the simulation events as offering simulation education is less effective when the staff that most need the education are unable to participate.

Contributions of the Doctoral Project Team

The success of this project was largely in part due to the cooperation of the project team. The primary stakeholders were the operating room nurses. Working closely alongside them we identified gaps in knowledge surrounding the care for a patient experiencing an MH crisis. Together we brainstormed to find a meaningful way to fill that gap. The perioperative nurses helped to shape the simulation scenario into one that could reasonability be executed and completed in the allotted time frame. Those primary stakeholders took accountability in working towards improving the outcomes for everyone. After completing the MH simulation scenario, nurses have begun to discuss other trainings that would be more meaningful presented in a similar way, using simulation. They are seeking input from the operating room director and the education department as to ways they can be involved. Their goal is to have something in place by next year.

Strengths and Limitations of the Project

Both strengths and limitations can be found in this project. One identified strength was the involvement of various members of the surgical team. In attendance, one could find an operating room director, an assistant nurse manager, multiple circulating nurses, several post-anesthesia care unit nurses, an anesthesia licensed practical nurse and an ambulatory nurse. This solid team of 15 interdisciplinary nurses gave strength to the results found.

Another strength of the project was the manner in which it educated the staff. Using simulation brought into the mix an active way to learn. Nurses were engaged and

actively participating in the mock MH crisis. Active learning helps to solidify the knowledge and transfer easily into practice in those emergency situations.

The first identified limitation was the lack of participation from anesthesia providers and/or surgeons. While the event was attended by an anesthesia technician, no anesthesiologist or certified nurse anesthetist was in attendance. As noted throughout this project, care of the patient in the operating room is really a team effort. Having members from both those teams would have enhanced the entire experience.

Another identified limitation was the time constraint of the project itself. To really test the knowledge retention of this simulation event, participants should be re-tested again at an extended interval of time. An ideal follow up would be to have participants complete the posttest at the 6-month time window and compare those results to those found immediately following the simulation.

A future project, similar to this one, which could add further strength to the research surrounding the use of simulation in MH training would be to run two different education groups. One group would receive traditional classroom training while the other group would participate in a simulation event. Each group would take the same pretest and same posttest. Comparison could be made between the two groups. Further research could be done at a 6-month time frame, with all participants taking the same posttest. Again, results could be compared to see if one group stood out from the other in knowledge retention.

Section 5: Dissemination Plan

Program development is not worth the time and commitment if the results are not disseminated to those who can benefit from them. The same is true for the results from this staff education project. An appointment has been scheduled to discuss the results of this project with both the director of the operating room and with the education department at the hospital. The operating room director will be provided the basic knowledge of the participants in regard to management of an MH crisis as well as the participants' thoughts on simulation for other methods of training. Additionally, the incidental findings surrounding the relationship between confidence and simulation training will be shared with the education department. The organization recently purchased a simulation mannequin and is working to utilize it in staff trainings. The results from this project can help support the continued use of routine and annual staff education.

Analysis of Self

Completing this doctoral project has been an overwhelming but fulfilling accomplishment. In my role of practitioner, I have also grown and solidified my knowledge of MH. As a scholar, I have worked to identify a knowledge-practice gap and researched how to close this gap. I have learned to enjoy researching topics for the most up-to-date evidence. As a project manager I have learned my weakness of time management and my strength of perseverance. I have learned to tackle the impossible task during the most impossible times. This project aligns with many of my long-term

professional goals to continue to develop and disseminate evidence-based research and refine nursing practice.

Summary

Providing the best patient care is the focus of health care. Patients deserve quality care that is reflected in positive patient outcomes. Identifying ways to train nurses so the knowledge-to-practice gap is addressed will help maintain ideal outcomes. Providing e trainings utilizing the most current evidence-based practice is key. The results of this doctoral project support the use of simulation to educate operating room nurses in the care of patients experiencing an MH crisis. The project's incidental findings surrounding the relationship between knowledge and confidence provides support to the additional use of simulation in other areas of education. Staff educators can develop nursing simulation education experiences to reduce or eliminate negative patient outcomes.

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