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Student Registered Nurse Anesthetist Simulation Training with the Use of Cognitive Aids in Malignant Hyperthermia Recognition and Treatment

Daniel Martin

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STUDENT REGISTERED NURSE ANESTHETIST SIMULATION TRAINING WITH
THE USE OF COGNITIVE AIDS IN MALIGNANT HYPERThERMIA
RECOGNITION AND TREATMENT

by

Daniel B. Martin

A Capstone Project
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December 2017
STUDENT REGISTERED NURSE ANESTHETIST SIMULATION TRAINING WITH THE USE OF COGNITIVE AIDS IN MALIGNANT HYPERThERMIA RECOGNITION AND TREATMENT
by Daniel B. Martin
December 2017

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ABSTRACT

STUDENT REGISTERED NURSE ANESTHETIST SIMULATION TRAINING WITH THE USE OF COGNITIVE AIDS IN MALIGNANT HYPERThERMIA RECOGNITION AND TREATMENT

by Daniel B. Martin

December 2017

One of the most stressful times in the life of a student registered nurse anesthetist (SRNA) is during the integration of didactic work with that of clinical anesthesia practice (Chipas et al., 2012). One method that has been proven effective in other avenues of student nursing education is the use of procedural simulation labs. These simulation labs allow SRNAs to experience what it is like to be in the operating room setting, while also showing distinct differences within each case, treatment, and the importance to be familiar with all aspects of anesthesia. The purpose of this project was to examine if SRNA’s found the use of cognitive aids increased their confidence in the recognition and treatment of a simulated malignant hyperthermia crisis. The population of this project was all SRNAs enrolled in the doctoral-level NAPs. For ease of accessibility the sample used for the project was the SRNA class of 2018 for the academic institution’s NAP. Inclusion criteria was students who have their bachelor of science in nursing degree, are of varying ages, backgrounds, and experience levels. No exclusions were made based on previous experience with simulation, or demographic data. The only exclusion criteria were of SRNAs who previously had experience in the clinical setting managing an MH crisis. SRNAs were placed into two groups at random. One group received simulation training using the cognitive aid, while the second group received simulation training
without the use of a cognitive aid. A pre/post-test design was used to determine if the students found the use of the cognitive aid beneficial during the crisis. For ethical considerations, after the post-test results were collected the control group received the same simulation as the test group. While the increase in confidence levels of both the cognitive aid and control group were 16% post-simulation, an independent t-test showed that the difference in the confidence levels was not significant, \( t(12) = -1.15, p = 0.14 \). Regardless of the findings, SRNAs involved in the project stated they believed that the cognitive aids were beneficial, and plan to continue their use in their operating room practice.

Keywords: simulation training, student registered nurse anesthetist, MH, and cognitive aids.
ACKNOWLEDGMENTS

I would like to thank my committee chair, Dr. Cathy Hughes, and the other members of my committee, Dr. Michong Rayborn and Dr. Marjorie Everson, for guiding me through the process of completing my doctoral project.
DEDICATION

I would like to thank my fiancé for her love, support, and sacrifices she made while I earned my Doctorate of Nursing Practice degree. I would also like to thank my parents, family, and friends for their continued love and support throughout this process. Without these people in my life this would not have been possible.
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<tr>
<td>AANA</td>
<td>American Association of Nurse Anesthetist</td>
</tr>
<tr>
<td>CRNA</td>
<td>Certified Registered Nurse Anesthetist</td>
</tr>
<tr>
<td>DNP</td>
<td>Doctorate of Nursing Practice</td>
</tr>
<tr>
<td>MH</td>
<td>Malignant Hyperthermia</td>
</tr>
<tr>
<td>NAP</td>
<td>Nurse Anesthesia Program</td>
</tr>
<tr>
<td>NLN</td>
<td>National League of Nursing</td>
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<tr>
<td>OR</td>
<td>Operating Room</td>
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<tr>
<td>SRNA</td>
<td>Student Registered Nurse Anesthetist</td>
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CHAPTER I – INTRODUCTION

Clinical Question

For second year student registered nurse anesthetist (SRNA) in a Doctoral Prepared Nurse Anesthesia Program (NAP) is case simulation training using cognitive aids, when compared to those with case simulation not using cognitive aids, beneficial in increasing confidence to recognize and treat malignant hyperthermia (MH)? The use of clinical simulation experiences allows educators to provide SRNAs with the ability to treat patients in a controlled environment. Using simulated MH conditions allow educators to foster an expansion of knowledge on the subject while maintaining a controlled environment to evaluate and or instruct the student without fear of adverse outcomes to the patient.

Introduction

One of the most stressful times in the life of a SRNA is during the integration of didactic work with that of clinical anesthesia practice (Chipas et al., 2012). During this time, there are overwhelming feelings of excitement, followed by anxiety, and then questions of whether or not he or she is prepared enough to take this next step in their education. One method that has been proven effective in other avenues of student nursing education is the use of procedural simulation labs. These simulation labs allow SRNAs to experience what it is like to be in the operating room setting, while also showing distinct differences within each case, treatment, and the importance to be familiar with all aspects of anesthesia.
Background

MH is a medical emergency that is rarely seen in the clinical anesthesia setting due to vigilance and protocols in place to try to protect patients from known triggers. Due to the rarity of direct experience with MH in patients within the clinical setting, there is a need to supplement SRNA training with didactic and simulation experiences. While the rarity of such a medical problem is one example to the use of evidence-based practice for patients, it can have a down side among providers, namely lack of experience with the disease and treatment. Clending (2016) depicted a surgical procedure at Monroe Carroll’s Pediatric Hospital at Vanderbilt University where the patient exhibited signs and symptoms of MH, and due to the quick response of the anesthesia providers and operating room staff who had just undergone MH simulation training, the patient had a positive outcome with no problems after treatment.

Significance

There are currently 116 accredited NAPs across the United States training SRNAs to care for patients every day. The MH Association of the United States lists the exact figures as unknown. Estimates show the incidence could be as high as 1:100,000 in adults, 1: 30,000 in pediatric patients, and the number of patients that are genetic carriers that make them susceptible is around 1: 2,000 patients (MH Association of the United States, n.d.).

Problem Statement

This project looked to determine if the use of simulation training with cognitive aids was beneficial to SRNAs confidence in the recognition and treatment of MH. MH is a potentially deadly reaction to anesthetic drugs that is rarely seen in the operating room
setting. The use of simulation training allows anesthesia educators to expose SRNAs to situations they otherwise might not experience in the clinical setting.

Purpose

The purpose of this research project was to determine if the use of simulated operating room experience with cognitive aids was effective in increasing confidence levels of SRNAs in the recognition and treatment of MH. This type of operating room training is vital to the education of SRNAs who may otherwise never clinically experience such an event. Providing these clinical experiences for SRNAs allow them to build upon their didactic knowledge and develop their clinical skills.

Needs Assessment

The (S) strength of this project was that it provided students with exposure and experience with MH that they might not otherwise get. The simulation allowed the student to see the real time patient reactions to a MH crisis within the operating room setting. Weaknesses (W) of this project included small focus group size, cognitive abilities of the reader in the simulation, and limited resources to produce the simulation model.

There were valuable experiences (O) as well as educational benefits to be gained through this research project. Developing better simulation models that will help to better educate students, and in turn, lead to better patient outcomes. Things that threaten (T) to skew the results of this research project involved the student’s willingness to participate in such an experiment, whether or not they will be honest in their evaluations of the project, the possible number of SRNAs practicing clinically, as well as the number of MH cases and deaths that are reported annually.
Synthesis of Evidence

A comprehensive literature review was conducted to discover articles that were relevant to SRNA simulation training practices using cognitive aids related to MH emergencies during anesthesia and the effects these practices have regarding SRNA information retention. The electronic databases used to perform the searches were EBSCOhost, and Google Scholar. The inclusion criteria used to determine relevant articles were that they were full text, peer-reviewed, English language, and written within the last seven years. Initial searches with the keywords yielded 307 articles. After adjustments to include no articles written prior to 2010, the search revealed 25 articles. The keywords that were used in this search for articles included simulation training, student registered nurse anesthetist, MH, and cognitive aids. Of the 25 articles discovered from this search, only the 10 articles that focused on the use of cognitive aids in SRNA simulation training were included in the project.

Use of Simulation in Training

The American Association of Nurse Anesthetist (AANA) (2015) position statement regarding the preparation and treatment of MH supports this method of emergency preparation to develop and evaluate team member and plan preparedness. The AANA position statement goes on to develop ways to improve the treatment plan. These ways include a debriefing from the simulation training, along with continual training through simulation to become more familiar with it ensuring better patient treatment translating to improved patient outcomes (AANA, 2015). Mullen and Byrd (2013) discussed the use of simulation techniques to prepare team members on how to react to problems that can arise during an emergency, as well as evaluations of team
members and procedures to ensure that the operating room (OR) team can respond quickly and appropriately to anesthetic emergencies. Through repeated simulation and evaluation of the planned response to a MH event, it is possible to not only improve the patient outcome, but also the providers feeling of preparedness, along with their comfort in using the cognitive aid if one is available (Cain, Riess, Gettrust, & Novalija, 2014). Hawkins et al (2014) showed that practicing certified registered nurse anesthetists (CRNAs) believe that simulation is an effective teaching tool that should be considered in use for initial certification as well as continuing education opportunities.

**Cognitive Aids**

The use of cognitive aids during rare medical emergencies can be extremely useful for healthcare providers. According to Goldhaber-Fiebert and Howard (2013), there were four elements essential to the framework of building a cognitive aid: create, familiarize, use, and integrate. The authors of the study concluded that the use of cognitive aids meet a need with providers, and that even though the implementation cost may be high they outweigh the cost of additional patient care and services if not used. (Goldhaber-Fiebert & Howard, 2013). Cognitive aids are meant to benefit providers during high stress situations, aiding them by providing information needed to quickly react to an emergency in a quick and easy to use format. (Watkins et al., 2015). Cognitive aids have been around for more than 30 years, with Stanford being one of the universities involved in the early development for use in anesthesia training. In their study, Pollock, Berekynie, Nandagopal, Howard, and Goldhaber-Fiebert (2014) discussed how the university has evolved their use of cognitive aids in the operating room in conjunction with its use in training to allow providers to better utilize the information.
Another cognitive aid that has been used within the operating room setting is the MH Association of the United States cognitive aid MH treatment poster, which was one of the earliest used in anesthesia. It has evolved over the years to use colors, easy to understand pictures, along with an easy to follow algorithm making its use much more effective. This aid has been in use since 1991 and there are still a large number of providers and operating rooms utilizing this version of a cognitive aid are a testament to the benefits it serves in aiding the treatment of MH (Pinyavat, Wong, & Rosenberg, 2014).

The use of checklists in the operating room setting are modeled after those used in the aviation industry (Weiser et al., 2010). They increase safety through aiding the provider in catching errors and possible oversights within routine anesthetic care. Cognitive aids must focus on precise steps or events to be effective in increasing patient safety for providers. Ultimately it is still the responsibility of the provider to ensure he or she is providing the safest care possible to each patient they care for (Krombach, Marks, Dubowitz, & Radke, 2015).

Benefits of Simulation Focused on MH

Clendening (2016) showed the benefits of simulation training for MH and the affects it can have on real life patients. The CRNA and OR staff recently completed MH crisis simulation training. As a result of the recent MH training the team responded accurately and efficiently to save the child’s life. The findings of this study serve as an example of the clinical applications of using simulation to train providers for response in an anesthetic emergency. (Clendening, 2016). The AANA position statement on the treatment of MH stresses the importance of having an MH plan, which helps to show the
significance of performing the proposed plan of treatment to assess its effectiveness (AANA, 2015). The position statement also indicated the importance of continuous improvement of the plan, which involves the debriefing process to develop ways to improve it. This is another staple of the practice of simulation training. The last point made within the AANA position statement is about ongoing competency. The more training and familiarity a provider has with such an experience the better providers are able to understand their roles, and the flow of the MH treatment plan to ensure the best possible outcome for the patient (American Association of Nurse Anesthetists, 2015).

*Developing Simulation Drills for MH with Cognitive Aids*

There are a number of important aspects to developing effective MH drills to better prepare anesthesia providers. Things that are important to include within the simulation drill include identifying signs and symptoms, preparing dantrolene, use of cognitive aids, along with participating in the debriefing process after the drill (Dirksen, Wicklin, Mashman, Neiderer, & Merritt, 2013). The AANA position statement (2015) stated the importance of having a treatment plan for MH, this point emphasized the importance of practicing and perfecting the proposed plan of treatment.

*Theory*

The Jeffries Simulation Theory provides a framework for researchers and educators to base simulation training development on to achieve the highest results among participants. The theory takes into account attributes of the participants that can affect the outcomes of the simulation experience. Through analysis of the basic components that influence simulation work the theory gives a better understanding of where changes can be made or adapted to determine training methods that will be the
most effective. The Jeffries Simulation Theory framework allows researchers to assess and implement interventions within the clinical simulation experience to determine what is effective in achieving the optimal learning environment for the participants. The basic framework of the theory is made up of five categories: teacher, student, educational practices, simulation design characteristics, and outcomes (Jeffries, 2016). By giving a basis on which to evaluate the influences that go into creating a successful simulation experience, the theory allows the researcher to determine which influences would have the greatest impact on the specific area of interest (Groom, Henderson, & Sittner, 2014). The National League for Nursing (NLN), Pamela Jeffries, and Jeffery A. Groom PhD, CRNA developed the Jeffries Simulation Theory to provide researchers and educators with a better way to develop and evaluate simulation training. The theory helps to explain the influences within a clinical simulation experience through exposing how the known relationships within the simulation affect each other. This theory allows the researcher to develop a strong foundation for research studies, education, and provides a framework to build and determine the most effective methods of simulation training (Jeffries, 2005).

DNP Essentials

The eight Doctorate of Nursing Practice (DNP) essentials are paramount to building a quality doctoral project, and should always be on the mind of the DNP prepared nurse. The DNP essentials are the path by which the DNP prepared nurse relates clinical questions and purposes to patient outcomes to advance clinical nursing practice. The following paragraphs describes how this research project addressed each aspect of the DNP essentials.
**Essential One: Scientific Underpinnings for Practice**

This project was directed towards improving the retention of information for SRNAs in the recognition and treatment of MH. The author attempted to determine if the addition of simulation with cognitive aids to the didactic learning schedule of SRNAs would improve information retention. Increased awareness of pathology and signs and symptoms will lead to a more knowledgeable provider.

**Essential Two: Organizational and Systems Leadership for Quality Improvement and Systems Thinking**

This project reviewed the current didactic curriculum of the NAP to determine where the addition of simulation teaching would be most beneficial to the SRNA. The conclusions drawn from this project could be used to determine teaching schedules that would provide the optimal learning experience for each student within the program. These quality improvement methods could then be shared with other NAPs to aid in the development of a simulation training program.

**Essential Three: Clinical Scholarship and Analytical Methods for Evidence-Based Practice**

This essential focuses on using research to identify provider needs within the clinical setting. Understanding the importance of applying evidence-based interventions and determining the best practice for providers is a part of the role development of the DNP researcher. By conducting a review of literature to determine the most current accepted evidence-based practice regarding the use of simulation in the training of medical professionals, this project has instituted that practice into the simulation experience for the SRNA.
Essential Four: Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care

The project addressed this essential through the use of the simulation lab, including the computer system and simulation man, maintained by the NAP. Through the use of real time clinical changes in the patient’s condition, as well as adaptations to the condition related to the interventions performed by the SRNA. The simulation lab allows the SRNA to obtain clinical experience within the safest setting possible.

Essential Five: Health Care Policy for Advocacy in Health Care

The policy that would most be most affected through this project would be that of doctoral NAP’s regarding the integration of simulation into teaching policies. Influencing teaching policies demonstrate the leadership qualities of development and implementation that this essential is based on. This doctoral project also meets this DNP essential through the development and evaluation of provider practice.

Essential Six: Interprofessional Collaboration for Improving Patient and Population Health Outcomes

This project addressed this essential through the simulation experience in which students assumed different roles within the operating room setting. The CRNA role was expected to delegate task to other roles to aid in the care of the patient. The other roles portrayed during the simulation allowed participants to experience delegation, and interprofessional collaboration to meet the need of treating the patient during the MH crisis.
Essential Seven: Clinical Prevention and Population Health for Improving the Nation’s Health

Clinical prevention was addressed within this project through the preoperative steps of assessing the patient’s risk of MH. Intraoperative recognition of vital sign changes that signal the provider of what may be happening to the patient is another part of this clinical prevention essential. The final portion of this essential met by the doctoral project was the development and implementation of a treatment plan by the anesthesia provider.

Essential Eight: Advanced Nursing Practice

This project addressed this essential through teaching students involved in the simulation the advanced nursing practice of anesthesia. Another aspect of this essential met by the doctoral project is the CRNA performing a complex and comprehensive assessment of the situation and patient status to determine a treatment plan. Finally, the implementation of the treatment plan by the provider showed an advanced level of clinical judgement in providing evidence-based care for the patient during the simulated MH crisis.

Summary

Chapter I reviewed the background and significance, theoretical framework, and the purpose of the project. As well as the way, the research plan addresses the doctorate of nursing practice essentials within this project. The studies discussed in this review of literature were used to demonstrate the educational and practice benefits of simulation training for the clinically practicing SRNA. The following section will describe the
methodology, design, as well as data and analysis techniques that were utilized in performing this project.
CHAPTER II - METHODOLOGY

Method of Exploration

The project focused on an experimental descriptive project by assessing the
SRNA’s confidence level before and after completing the simulation. This type of focus
makes this doctoral project ideal to observe and record the effects of simulation training
with the use of cognitive aids on SRNAs confidence in their reaction and response to a
MH crisis. Experimental designed studies provide the best controls against any outside
variables and provide the highest levels of internal validity. These types of studies often
generate the most reliable types of research outcomes and conclusions (Zaccagnini &
White, 2013).

Design

There were two groups in this project, the control group, and the intervention
group, both of which were determined using a random number generator. The group that
did not receive the intervention was the external control group against which the agent of
interest was compared. In these types of projects cohort studies are extremely useful
because this allows the researchers to ethically study causes that affect the outcome and
the process through which it was achieved. The doctoral student constructed a pre-
simulation survey and post-simulation survey, along with a post simulation debriefing.
These aspects of the project are part of the framework of The Jeffries Simulation
Theory’s design characteristics to develop student learning and outcome achievements
expected of the simulation (Jeffries, 2005). The quizzes and simulation experience were
provided only in English language, because all of the participants in the project were
English speaking. The groups were each given instructions regarding the pre-simulation
survey, simulation expectations, and post-simulation survey. After completing the pre-
simulation survey, the groups each participated in the simulation, and then in debriefing
and post-simulation survey. All participants were required to complete the given quizzes
as a part of participation in the research project. Demographic information that was
analyzed within the project included gender, age, years of OR experience, and
race/ethnicity.

Population

The population of this project included all SRNAs enrolled in the doctoral-level
NAPs. For ease of accessibility the sample used for the project included the SRNA class
of 2018 for the academic institution’s NAP. Inclusion criteria included students who
have their bachelor of science in nursing degree, were of varying ages, backgrounds, and
experience levels. No exclusions were made based on previous experience with
simulation teaching, or demographic data. The only exclusion criteria made included
SRNAs who had previous experience in the clinical setting managing an MH crisis.
SRNAs were placed into control and interventional groups using a random number
generator. The first group received the simulation training with a cognitive aid and
debriefing post-training exercise, while the second group received simulation training
without the use of a cognitive aid and a debriefing post-training exercise. The two groups
of students were divided into groups of three to four students per simulation with the
roles as follows: certified registered nurse anesthetist, surgeon, operating room
technician, and circulating room nurse. To prevent bias from altering the reported results
from the project, the simulation training experiences were held in the simulation
laboratory at the academic institution, and conducted by one of the institution’s NAP
faculty and the author. The results from the post training, as well as the pre-simulation and post-simulation quizzes, were recorded and reviewed by a panel of institution’s NAP faculty, the author, and an independent t-test to ensure the accuracy of the data. To ensure that the students from one simulation group are unable to inform the following group of what to expect, the simulation groups received the simulation scenarios at different times while participating in the training.

Variables

The independent variable in this project was the implementation of case stimulation exercises with the use of a cognitive aid in recognition and response treatment of MH. Another aspect of any project is the dependent variable. The dependent variable is the variable within the project that is influenced one way or another by the independent variable. For this project, the dependent variables were the SRNAs.

The operational definitions for this project were clinical anesthesia simulation, SRNA, cognitive aid, MH, and NAP. Clinical anesthesia simulation is the use of monitors, equipment, computers, and a simulation model to train SRNAs. A SRNA is any individual who is currently enrolled in a NAP. Cognitive aids are prompts designed to help users complete a task or series of tasks. MH is a disease that causes a fast rise in body temperature and severe muscle contractions when someone with the disease receives general anesthesia. A NAP is a graduate level anesthesia education program that is governed by the Council on Accreditation.

Data Collection

The two groups of SRNAs who participated in the project received formal classroom instructions on the recognition and treatment of MH. Both groups were given
a pre-simulation survey, were asked to rate their confidence in responding to a MH crisis, and whether or not they think the use of a cognitive aid would be beneficial. After the pre-simulation survey, the SRNAs were divided into the control and intervention groups, and simulation times then were scheduled over the following days where the students were able to participate in the simulation training. After the simulation training was completed the control and intervention groups were given a post-survey, which asked them to rate their confidence in responding to a MH crisis, and whether or not they thought the use of a cognitive aid was beneficial.

Statistical Analysis

The statistical analysis used for this project was that of an independent t-test, which has been shown to be quite accurate for smaller sample sizes ranging from 5-30. This type of analysis is ideal for non-binary rating scales used to evaluate the data collected. The independent t-test was used to test the mean difference between two samples of data obtained.

Data Analysis

The expected outcome of this research project was that simulation training experience with the use of cognitive aids would increase SRNA confidence in clinical recognition and treatment of MH. After the results were reviewed and compiled, an independent t-test was applied to the confidence ratings to determine significance. Descriptive statistics were used to define the other demographic information from the surveys. These analysis methods were chosen to ensure that the statistical analysis of the data recorded provided an accurate description of the testing methods that were applied during the research project.
Outcomes

The expected outcome of the project was that there would be an increase in SRNA confidence of clinical recognition and treatment by those students who received the simulation training with cognitive aid, when compared to those students who were apart of the simulation exercises without the use of a cognitive aid. The expected outcome of this project was to ultimately discover more effective ways of training SRNAs for clinical practice. The more teaching methods of SRNAs are studied for effectiveness, the better educators are able to manipulate these techniques to provide optimal learning opportunities for each student. Ultimately the better-prepared SRNAs are for clinical practice, the better the quality of care will be provided to the patients they come into contact with resulting in better patient outcomes as well as experiences.

Limitations

There were only a limited number of subjects in the class present for the project. Limitations to the project included lack of participation from the students. The decision not to participate by any number of the students could significantly alter the observed data one way or the other. Other possible limitations for the project were the availability of proper simulation resources to perform the project. Notable limitations were the availability of use of the simulation equipment, or limitations of the SRNAs available free time to attend the simulation training exercises. Some SRNAs were unable to attend due to a clinical requirement to attend orientation at a new clinical site.

Ethical Considerations

Ethical considerations within evidence-based practice research are vital components to producing accurate and applicable research studies. It promotes the
truthfulness of data collected, ensuring that researchers do not falsify, or misinterpret observed data through each project performed. Maintaining ethical values in research also promotes trust and accountability in the collaborative work that it takes to properly perform a research project. Accountability in the collaborative work involves giving contributors credit for his or her contributions to the project, and ensuring that no ideas were stolen in the process of reporting or recording the findings. Lastly, ethical values in research ensure that those involved in the reported project are accountable to the public, to which the findings are reported. Following ethical values throughout the project ensured not only the integrity of this SRNA and reported data but, also, the safety of the subjects of the project itself. To maintain the ethical considerations of the research project, a second simulation allowing the use of cognitive aids was provided for the control group so that all SRNAs involved received the same educational training and benefits.

**Summary**

This section discussed the methodology involved with this research project. It elaborated on method of selection of participants, population, variables, data collection, and data analysis. The following section discusses the analysis of the data collected and presentation of project findings.
CHAPTER III - ANALYSIS OF DATA

Overview

This project was performed to determine if the use of a cognitive aid in simulation training was beneficial for SRNA’s in the recognition and treatment of MH. The expected outcome of this doctoral project stated that simulation training experience with the use of cognitive aids increases SRNA confidence in the clinical recognition and treatment of MH more than simulation alone. An alpha value of 0.05 and an independent t-test was used in determining the level of significance of the data. The pre-simulation and post-simulation surveys were provided only in English, and were provided to the participants on paper.

Fourteen participants were included in this project for the final data analysis. No participant was excluded from the project due to meeting the exclusion criteria for the project. The sample group (cognitive aid group) included 7 participants who received the simulation experience with a cognitive aid, and 7 participants (no cognitive aid group) who were the control group for the project. The gender demographics of the project participants included 9 women (64%), and 5 males (36%). The cognitive aid group was made up 100% female SRNAs (n= 7), while the non-cognitive aid group was made up of 5 males (71%) and 2 females (29%). Of those 14 participants, the racial demographics were 2 Asian American (14%), 1 African American (7%), and 11 White (non-Hispanic) (79%). The cognitive aid group included 1 Asian American (14%), and 6 White (non-Hispanic) (86%). The control group included 1 Asian American (14%), 1 African American (14%), and 5 White (non-Hispanic) (72%).
Figure 1. Racial Demographics of SRNAs

The age of the participants ranged from 25 years old to 39 years old. The control group included 4 SRNAs age 25 to 29 years old (57%), and 3 SRNAs age 30 to 39 years old (43%). The sample group included 5 SRNAs 25 to 29 years old (71%), and 2 SRNAs 30 to 39 years old (29%).

Figure 2. Age and Gender Demographics of SRNAs
While none of the participants have any experience with treating MH within the OR setting they do have experience participating in procedures within the OR. The experience of the 14 participants are 7 with less than 1 year of experience (50%), 5 with 1 to 2 years of experience (36%), and 2 with 3 to 4 years of experience (14%). The control group’s OR experience included 3 SRNAs with less than 1 year of experience (43%), and 4 SRNAs with 1 to 2 years of experience (53%). The sample group’s OR experience included 4 SRNAs with less than 1 year of experience (57%), 1 SRNA with 1 to 2 years of experience (14%), and 2 SRNAs with 3 to 4 years of experience (29%).

![Figure 3. Years of OR Experience Among SRNAs](image)

Another experience that 3 of the participants (21%) shared was previous participation in a simulation that utilized a cognitive aid, while 11 of the participants (79%) had no previous experience using cognitive aids in the simulation setting. Even though some participants had prior experience using aids, only 4 SRNAs (29%) had ever previously reviewed the cognitive aid provided in this simulation. All the 14 SRNAs in
the project stated they believed simulation and the use of cognitive aids to be beneficial in enhancing provider training and education.

**Statistical Analysis**

The SRNAs were asked to rate their confidence level of treating MH within the operating room setting prior to the simulation on a scale that ranged from 1 to 5, with 1 being not confident, 3 being somewhat confident, and 5 being completely confident. The participants were then asked to rate their confidence level using the same rated scale after completing the simulation experience to determine if there was a higher increase in the level confidence among the sample group than the control group. The control group rated their confidence levels as; 1 SRNA chose level 1-not confident (14%), 4 SRNAs chose level 2 (57%), and 2 SRNAs chose level 3-somewhat confident (29%). After completing the simulation experience the control group rated their confidence levels as; 1 SRNA chose level 2 (14%), and 6 SRNAs chose level 3-somewhat confident (86%). The cognitive aid group rated their confidence levels prior to the simulation as; 4 SRNAs chose level 1-not confident (57%), 1 SRNA chose level 2 (14%), and 2 SRNAs chose level 3-somewhat confident (29%). After completing the simulation with the cognitive aids the intervention group listed their confidence levels as; 3 SRNAs chose level 2 (43%), and 4 SRNAs chose level 3-somewhat confident (57%). The confidence level of the cognitive aid group (n=7) was $2.57 \pm 0.53$, while the confidence level of the non-cognitive aid group (n=7) was $2.86 \pm 0.38$. This difference was not significant, $t(12) = -1.15, p = 0.14$. 
Discussion of Results

Post-simulation survey confidence data was compared between the cognitive aid group and the non-cognitive aid group and results were noted. While the non-cognitive aid group showed a higher pre-simulation and post-simulation mean confidence level, the overall mean confidence level increase of both the cognitive aid and non-cognitive aid groups were 16% on the 1 to 5 confidence scale. The independent t-test showed that the difference in the confidence levels was not significant, $t(12) = -1.15$, $p = 0.14$, meaning that the use of simulation with cognitive aids either increases or does not decrease the confidence of clinical recognition and treatment of MH compared to simulation training without a cognitive aid.

While 1 (14%) of the participants in the cognitive aid group were unsure of whether or not they would use a cognitive aid within their practice in the OR prior to the project, after their participation 7 (100%) stated that they would indeed utilize a cognitive aid during the treatment of MH. Since all test scores were kept confidential, individual
scores cannot be paired to a specific participant. Before participating in the simulation experience, all the participants were asked to choose the earliest sign of MH and to determine the correct initial treatment for MH. In both the pre-simulation and post-simulation survey 100% of the SRNAs chose the correct initial treatment for MH within both the control and interventional group, one SRNA (14%) within the interventional group initially chose the wrong earliest sight of a MH event. After completing the simulation experience the participants were again asked to choose the earliest sign of MH, with all 14 of SRNAs (100%) selecting the correct answer. All the 14 SRNAs felt that the simulation resembled real life OR experiences and would participate in other cognitive aid simulations for education and training purposes.

Barriers and Limitations

The major limitation to the project was the small sample size of participants. Due to the lack of sample size the results of this project may not be applicable or replicable in a larger population of SRNAs. Other barriers to the project included amount of simulations received by the participants, scheduling conflicts with the SRNAs, and time available to complete the project and gather the required information.

Recommendations

One recommendation for a further project would be to include multiple simulations carried out over a more significant amount of time to determine to what extent the cognitive aid benefits the SRNA. Further studies would also benefit from using a larger sample size to attempt to replicate the same results. Another recommendation for possible future studies could be to determine what size of cognitive aid worked best for those involved. Many of the participants involved voiced that they
felt SRNAs would benefit from a portable “badge” sized version of the cognitive aid. Other recommendations include using cognitive aids to prepare SRNAs for other high-risk occurrences in the operating room and placement of the cognitive aid within the operating room. The surveys used in future studies could be collected electronically to expedite data collection as well as ease of completion for participants. Contacting a pharmacy or product representatives to help provide consistent or appropriate delivery methods in bottles and syringes for training purposes would be another recommendation.

Implications for Future Practice

Although the use of cognitive aids in MH simulation was not shown to significantly increase confidence levels more than just simulation itself, all of the participants stated that they plan to use cognitive aids in their future treatment of MH events within the OR. The inclusion of cognitive aids in simulation training of the treatment of MH could aid SRNAs in the development of clinical skills and knowledge needed to treat such an event as well as increase their comfort of utilizing cognitive aids during rare operating room emergencies. This type of training could be useful for hospitals or anesthesia groups who wish to perform yearly workforce preparedness training with their CRNA workforce. If the workforce training route was considered, a cost-benefit analysis would provide insight into cost effectiveness of such training.

Conclusion

Implementing evidence-based research into the clinical aspects of training is important for the doctoral prepared nurse. This project was designed to determine if simulation with cognitive aides increased the confidence of clinical recognition and treatment of MH more than the use of simulation training alone. In this convenience
sample, the use of a cognitive aid with simulation was not more effective at increasing
the confidence levels for SRNAs when compared to simulation training alone. While the
statistical results show that the use of cognitive aids neither increase or decrease
confidence levels more than just simulation, the SRNAs involved with the project
expressed their desire to include the use of a cognitive aid in their clinical practice and
suggested the use of the badge with MH treatment protocol/algorithm for their practice.
As the expansion of research regarding utilizing cognitive aids and simulation training
continues, SRNAs and NAP faculty will reap the benefits of improved training methods
to increase clinical knowledge and skills.
APPENDIX A – PRE-SIMULATION SURVEY TOOL

1. By participating in the survey, I consent to participation in this project, and confirm that I am 18 years or older

2. Gender:
   a. Male
   b. Female

3. What is your age group?
   a. <25
   b. 25 – 29
   c. 30 – 39
   d. 40 – 49
   e. 50 – 59
   f. 60 – 69
   g. 70+

4. Race/Ethnicity:
   a. American Indian or Alaska Native
   b. Asian
   c. African American
   d. Hispanic
   e. Native Hawaiian or Other Pacific Islander
   f. White (Non-Hispanic)

5. Do you have any experience with MH in the OR?
   a. Yes
b. No

c. (if yes, thank you for your participation thus far. This concludes your participation with this project)

6. **What is the earliest sign of MH?**
   a. Rise in Temp
   b. Rise in ETCO2
   c. Decrease in Vt
   d. Increased Respirations

7. **What is the initial treatment for MH?**
   a. Increase depth of anesthesia
   b. Give appropriate dose of dantrolene
   c. Initiate active cooling measures
   d. Stop volatile agent and hyperventilate with 100% O2

8. **Opinion of simulation training:**
   a. It is beneficial to clinical education
   b. It is not beneficial to clinical education

9. **Opinion of cognitive aid/checklist use in the OR:**
   a. I think it is beneficial
   b. I think it is not beneficial

10. **Rate your confidence level in being able to properly respond to a MH crisis in the OR.**
    a. 1 – Not confident
    b. 2
c. 3 – Somewhat confident

d. 4

e. 5 – Confident

11. Have you reviewed the cognitive aids available in the simulation lab or online related to MH?
   a. Yes I have
   b. No I have not

12. Have you taken part in any training or simulation that included the use of cognitive aids within the operating room setting?
   a. Yes I have
   b. No I have not

13. Have you ever taken part in a MH simulation prior to this project?
   a. Yes I have
   b. No I have not

14. Have you ever taken part in a MH simulation using cognitive aids?
   a. Yes I have
   b. No I have not

15. Would you utilize cognitive aids in your own anesthetic practice in the OR setting?
   a. Yes I would
   b. No I wouldn’t
   c. I don’t know
16. How many years of OR experience do you have (including anesthesia school)?

   a. <1
   b. 1-2
   c. 3-4
   d. >5
APPENDIX B – POST-SIMULATION SURVEY TOOL

1. What is the earliest sign of MH?
   a. Rise in Temp
   b. Rise in ETCO2
   c. Decrease in Vt
   d. Increased Respirations

2. What is the initial treatment for MH?
   a. Increase depth of anesthesia
   b. Give appropriate dose of dantrolene
   c. Initiate active cooling measures
   d. Stop volatile agent and hyperventilate with 100% O2

3. Rate your confidence level in being able to properly respond to a MH crisis in the OR.
   a. 1 – Not confident
   b. 2
   c. 3
   d. 4
   e. 5 – Somewhat confident

4. Opinion of simulation training:
   a. It is beneficial to clinical education

5. Opinion of cognitive aid/checklist use in the OR:
   a. I think it is beneficial
   b. I think it is not beneficial
6. Gender:
   a. Male
   b. Female

7. What is your age group?
   a. <25
   b. 25 – 29
   c. 30 – 39
   d. 40 – 49
   e. 50 – 59
   f. 60 – 69
   g. 70+

8. Race/Ethnicity:
   a. American Indian or Alaska Native
   b. Asian
   c. African American
   d. Hispanic
   e. Native Hawaiian or Other Pacific Islander
   f. White (Non-Hispanic)

9. Did the scenario presented in the simulation resemble that of a real OR?
   a. Yes it did
   b. No it didn’t

10. Would you participate in other MH simulations using cognitive aids?
    a. Yes I would
b. No I wouldn’t

11. Do you plan to utilize cognitive aids in your own anesthetic practice in the OR setting?
   a. Yes I do
   b. No I don’t
APPENDIX C – PRE-SIMULATION BRIEFING

Simulation Plan

- Bob is a 25-year-old male undergoing a laparoscopic cholecystectomy that weighs 70kg. He has no surgical history, and has no known allergies. The surgery has been in progress for about 10 minutes (prior to the beginning of the simulation). The surgical team is working on the patient. After 1-2 minutes the patient will exhibit signs of malignant hyperthermia

- Progressive complexity
  - Maintenance of anesthesia
  - Signs of MH
  - Physiological system failure

Sequence of Events

- 1 minute into the scenario:
  - Temperature increase to 39 C
  - ETCO2 increases
  - BP drops to 70/30
  - HR 95
  - PVC’s noted on EKG

- 2 minutes into the scenario:
  - BP 65/30
  - Temperature 41 C
  - ETCO2 increases

- CRNA or SRNA announces that they suspect MH
• Simulation will Continue for 5 minutes or until all of the following treatments are completed.
  o Team member calls for MH cart and Code cart into the room and determines team leader
  o Stops triggering agent, hyperventilate with 100% O2, draw ABG, announce for team member to call MH Hotline, start arterial line or any other needed IV lines, treat hyperkalemia, give Na+ bicarbonate if metabolic acidosis is present (1-2 mEq/kg), Treat dysrhythmia, place NG tube
  o Retrieve MH cart. (use cognitive aid if in interventional group)
  o Start dilution of dantrolene of 9-12 vials and reconstitute with 60ml of sterile water to yield 20mg per vial. (2.5mg/kg dosing)
  o Call for OR nurse or team members to apply cooling measures, insert foley, insert rectal tube, cool IV fluids.

Pre-Simulation Participant Briefing

• Scenario
  o Setting: Operating room/Simulation Lab
  o Pre-brief: 10-15min
  o Time: Simulation 5-10mins
  o Debrief: 15-20mins
  o Roles:
    ▪ CRNA
    ▪ Circulating RN
    ▪ Surgeon
• OR tech
  o Patient Hx and Procedure

• Objective of the simulation
  o The team will properly act during the crisis following the MH management checklist.
  o The CRNA and SRNA will properly communicate with members of the perioperative team during a MH crisis.
  o The CRNA or SRNA will demonstrate correct treatment of MH
  o Team members will correctly complete steps for treatment of MH
APPENDIX D – POST-SIMULATION DEBRIEFING

Standardized Debrief Questions

- How did the simulation experience make you feel about your ability to care for a malignant hyperthermia patient?
- Where you able to meet the clinical objectives of this simulation experience? What areas did you identify in your knowledge that might be weak in regard to caring for a malignant hyperthermia patient?
- If given a second chance to complete the scenario, how would you handle the patient’s care differently?
- What do you think that you performed well on during the simulation?
- How well did the two of you work together within your roles?

Debrief Questions for Observers

- What were the positives that you noticed during the simulation?
- What were the negatives that you noticed during the simulation?
- Are there any other points that you would like to cover with the participants about the scenario?

MH Specific Debrief Questions

- Do you feel like the cognitive aid would’ve helped or hurt your performance in this simulation?
- During the MH scenario how did you decide which team member would assume which role during the simulation?
- What are your thoughts about the team’s performance during the simulation?
• What do you think could’ve helped the team’s performance in dealing with the MH patient?

Review learning objectives.

Review participants, roles and team expectations.

Review of communication expectations

Post simulation survey.
APPENDIX E - IRB APPROVAL

INSTITUTIONAL REVIEW BOARD

NOTICE OF COMMITTEE ACTION

The project has been reviewed by the Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months. Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 17072505
PROJECT TITLE: Student Registered Nurse Anesthetist Simulation Training with the Use of Cognitive Aids in Malignant Hyperthermia Recognition and Treatment
PROJECT TYPE: New Project
RESEARCHER(S): Daniel Brock Martin
COLLEGE/DIVISION: College of Nursing
DEPARTMENT: Advanced Practice
FUNDING AGENCY/SPONSOR: N/A
IRB COMMITTEE ACTION: Exempt Review Approval
PERIOD OF APPROVAL: 07/31/2017 to 07/30/2018

Institutional Review Board
APPENDIX F LETTER OF SUPPORT

July 8, 2017

Dear [Name],

I have reviewed Daniel Martin’s plan for his DNP Project. I understand that he plans to determine if the use of cognitive aids in simulation training helps the student registered nurse anesthetist to recognize and treat malignant hyperthermia. I understand he is asking 2nd year nurse anesthesia students to complete surveys pre and post an simulation education intervention.

The College of Nursing supports Mr. Martin’s project. This project is sound and has merit. Please let me know if you need anything further as you move forward. Thank you for serving as his project chair. I look forward to learning of his results.

Sincerely,

[Name]
Assistant Dean for Research and Evaluation
Interim Chair, Advanced Practice Department
PhD Program Director
Associate Professor
REFERENCES


http://dx.doi.org/10.1213/ANE.0000000000000923


http://dx.doi.org/10.1007/s10877-015-9714-7
