

The University of Southern Mississippi  
**The Aquila Digital Community**

---

Doctoral Projects

---


Fall 2020

## Educating Student Registered Nurse Anesthetist on Malignant Hyperthermia Using an Objective Structured Clinical Examination

Ednita Street Fountain

Faith Sherman

Follow this and additional works at: [https://aquila.usm.edu/dnp\\_capstone](https://aquila.usm.edu/dnp_capstone)

 Part of the [Critical Care Nursing Commons](#), [Other Nursing Commons](#), and the [Perioperative, Operating Room and Surgical Nursing Commons](#)

---

### Recommended Citation

Fountain, Ednita Street and Sherman, Faith, "Educating Student Registered Nurse Anesthetist on Malignant Hyperthermia Using an Objective Structured Clinical Examination" (2020). *Doctoral Projects*. 142.

[https://aquila.usm.edu/dnp\\_capstone/142](https://aquila.usm.edu/dnp_capstone/142)

This Dissertation/Thesis is brought to you for free and open access by The Aquila Digital Community. It has been accepted for inclusion in Doctoral Projects by an authorized administrator of The Aquila Digital Community. For more information, please contact [Joshua.Cromwell@usm.edu](mailto:Joshua.Cromwell@usm.edu).

EDUCATING STUDENT REGISTERED NURSE ANESTHETISTS ON MALIGNANT  
HYPERTHERMIA USING AN OBJECTIVE STRUCTURED  
CLINICAL EXAMINATION

by

Faith Sherman and Ednita Fountain

A Doctoral Project  
Submitted to the Graduate School,  
the College of Nursing and Health Professions  
and the School of Leadership and Advanced Nursing Practice  
at The University of Southern Mississippi  
in Partial Fulfillment of the Requirements  
for the Degree of Doctor of Nursing Practice

Approved by:

Dr. Mary Jane Collins, Committee Chair  
Dr. Nina McLain, Committee Member  
Dr. Stephanie Parks, Committee Member

December 2020

COPYRIGHT BY

Faith Sherman and Ednita Fountain

2020

*Published by the Graduate School*



THE UNIVERSITY OF  
**SOUTHERN**  
**MISSISSIPPI**®

## ABSTRACT

Malignant hyperthermia (MH) is a low-frequency, high-impact event that many student registered nurse anesthetists (SRNA) may be unprepared to manage due to limited exposure in clinical practice (Hackl et al., 1990). Lack of preparation for dealing with such low frequency, high impact events can lead to unfortunate adverse events resulting in death (Hackl et al., 1990). Thus, students should be are prepared to handle these situations if an event should occur.

An objective structured clinical examination (OSCE) is a structured method used to assess certain skills and underpinning knowledge required for practice (Harden & Gleeson, 1979). Students are allowed to demonstrate their competence in a given topic under a variety of simulated conditions. The purpose is to evaluate students objectively and independently of the examiner which eliminates bias (Smrekar et al., 2017).

The purpose of this doctoral project is to provide an evidenced-based objective structured clinical examination to The University of Sothern Mississippi (USM) Nurse Anesthesia Program (NAP) using the Malignant Hyperthermia Association of the United States' (MHAUS) MH protocol. Thus, an OSCE template was created based on the best recommendations supported by MHAUS. The template includes outcomes, objectives, a case scenario, grading rubric, and debriefing form. Further, a demonstration video based on the written protocol was conducted in USM's simulation lab. The items along with a questionnaire were disseminated through Qualtrics<sup>®</sup> to a designated panel of experts. Data collected yielded that implementation of the MH OSCE will be beneficial to USM's NAP program for the usage of faculty and students for the examination tool.

## ACKNOWLEDGMENTS

The completion of this doctoral project would not have been possible without the help and guidance of The University of Southern Mississippi faculty. We would like to personally thank our doctoral project chair, Dr. Mary Jane Collins, DHA, CRNA. Thank you for your time, patience, and continued dedication throughout this process. Further, we would like to acknowledge additional committee members, Dr. Nina McLain, Ph.D., CRNA, and Dr. Stephanie Parks, DNP, CRNA. Lastly, thank you to all of our classmates who participated in the demonstration video. The efforts of and contributions of the nurse anesthesia program faculty are truly appreciated.

## DEDICATION

### *Faith*

First, I would like to give thanks and honor to God, without Him none of this would be possible. I will be the first person in my family to obtain a doctoral degree. This is such an honor and a huge accomplishment, and I could not have done this without my support system: my parents, siblings, friends, and family. This accomplishment is dedicated to my grandparents who were not able to complete high school due to other family responsibilities. My grandparents taught me the meanings of sacrifice, hard work, and dedication. Further, this doctoral project is dedicated to my daughter, Milan. Thank you for being my driving force and my biggest supporter.

### *Ednita*

I would like to give thanks to God for opening this path and guiding me along my journey. My mother and father have always pushed academic excellence and told me to reach for the stars. I would like to thank my parents, Edna and Charles, for their love and support and for always believing in me. To my husband, Lorenzo, and children, Jamichael and Christopher, I would like to thank you for always being there for me, because when things were rough you always reminded me of my priorities and why I do what I do. It is a great honor to be the first in my family to obtain a doctoral degree. I would also like to thank my family, friends, church family, sister, and those who have supported me throughout this long journey. My pastor, Larry Burney, always told me “I am the thinker that thinks the thought that makes the thing.” I have lived by this affirmation since I was a young girl, and it has kept me focused on my dreams and aspirations.

TABLE OF CONTENTS

ABSTRACT ..... ii

ACKNOWLEDGMENTS ..... iii

DEDICATION ..... iv

LIST OF TABLES ..... viii

LIST OF ILLUSTRATIONS ..... ix

LIST OF ABBREVIATIONS ..... x

CHAPTER I - INTRODUCTION ..... 1

    Background ..... 1

    Statement of the Problem ..... 2

    Significance of the Problem ..... 2

    Available Knowledge ..... 3

        OSCE Defined ..... 4

        The Purpose of an OSCE ..... 4

        Clinical Skill and Competence ..... 5

        Formative Evaluation ..... 5

        Reliability and Validity ..... 6

        OSCE Structure ..... 7

    Malignant Hyperthermia Overview ..... 8

    Epidemiology ..... 9

    MHAUS ..... 9

Steps .....	10
Rationale .....	12
DNP Essentials.....	13
Essential One: Scientific Underpinning for Practice .....	13
Essential Two: Organizational and Systems Leadership for Quality and Improvement and Systems Thinking .....	14
Essential Three: Clinical Scholarship and Analytical Methods for Evidenced-Based Practice.....	14
DNP Essentials VI- Interprofessional Collaboration for Improving Patient and Population Health Outcomes .....	14
Specific Aims.....	14
Summary .....	15
CHAPTER II – METHODS .....	16
Introduction.....	16
Context.....	16
Interventions .....	18
Study of Interventions and Measures.....	19
Analysis.....	20
Ethical Considerations .....	20
CHAPTER III - RESULTS.....	22



Introduction.....	22
Steps of the Intervention.....	22
Outcomes.....	26
Limitations.....	27
Conclusion.....	27
CHAPTER IV – DISCUSSION.....	29
Summary.....	29
Interpretation.....	30
Conclusion.....	30
APPENDIX A – DNP Essentials.....	32
APPENDIX B Invitation to the Panel of Experts.....	33
APPENDIX C Malignant Hyperthermia OSCE Template.....	34
APPENDIX D –Evaluation Tool.....	39
APPENDIX E IRB Approval.....	40
APPENDIX F Standard Online Informed Consent.....	41
APPENDIX G Report of Findings.....	43
REFERENCES.....	45

## LIST OF TABLES

Table 1 Questionnaire Results from the Panel of Experts .....	25
Table 2 Panel of Experts Comments.....	26

LIST OF ILLUSTRATIONS

Figure 1. Results from Panel of Experts ..... 24

## LIST OF ABBREVIATIONS

<i>AANA</i>	The American Association of Nurse Anesthetists
<i>APRN</i>	Advanced Practice Registered Nurse
<i>CRNA</i>	Certified Registered Nurse Anesthetists
<i>DNP</i>	Doctor of Nursing Practice
<i>IRB</i>	Internal Review Board
<i>MH</i>	Malignant Hyperthermia
<i>MHAUS</i>	Malignant Hyperthermia Association of the United States
<i>OSCE</i>	Objective Structured Clinical Examination
<i>SRNA</i>	Student Registered Nurses Anesthetist
<i>NAP</i>	Nurse Anesthesia Program
<i>USM</i>	The University of Southern Mississippi

## CHAPTER I - INTRODUCTION

### Background

The objective structured clinical examination (OSCE) was first described in 1975 by authors Harden, Stevenson, Downie, and Wilson. In this article, published in the British Medical Journal, the aim was to assess clinical competency in medical students. Harden et al., defined the OSCE as a valid and reliable alternative method used in assessing clinical performance in a simulated environment (Harden et al., 1975).

Before OSCE development, students' simulated assessment could be affected by the simulated patient's performance, examiner bias, and the actual student's performance (Khan et al., 2013). Thus, the goal of the first OSCE was to reduce bias and introduce standardization into the assessment of medical students' clinical evaluations (Harden et al., 1975). Additionally, the OSCE allowed instructors to assess student's clinical skills, attitudes, problem-solving abilities, and application of knowledge in one examination without bias (Khan et al., 2013).

Although, an OSCE was first utilized to assess clinical competence in medical students it has now been applied to other specialties including advanced practice registered nurses (APRN). Further, according to the American Board of Anesthesiology, in order to obtain certification, anesthesia residents must pass a simulated OSCE in order to satisfy the applied examination requirement (American Board of Anesthesiology [ABA], 2016). Moreover, OSCE use has gained popularity in healthcare specialties and can be beneficial when applied to the clinical training of nurse anesthesia students.

## Statement of the Problem

Malignant hyperthermia (MH) is a low-frequency, high-impact event that many student registered nurse anesthetists (SRNA) may be unprepared to manage due to limited exposure in clinical practice (Mauritz et al., 1990). Lack of preparation for dealing with such low frequency, high impact events can lead to unfortunate adverse events resulting in death (Mauritz et al., 1990). Additionally, the lack of student preparation can lead to student poor patient outcomes and adverse effects (Ward & Barratt, 2005). Thus, to aid in preventing adverse student and patient outcomes, an OSCE was developed based on peer-reviewed, evidenced-based literature published by the Malignant Hyperthermia Association of the United States (MHAUS). The approved OSCE was presented to the administration of The University of Southern Mississippi (USM) Nurse Anesthesia Program (NAP), for consideration of usage. The American Association of Nurse Anesthetist (AANA) strongly recommends all anesthesia professionals delivering MH triggering agents such as potent volatile inhalation anesthetics or administering depolarizing muscle relaxants have the requisite drugs and supplies available as defined by MHAUS, indicating MHAUS as being the standard resource guide for evidenced based clinical guidelines for Malignant Hyperthermia treatment (American Association of Nurse Anesthetists [AANA], 2017).

## Significance of the Problem

Nurse anesthesia programs are designed to teach registered nurses how to safely and effectively deliver anesthesia to patients. Learning is facilitated through didactic lectures, clinical training, and simulations. Thus, students are held to a standard and are expected to know how to manage emergent situations such as MH even though this

condition occurs rarely. Failure to prepare students clinically can result in a lack of competence which can lead to poor patient outcomes, adverse reactions, or even death (Ward & Barratt, 2005).

There is a need for a structured method to assess clinical competency in nurse anesthesia students especially for rare, emergent situations such as MH. An objective structured clinical examination (OSCE) is an evaluative tool designed to assess the competence of a given topic (Harden, 1988). An OSCE formally assesses skills and knowledge with limited bias and standardizes grading (Aronowitz et al., 2017). An OSCE can be used in the USM's NAP program to help students deal with this emergent situation in a more realistic manner to foster better decision making when in actual clinical scenarios. The purpose of this project is to provide an evidenced-based objective structured clinical examination to The University of Southern Mississippi Nurse Anesthesia Program using the Malignant Hyperthermia Association of the United States (MHAUS) MH protocol.

#### Available Knowledge

Due to the increasing implementation of OSCEs in APRN education, a thorough review of available knowledge was conducted to review best practice guidelines, creating an OSCE for a given subject, and OSCE implementation. A literature matrix, shown in Appendix A, was created to synthesize the relevant evidence. The main themes of the literature reviewed were (a) reliability and validity of OSCEs, (b) usage to assess clinical competence, and (c) standardization of evaluations.

### *OSCE Defined*

Since the development of the initial OSCE, many definitions have been proposed. Harden (1988) defined it as, “An approach to the assessment of clinical competence in which the components are assessed in a planned or structured way with attention being paid to the objectivity of the examination” (p. 12). Newble (2004) defined it as an organizational framework that uses many different types of test methods to assess student competency and skills. Based on various descriptions of OSCE in the literature Khan et al. (2013) proposed a consolidated definition.

An assessment tool based on the principles of objectivity and standardization, in which candidates move through a series of time-limited stations in a circuit for the purposes of assessment of professional performance in a simulated environment. At each trained station candidates are assessed and marked against standardized scoring rubrics by trained assessors. (p. 1439)

With these foundational definitions in mind, authors agree that an OSCE is a standardized tool used to assess clinical competence and skills in such a way that limits bias. Defining an OSCE is important to this project as it establishes the framework and background that will be utilized to measure the necessary skills and competence needed to properly identify and treat MH.

### *The Purpose of an OSCE*

An OSCE is a structured method used to assess certain skills and underpinning knowledge required for practice (Harden & Gleeson, 1979). Students are allowed to demonstrate their competence of a given topic under a variety of simulated conditions. The purpose is to evaluate students objectively and independently of the examiner which



eliminates bias (Smrekar et al., 2017). The examination formally assesses clinical competence with a focus on the application of knowledge. Thus, a recent study supports that OSCE usage can enable nursing students to increase the complexity of their understanding and autonomy (Aronowitz et al., 2017). Additionally, OSCE usage has shown a positive impact on education. A study by Bouriscot (2010) supported that OSCE usage drives learning by creating a realistic recreation of scenarios. For this project, an OSCE was used to assess skills and competence related to identifying and treating MH. This will allow instructors to evaluate areas that are critical to treatment without bias and students will be able to apply the knowledge that was gained through lectures and other resources in a realistic setting similar to a clinical situation.

#### *Clinical Skill and Competence*

OSCEs assess clinical competency as well as clinical skills. The goals and objectives that provide structure to the OSCE are matched to specific tasks that require the application of skills. The simulated tasks allow the participant to progress from the *Knows* level of competence to the *Shows* level according to Miller's Pyramid (Miller, 1990). Thus, an OSCE can assess the second-highest level of competence. Without a proper assessment of knowledge and skills, students are at risk for being incompetent on how to manage emergencies such as MH which can lead to adverse outcomes for the patient and poor patient outcomes.

#### *Formative Evaluation*

An OSCE can be used to evaluate students' formatively. The goal of formative evaluations is to monitor student learning and provide ongoing feedback to improve teaching methods as well as enhance student learning (Lippincott Nursing Education,

2017). An OSCE is an assessment tool that measures student progress along the way and allows students to immediately target areas of weakness. Further, instructors such as clinical preceptors and professors are able to gather real data about students as they work which allows them to adjust their instruction as needed to better serve students. A systematic review by Norman (2012) on nursing simulation education supported that simulation is useful in creating a learning environment that contributes to knowledge, skills, safety, and confidence. USM's NAP evaluates students' clinical performance every two to three weeks during the first clinical year and every week for the second year. This OSCE can be used as an evaluation for MH during students' second year, and feedback on students' performance can point out areas of strengths and weaknesses in relation to the subject. Formative OSCEs also help to prepare students for placements, encourage them to engage with their learning, and help them to achieve their learning outcomes (Little, 2014).

#### *Reliability and Validity*

Literature supports that OSCEs both are reliable and valid in measuring clinical competence. A study by Ward and Barratt (2005) showed high face validity. Both the students and examiners believe that OSCEs measure skills relevant to clinical practice (Ward & Barratt, 2005). Additionally, studies have shown OSCEs are more reliable and valid than traditional forms of clinical assessments (Brosnan et al., 2006; Harden & Gleeson, 1979). Using an OSCE is one method to increase the validity of assessing clinical competence by minimizing examiner variation in the assessment of skills.

### *OSCE Structure*

An OSCE includes student instructions, a scoring rubric, and a debriefing form. Candidate instructions provide information to candidates before entering the OSCE station and should include the setting, patient's background and synopsis, the clinical task, the allotted time, and case objectives (Pugh & Smee, 2015). Students must be adequately prepped before conducting an OSCE. This involves explaining the design and purpose of the OSCE, grading rubric, rules, identifying the students' roles, orienting students to the setting, equipment, workstations, and material (Smrekar et al., 2017). Students are expected to behave as if they were in a clinical environment and may be asked to perform certain skills, apply theory-based knowledge related to disease processes, and make clinical decisions (Smrekar et al., 2017).

The scoring rubric is the instrument that scores the candidate's performance. Evaluation is based on a predefined grading instrument. This instrument can consist of a checklist and/ or rating scale. Checklists must be carefully constructed and tailored to the required clinical task. They are useful in the assessment of clinical skills and are objective and standardized (Pugh & Smee, 2015). The number of checklist items depends on the case and allotted time and should reflect the task described in the instructions. The role of educators is to monitor performance, provide feedback, and correct mistakes which can be done in a post-OSCE debriefing (Smrekar et al., 2017). The debriefing gives the instructor and candidates an opportunity to discuss the strengths and weaknesses of the OSCE. Additionally, students can recognize and learn from their mistakes, which leads to the development of active learning, critical thinking, and problem-solving necessary for safe patient care (Smrekar et al., 2017).

### *Malignant Hyperthermia Overview*

Malignant hyperthermia (MH) is a pharmacogenetic disorder of skeletal muscle that presents as a hypermetabolic response to potent volatile anesthetic gases such as halothane, sevoflurane, desflurane, isoflurane, and the depolarizing muscle relaxant succinylcholine, and rarely, in humans, to stressors such as vigorous exercise and heat (Rosenberg et al., 2015). The incidence of MH reactions ranges from 1:10,000 to 1:250,000 anesthetics (Rosenberg et al., 2015). However, the prevalence of the genetic abnormalities may be as great as one in 400 individuals (Rosenberg et al., 2015). The classic signs of MH include hyperthermia, tachycardia, tachypnea, increased carbon dioxide production, increased oxygen consumption, acidosis, hyperkalemia, muscle rigidity, and rhabdomyolysis, all related to a hypermetabolic response (Rosenberg et al., 2015).

Malignant hyperthermia is very serious and can be fatal disorder. The provider must be vigilant in recognizing signs, symptoms, and risk factors promptly (Rosenberg et al., 2015). Early recognition can determine the outcome of the patient with malignant hyperthermia (Rosenberg et al., 2015). The onset of an MH crisis can be very rapid, making early detection and treatment imperative for the survival of the patient (Rosenberg et al., 2015). The provider should be competent, confident, prepared, and efficient when treating the malignant hyperthermia crisis. Due to the severity of the disorder, the provider should have a solid foundation and be prepared to treat MH promptly. The provider should be aware of treatment guidelines and how to delegate related tasks. Prompt recognition and treatment of MH can prevent adverse outcomes and in turn, save the patient's life.

## *Epidemiology*

Even though an MH crisis may develop at first exposure to anesthesia with those agents known to trigger an MH episode, on average, patients require three anesthetics before triggering. Reactions develop more frequently in males than in females (2:1) (Riazi et al., 2014). All ethnic groups are affected, in all parts of the world. The highest incidence is in young people, with a mean age of all patients experiencing reactions of 18.3 years. A study found that children under 15 years of age comprised 52.1% of all reactions (Strazis & Fox, 1993). Hackl et al. (1990) found an incidence of 1:37,500 in patients who had been diagnostically tested, which was similar to the incidence estimated by Robinson et al. (2006) (1:30,000) although wide variability has been reported. A recent report suggested that the MH susceptible (MHS) trait may be present in 1:2000–3000 of the French population. A study of 12 million hospital discharges in the state of New York demonstrated the prevalence of MH to be one in 100,000 surgical procedures although the type of anesthetic was not indicated. These findings likely represent an underestimate of MH in association with general anesthesia (Brady et al., 2009). Although MH is a rare disorder, it has high mortality and should be promptly treated.

## *MHAUS*

Malignant Hyperthermia Association of the United States<sup>®</sup> (n.d.) is a 501 (c)(3) nonprofit organization responsible for developing an evidenced-based intervention protocol for malignant hyperthermia (Malignant Hyperthermia Association of the United States [MHAUS], n.d.). The protocol is supported by the American Association of Nurse Anesthetists (AANA) as this organization recognizes this protocol to be the standard of care in treating an MH crisis (AANA, 2017). The mission of MHAUS is to promote

optimum care and scientific understanding of MH and related disorders. MHAUS has four primary goals (MHAUS, n.d.).

1. Educate the entire spectrum of healthcare professionals so that MH is rapidly recognized and properly treated by persons in all of the medical disciplines.
2. Advise and prepare all medical facilities in the United States for prompt diagnosis and immediate treatment of an MH episode.
3. Help MH-susceptible patients and their families learn to live with MH susceptibility and share with them the experience and knowledge which has accumulated about MH.
4. Encourage and support research in MH, especially a highly accurate noninvasive diagnostic test.

MHAUS has a protocol detailing steps and emergency treatment for an acute MH event (MHAUS, n.d.).

#### Steps

1. Notify the surgeon to halt the procedure. Discontinue volatile agents and succinylcholine.
2. Get the dantrolene/MH cart. Call for help within the institution; also, call the MHAUS Hotline for additional advice.
3. Hyperventilate with 100% oxygen at flows of 10L/min to flush volatile anesthetics and lower end tidal carbon dioxide. If available, insert activated charcoal filters into the inspiratory and expiratory limbs of the breathing circuit.

4. Give dantrolene 2.5 mg/kg rapidly through large-bore IV. Repeat as frequently as needed until the patient responds with a decrease in end tidal carbon dioxide, decreased muscle rigidity, and/or lowered heart rate. Ryanodex 250 mg vial should be reconstituted with 5 ml of sterile water for injection and shaken to ensure orange-colored uniform, opaque suspension.
5. Obtain blood gas (venous or arterial) to determine the degree of metabolic acidosis. Consider administration of sodium bicarbonate, 1-2 mEq/kg dose, for base excess greater than -8 (maximum dose 50 mEq).
6. Cool the patient if the core temperature is  $>39^{\circ}\text{C}$  or less if rapidly rising. Stop cooling when the temperature has decreased to  $<38^{\circ}\text{C}$ .
7. If hyperkalemia ( $\text{K} > 5.9$  or less with ECG changes) is present, treat with:
  - (a) Calcium chloride 10 mg/kg (maximum dose 2,000 mg) or calcium gluconate 30 mg/kg (maximum dose 3,000 mg) for life-threatening hyperkalemia
  - (b) Sodium bicarbonate
  - (c) 1-2 mEq/kg IV (maximum dose 50 mEq)
  - (d) Glucose/insulin.
8. Check glucose levels hourly.
9. For refractory hyperkalemia, consider albuterol (other beta-agonist), kayexelate, dialysis, or ECMO if the patient is in cardiac arrest.
10. Treat dysrhythmias with standard medication but avoid calcium channel blockers. Treat acidosis and hyperkalemia if present.

11. Diurese to  $>1\text{ml/kg/hr}$  urine output. If CK or  $\text{K}^+$  rise, assume myoglobinuria and give bicarbonate infusion of  $1\text{ mEq/kg/hr}$ , to alkalinize the urine.
12. Institute appropriate monitoring including core temperature, urine output with a bladder catheter, and consider arterial and/or central venous monitoring if warranted by the clinical severity of the patient.
13. Follow HR, core temperature,  $\text{ETCO}_2$ , minute ventilation, blood gases,  $\text{K}^+$ , CK, urine myoglobin, and coagulation studies as warranted by the clinical severity of the patient.
14. When stable, transfer to the post-anesthesia care unit or intensive care unit for at least 24 hours.

#### Rationale

Miller's pyramid of competence is a framework that details the stages of skills students should achieve. The pyramid has four stages: knows, knows how, shows how, and does (Miller, 1990). At the base of the pyramid, also known as the *Knows* stage, it implies that the student has the knowledge base to carry out specific patient-related functions (Miller, 1990). This knowledge can be measured using examinations and serves as an excellent theoretical framework for this project. To fulfill the broader objective students must *know how* to use the acquired knowledge which encompasses the next stage of the pyramid. In this stage of competence, the students utilize various resources such as objective and subjective to translate findings (Miller, 1990). The next stage is *Shows How* which cannot be tested by academic examinations. Thus, the use of OSCEs can be used to test clinical skills, performance knowledge, and competence all of which



comprise the *Shows How* stage. Moreover, students can demonstrate what they have learned didactically and apply it in a simulated environment. The final stage is *Does* which is demonstrated by performing in the actual clinical setting.

In summary, the OSCE assesses skills in three of four stages that include competence level and application of knowledge. Further, it tests psychomotor, cognitive, and affective skills without bias which cannot be accomplished by academic testing or standard simulation. Miller's pyramid explains why an OSCE can be used objectively to test clinical competence (Little, 2014). Testing using an OSCE encompasses the *Shows how* stage, the second-highest level of competence, which cannot be assessed using traditional testing measures (Little, 2014). Thus, this evaluative method offers numerous advantages to nurse anesthesia students and serves as the best theoretical framework for the proposed project.

#### DNP Essentials

The involvement of the Doctor of Nursing Practice (DNP) Essentials is fundamental in developing this project. This study was developed using the following essentials as a foundation.

##### *Essential One: Scientific Underpinning for Practice*

This project aims to provide an evidenced based OSCE to USM's NAP using MHAUS' protocol for the treatment of MH. The researchers developed this tool using the best evidence that was evaluated by an expert panel.

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

This essential involves using a team approach to meet the goals of this project. An expert panel was created, and these members evaluated the OSCE before it was presented to USM's NAP for acceptance.

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

This essential requires applying current evidenced-based research to meet the aims of this project. Literature was reviewed, and best practice guidelines were used to create the OSCE.

*DNP Essentials VI- Interprofessional Collaboration for Improving Patient and Population Health Outcomes*

The panel of experts is composed of members from various areas such as faculty members from USM, clinical nurse anesthetists with a special interest in MH, and a nurse practitioner instructor who has written and implemented OSCE. The panel evaluated the OSCE and gave feedback for adjustments and revisions.

Specific Aims

The purpose of this doctoral project is to develop an OSCE to potentially improve student competence and patient outcomes related to the treatment of MH. The specific aim is to assess students' knowledge and application of skills using MHAUS's MH protocol. By using a structured method, the goal is to evaluate students fairly with limited bias. The short-term goal is to increase student OSCE participation at USM enabling students to increase their knowledge base on malignant hyperthermia. The protocol

implementation will promote the problem-solving skills necessary for the clinical setting. Post-implementation of the protocol will result in an increase in skill efficacy on a standardized scale among SRNAs developed on the OSCE. The overall goal is to improve patient safety in the clinical setting.

#### Summary

Nurse anesthesia students can benefit from OSCE use. This tool can be used to assess knowledge and skills in a low-stress environment. Students can focus on the application of learned knowledge from the didactic setting and can hone skills not traditionally used in the clinical setting. Additionally, students can practice scenarios that are high impact with low occurrences such as malignant hyperthermia pre-evaluation, identification, and management in a setting that does not harm actual patients. By practicing scenarios, this can lead to a decrease in stress levels, an increase in confidence, and performance when exposed to scenarios in the clinical setting thus, optimizing the student's clinical learning experience while enhancing patient safety.

## CHAPTER II – METHODS

### Introduction

Malignant hyperthermia (MH) is a low-frequency, high-impact event that many student registered nurse anesthetists (SRNA) may be unprepared to manage due to limited exposure in clinical practice (Hackl et al., 1990). Lack of preparation for dealing with such low frequency, high impact events can lead to unfortunate adverse events resulting in death (Hackl et al., 1990). Additionally, lack of student preparation can lead to poor patient outcomes and adverse effects (Ward & Barratt, 2005). Thus, to aid in preventing adverse student and patient outcomes, an OSCE was developed based on peer-reviewed, evidenced-based literature published by MHAUS. The approved OSCE was presented to the administration of USM's NAP, for consideration of use in the nurse anesthesia program.

### Context

Transitioning from student to professional can often be a frightening and stressful matter. Going from reading about an intervention to implementation of interventions are two very different things requiring different skill sets. Students must be prepared to make this transition. Malignant hyperthermia is a big subject in anesthesia. As mentioned before, the incidence of MH reactions ranges from 1:10,000 to 1: 250,000 anesthetics (Rosenberg et al., 2015). However, the prevalence of the genetic abnormalities may be as great as one in 400 individuals (Rosenberg et al., 2015). Studies revealing 12 million hospital discharges in the state of New York demonstrated the prevalence of MH to be one in 100,000 surgical procedures, although the type of anesthetic was not indicated, arises the need for competent care for patients who experience MH (Rosenburg et al.,

2015). Students need to be proficient and prepared to handle situations such as this when they arise with confidence and accuracy. As a result, the development of an OSCE on malignant hyperthermia was developed for use of USM NAP students. Achieving good health outcomes, whether for individuals or populations, is the fundamental purpose of healthcare (Murphy, 2012). Students must be adequately prepped before conducting an OSCE. Preparation involves explaining the design and purpose of the OSCE, grading rubric, rules, identifying the students' roles, orienting students to the setting, equipment, workstations, and material (Smrekar et al., 2017).

The location of the OSCE was implemented at the USM NAP student simulation lab. The facility location is USM, a public state university. The population required to complete the OSCE is one faculty member per four SRNAs. In summary, this equals five groups of four for any given cohort, for a total of twenty students. The setting simulates a real-life operating room scenario influencing the effectiveness of the simulation.

The development of an OSCE on malignant hyperthermia for SRNAs is important to USM. USM currently does not have any practices that would affect our project. The need for a current OSCE template was verified by faculty and staff at USM. According to NAP Assistant Program Coordinator Dr. Mary Jane Collins, USM is changing the program to include OSCE assessment with a request for collection of data and development of OSCE on current content. The NAP faculty is very supportive of this project and have the infrastructure to support OSCE use and development, resource availability for faculty and either static or standardized patients, and workforce focused on improvement.

## Interventions

This project received approval from the USM Institutional Review Board (Protocol # IRB-20-50). Next included the creation of an MH OSCE, formation of a panel of experts, questionnaire dissemination, and data collection. The following interventions are detailed below.

1. Obtain Institutional Review Board (IRB) approval from The University of Southern Mississippi (USM).
2. Obtain approval from The University of Southern Mississippi Nurse Anesthesia Program and identify a collaborating faculty member.
3. Develop an Objective Structured Clinical Examination (OSCE).
4. Develop an expert panel questionnaire based on the quality of the objective structured clinical examination developed using the MHAUS protocol (MHAUS, n.d). This is a pilot study; as a result, no testing on validity and reliability required.
5. Form a panel of experts consisting of four faculty members from The University of Southern Mississippi, as they are currently in charge of the testing practices for this topic. The panel of experts was invited via email.
6. Present a demonstration of Malignant Hyperthermia Objective Structured Clinical Examination via email to the panel of experts along with expert panel questionnaire.
7. Collect and evaluate expert's confidence and recommendations of the objective structured clinical examination implementation via the anonymous

survey link. The anonymous surveys were sent using Qualtrics<sup>®</sup> and scanned into a password-protected computer's electronic database for safe record keeping.

8. Feedback from the panel of experts' questionnaire will be recorded into a table for analysis. Adjustments to the objective structured clinical examination will be made if needed and supported by peer review evidenced-based literature.
9. The Malignant Hyperthermia objective structured clinical examination will be presented to the administration and faculty of the USM Nurse Anesthesia Program for consideration for adding to the current curriculum.
10. DNP project will be disseminated at USM Scholarship Day.
11. Electronic data will be destroyed by deleting files and emptying trash files on password-protected computers.

#### Study of Interventions and Measures

Data will be gathered by a questionnaire emailed through Qualtrics<sup>®</sup> to a designated panel of experts. The purpose of the questionnaire is to critique the OSCE on MH. The OSCE was developed using current MHAUS best practice guidelines for Malignant Hyperthermia. This OSCE contains content that assesses the baseline of knowledge and skill set of each individual before completing the OSCE, refer to Appendix C. The scenario contains the exact objectives and goals of the OSCE. This involves explaining the design and purpose of the OSCE, grading rubric, rules, identifying the students' roles, orienting students to the setting, equipment, workstations, and material (Smrekar et al., 2017).

Recommendations were implemented based on questionnaire feedback and approval from the committee chair. The goal is to ascertain the usability of the OSCE while the expected outcome of the data collected will be role identification and anesthetic management in an MH crisis. This information will be very valuable in determining the value of the implementation of an OSCE. The questionnaire is listed in Appendix D. The questions are asked to allow input from experts so adjustments can be made.

### Analysis

Quantitative and qualitative data were collected via the evaluation tool, Appendix D, from the panel of experts. The data were entered into a table, shown in Table 1. For feedback questions, data were combined to create common themes. Data from the Likert scale, ranging from strongly agree to strongly disagree, were recorded according to the greater amount. No statistical analysis was done as the data was analyzed qualitatively. This information was used to revise the presented OSCE. The OSCE shown in Appendix C reflects feedback from the panel of experts.

### Ethical Considerations

Current ethical situations to be considered is the timing of the implementation of the OSCE. The timing of the implementation of the OSCE may be considered an ethical dilemma for classes before the implementation who do not receive this same training. Senior students who are approaching graduation may feel that OSCE implementation would be beneficial to them in their current preparation for boards and clinical practice as a professional. Unfortunately, this project cannot be taken back into the past, but we can implement this standardized clinical examination for future classes to come. An educational ethical consideration that could arise is 100% compliance in the



implementation of the OSCE, which would be two levels of education for the students. There are no foreseen conflicts of interest. To avoid ethical conflicts the project was submitted to IRB for oversight. The benefits of implementation of the Malignant Hyperthermia OSCE far outweigh the ethical dilemma and will be beneficial to students, preceptors, and patients in the clinical setting.

## CHAPTER III - RESULTS

### Introduction

There is a need for a structured method to assess clinical competency in nurse anesthesia students especially for rare, emergent situations such as MH. An OSCE can be used to uniformly assess skills and knowledge while limiting bias. The purpose of this project was to provide an evidenced based objective structured clinical examination, clinical scenario, and video demonstration to The University of Sothern Mississippi Nurse Anesthesia Program for identification and anesthetic management of malignant hyperthermia according to MHAUS' MH protocol (MHAUS, n.d.).

### Steps of the Intervention

Following the project proposal, approval was granted from the DNP chair and committee. Upon approval, an OSCE template was created based on best practiced evidence supported by MHAUS. The template includes outcomes, objectives, a case scenario, grading rubric and debriefing form. Further, a demonstration video, based on the written protocol, was conducted in USM's simulation lab. There were four participants. The video demonstrated the implementation of steps in managing an MH crisis and highlights critical parts of the treatment process. The purpose of the video is to give students a guide and visual expectations of how anesthetic management should be conducted. The OSCE, demonstration video, clinical scenario, rubric, and debriefing form were included in the IRB application. After IRB approval, as cited in Appendix E, a panel of experts was formed. This panel consists of three NAP faculty, who teach anesthetic management of MH, and an advanced nursing instructor, who routinely develops and manages OSCE evaluations. Moreover, an expert panel questionnaire was

developed. Questions were designed to ascertain the quality of the objective structured clinical examination.

The process of data collection included informed consent, a questionnaire, video demonstration, and report of findings document that was sent to the panel of experts using Qualtrics<sup>®</sup>, an anonymous survey platform, to determine the quality of the evidenced-based OSCE. Data were collected anonymously. Summarized, the following questions were asked: (1) if the participants consented to the study (2) if the learning objectives were clear, (3) if the scenario provides a realistic model of managing malignant hyperthermia, (4) if the tool was appropriate for doctoral-level work, (5) if the OSCE rubric reciprocates guidelines recommended by MHAUS, (5) if the implementation of the OSCE will be beneficial to SRNAs learning how to manage MH (6) and a text entry for additional feedback.

Feedback from the panel of experts' questionnaire was recorded into a table for analysis, refer to Figure 1 and Table 1. Seventy-five percent of the panel strongly agreed that the OSCE met the learning objective while 25% agreed. Further, 100% of the panel concluded that the OSCE demonstrated an appropriate level of doctoral work and followed MHAUS recommendations. Additional qualitative feedback in regard to the demonstration video supported that it was a great presentation, but the participants should speak louder and communicate pertinent information. For example, the SRNA needs to tell the surgeon to cancel the case. Further, in the demonstration video participants should have worn gloves and the provider should have used an Ambu bag to administer 100% oxygen.

Based on feedback, comments, and approval from the DNP chair three areas were addressed in the demonstration video. The video was re-recorded, addressing the areas stated above and in Table 1. All participants were instructed to wear gloves, an Ambu bag was used instead of an anesthesia machine to administer 100% oxygen during management, and SRNA was instructed to tell the surgeon to stop the surgery. The final video was approved by the DNP chair and committee. Further, the OSCE, supporting documentation, and the video was presented to the USM NAP program director for consideration of adopting as a tool for the use of evaluating clinical anesthetic management skills in malignant hyperthermia. Results will be disseminated at USM’s scholarship day.

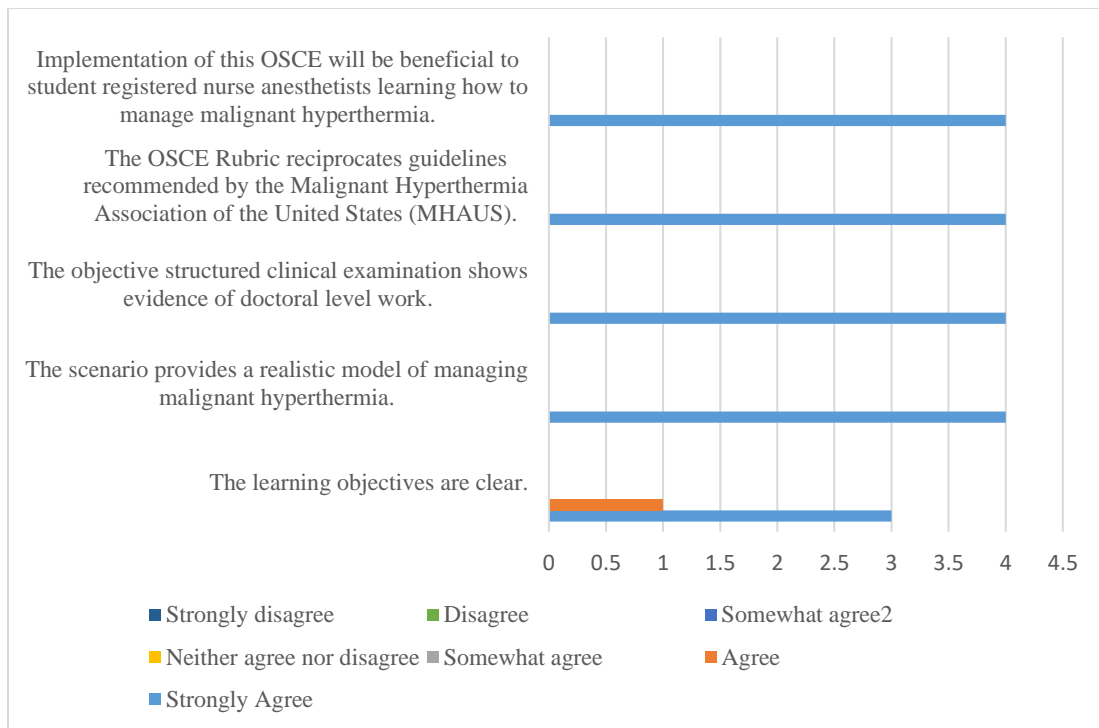


Figure 1. Results from Panel of Experts

Table 1

*Questionnaire Results from the Panel of Experts*

<b>Do you consent to this study?</b>	<b>The learning objectives are clear.</b>	<b>The scenario provides a realistic model of managing malignant hyperthermia</b>	<b>The objective structured clinical examination shows evidence of doctoral-level work.</b>	<b>The OSCE Rubric reciprocates guidelines recommended by the Malignant Hyperthermia Association of the United States (MHAUS).</b>	<b>Implementation of this OSCE will be beneficial to student registered nurse anesthetists learning how to manage malignant hyperthermia.</b>
Yes	Agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
Yes	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
Yes	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
Yes	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree

Table 2

*Panel of Experts Comments*

	Comments
Panel Member 1	Great presentation. My advice would be to wear gloves. The individual that is assisting the MSARF should speak clearly. Would it be feasible to say steps/medications aloud to ensure safety?
Panel Member 2	The written MH OSCE states for the provider to use 100% O2 per Ambu bag. The video varies from this step. The video needs to be altered to reflect compliance with this step.
Panel Member 3	A couple of comments: Communicate with the surgeon and cancel the case. Also start New extra IV start IV fluid and insertion of foley catheter for measuring UOP and Rhabdomyolysis. Great job!!
Panel Member 4	This was very well done and pertinent to the care we need to provide our patients. Good job.

Outcomes

The purpose of the evaluation process was to critique the OSCE, gain feedback, and implement recommendations to improve the tool. The goal is to ascertain the usability of the OSCE while the expected outcomes of the data collected will be an increase in confidence, competence, and role identification in an MH Crisis in nurse anesthesia students. Overall, results support that this OSCE would serve as a valuable asset to uniformly assess students' clinical performance through simulation training if incorporated by the program. Based on the results, utilization of the OSCE will serve as a standardized method to grade and train SRNAs on the identification and anesthetic management of the MH crisis.

## Limitations

Limitations include that there was a small sample size of evaluators serving on the panel of experts. More participants could have yielded more recommendations and made the results more generalizable. The panel of experts that were selected all had knowledge of MH, clinical skill evaluation, and experience of OSCEs to provide rich data and feedback. The panel selected were chosen because of their ability to ensure quality feedback on the OSCE. Another limitation of the study is the limited number of questions in the survey tool. These questions addressed the overall general evaluation of the tool. Questions could have been more specific and targeted to sections of the OSCE, supporting documentation, and video demonstration. However, the number of questions was limited to decrease the interaction time and the number of required interactions to decrease the inconvenience of the participants. Delivering the study with more detailed questions in the future could allow the study of more in-depth feedback on improvements for the OSCE.

## Conclusion

Evidenced-based practice is a combination of research evidence, clinical expertise, and patient expectations (Wallen et al., 2010). The proposed OSCE addresses all three aspects required of evidenced-based practice. The OSCE, supporting documentation, and video demonstration are useful works because they can serve as a valuable learning tool for identifying and anesthesiologically managing an MH crisis. Sustainability of the study and recommendations for future research would be to conduct the OSCE on second year nurse anesthesia students before entering clinical. Students should be presented with the video demonstration, report of findings handout, and OSCE

template and should be expected to conduct the scenario without guidance. The OSCE should be recorded in USM's simulation lab. Afterward, a debriefing session should be held with the students and the instructor. The need for future research would be to examine the implementation of the created MH OSCE. Another aspect that could be explored is student perception of the OSCE and the effectiveness of its implementation, and even preceptors' perception. Future research would provide feedback on the effectiveness of the OSCE and adjustment can be made as needed based on results. The potential of the use of OSCE implementation could be utilized in other schools if clinical settings view a strong clinical foundation from students who utilize OSCE as a suggestion to other nurse anesthesia programs. Because information can be standardized for testing, ensuring students receive the same information rendered by evidenced-based practice, OSCE implementation can be the future of testing and examination for clinical practice settings for nurse anesthesia students.



## CHAPTER IV – DISCUSSION

### Summary

The goal of this doctoral project was to provide a uniform clinical evaluation using an evidenced-based OSCE, demonstration video, debriefing form, and rubric for the identification and management of malignant hyperthermia. This OSCE and supporting documents were presented and evaluated by a panel of experts. Data was recorded and recommendations were implemented based off feedback from the panel.

Results from the survey, completed by the panel of experts, supports the OSCE conveying it meets learning objectives and displays doctoral-level work. Additionally, the related MH simulation scenario applies to identify and anesthesiologically managing the real-life MH crisis. The OSCE reciprocates guidelines recommended by MHAUS and can be compared for reflection as evidenced-based practice guidelines. As a result, the MH OSCE created can be used as an asset to uniformly evaluate clinical simulation for nurse anesthesia students.

The strengths of this project include the OSCE is evidenced based using MHAUS' MH protocol. The MH OSCE is standardized and provides a hard copy of anesthetic management instruction, clinical scenario, rubric, video demonstration, and debriefing form to the student allowing the student the opportunity to study the material before testing. Additionally, the recorded video demonstration included realistic features and responses to interventions and serves as a reference tool for the students, professors, and laboratory personnel. Thus, video demonstration offers a different learning modality than the conventional method. Further, the OSCE is designed to be completed utilizing teams that assess if students can successfully demonstrate leadership during crisis,

identify roles, and communicate effectively among one another as well as with others. The OSCE has the potential to provide the student nurse anesthetist the opportunity to exercise collaboration through effective communications and team building. Lastly, this tool has the potential to reduce the bias of the evaluator, because it is uniform. Students can have more confidence in performing skills because it is known what is expected and how they will be evaluated.

### Interpretation

The link of the intervention, the OSCE, and the outcome is presenting as beneficial to anesthesia students and instructors. There are no other studies on utilizing OSCEs for MH management. The impact of this study for SRNAs and graduate-level nursing instructors is that the OSCE provides a baseline, evidenced-based guideline to assist the students with high stressful low impact clinical scenarios such as MH. The outcomes lined up with our predicted outcomes. The prediction is the OSCE would yield to be beneficial to SRNAs enrolled in nurse anesthesia schools who deal with MH in the clinical setting. The expert feedback supported the predicted outcomes. Because MHAUS was utilized for the development of the OSCE, the experts supported the development of the OSCE. There were no cost and strategic tradeoffs in this study.

### Conclusion

In summary, MH OSCE implementation can be useful to USM's NAP students. Utilization can facilitate learning as well as reduce bias. The NAP faculty are very supportive of this project and have the infrastructure to support OSCE use and development. Additionally, resources are available for both students and faculty. Thus,

the MH OSCE can be used as an asset to uniformly evaluate clinical simulation for nurse anesthesia students.

APPENDIX A – DNP Essentials

DNP Essentials	How the Essential is Completed
DNP Essential I- Scientific Underpinnings for Practice	Review relevant evidence on the topic.
DNP Essential II- Organizational and Systems Leadership for Quality and Improvement and Systems Thinking	Communicate with stakeholders and combine best practice guidelines to promote a different educational tool to enhance patient care.
DNP Essential III- Clinical Scholarship and Analytical Methods for Evidenced Based Practice	Combine best practices and methods to create an alternative educational tool.
DNP Essentials IV- Information Systems or Technology and Patient Care Technology for Improvement and Transformation of Health Care.	Utilize patient simulation lab and monitoring equipment to conduct the OSCE.
DNP Essentials VI- Interprofessional Collaboration for Improving Patient and Population Health Outcomes	Collaborate with stakeholders from other disciplines and healthcare facilities to critique the OSCE template.

## APPENDIX B Invitation to the Panel of Experts

We are conducting research on developing an objective structured clinical examination (OSCE) related to the treatment protocol of Malignant Hyperthermia (MH). We are inviting you to participate because you are considered an expert in either the academic or clinical area of nurse anesthesia.

Participation in this project includes reviewing the attached OSCE for the MH proposal and accompanying video. Following the review, we ask that you complete a brief questionnaire about the appropriateness of the OSCE for MH. The estimated time to complete is less than an hour. Participation is voluntary and anonymous. There will be no repercussions for non-participation and no identifying information will be asked or used. If you have any questions, please contact us using the information provided below.

Thanks in advance for your time and cooperation!

Ednita Fountain (ednita.street@usm.edu)

Faith Sherman (faith.sherman@usm.edu)

## APPENDIX C Malignant Hyperthermia OSCE Template

### Malignant Hyperthermia OBJECTIVE STRUCTURED CLINICAL EXAM

**LEARNER OUTCOMES:** Students will be able to:

1. Properly use operating room equipment and medications during a malignant hyperthermia crisis
2. Be able to identify the signs and symptoms of malignant hyperthermia.
3. Identify safe and unsafe anesthetics inpatient population with MH history.
4. Understand roles in malignant hyperthermia crisis.
5. Properly identify or demonstrate the proper dosages and administration of Dantrolene and/or Raynodex.
6. Properly manage signs symptoms associated with malignant hyperthermia crisis

**DOMAINS:**

Formative Evaluation- Feedback
Clinical Skill
Critical Thinking

**PURPOSE:** The purpose of the OSCE is to assess the identification and management of a malignant hyperthermia crisis

**LEARNER OBJECTIVES:**

1. Identify four major components of MH event as outlined by MHAUS
2. Demonstrate understanding of pathophysiology and clinical application of treating malignant hyperthermia and symptom management.
3. Appropriately identifies signs and symptoms of malignant hyperthermia, with appropriate treatment to manage symptoms.
4. Appropriately identify and calculate all emergency drugs utilized during crisis management.

**INDIVIDUAL OR GROUP OSCE:** Group

**REQUIRED READING and ASSOCIATED LECTURES:**

Stoelting, R. K., Hines, R. L., & Marschall, K. E. (2012). *Stoelting's anesthesia and co-existing disease*. Saunders/Elsevier.

Malignant Hyperthermia Association of the United States. (2019). *Managing a crisis*. Retrieved from: <https://www.mhaus.org/healthcare-professionals/managing-a-crisis/>

**REQUIRED VIDEO:** Malignant Hyperthermia Demonstration Video

**REQUIRED PARTICIPANTS:** Four students and an examiner

**VENUE:** University of Southern Mississippi's School of Nursing Simulation Lab

**STUDENT LEVEL OF OSCE:** Semester **3-4**, (Circle one)

**TIME ALLOTTED:** 15 minutes

**SEQUENTIAL PRACTICE & TESTING:** The OSCE is an evaluation and requires no further testing.

**RECOMMENDED PRACTICE before EXAMINATION:** 60 minutes

### CONTENT OUTLINE

**CONTEXT:**

You are assigned to identify, manage, and treat a malignant hyperthermia case.

Mr. Stethoscope, a 22-year-old male, is scheduled for laparoscopic cholecystectomy. He is 70 kg, with no known allergies. Mr. Stethoscope was adopted and unaware of his family history. He has never had any surgeries in the past. Preoperatively his vital signs are a blood pressure of 116/72 mmHg, Heart Rate 67 bpm, Respiration Rate 16, oxygen saturation 100% on room air. You induce the patient with Versed 2mg, Fentanyl 100 mcg, Lidocaine 70 mg, Zemuron 5 mg (defasciculating dose), Propofol 100mg, and Succinylcholine 100 mg. Intubation goes very well as evidenced by bilateral chest breath sounds, chest rise, and end-tidal carbon dioxide (ETCO<sub>2</sub>) of 36. Sevoflurane is initiated and increased to 1 minimum alveolar concentration (MAC). Suddenly the patient ETCO<sub>2</sub> begins to elevate and is now 74. Additionally, the heart rate is now 140 bpm, and the body temperature is 104 degrees Fahrenheit. The patient is developing signs and symptoms of malignant hyperthermia. Arterial blood gas and point of care electrolytes are obtained results include: Ph: 7.04, ETCO<sub>2</sub>: 78, bicarbonate: 17, potassium 6, calcium. 6.0 How will you manage this scenario?

**EQUIPMENT & SUPPLIES:**

- Anesthesia Machine with Circuit
- Simulation man
- Intravenous tubing
- (Simulation) Dantrolene
- Ambu Bag
- Monitors: 5 lead electrocardiogram, pulse oximeter, blood pressure
- Syringes for induction and treatment medications
- Endotracheal tube, tape, Laryngoscope
- Operating room table
- Drug Cart

- MH Cart
- Phone

SITE SELECTION: USM's NAP simulation lab

**TASK STATEMENT:**

The purpose of this OSCE is to identify signs and symptoms and demonstrate proper management of malignant hyperthermia.

**PROCESS**

1. Identify that the patient has malignant hyperthermia
2. Turn off all anesthetic agents and disconnect the patient from the circuit.
3. Administer 100 % oxygen and hyperventilate with an Ambu bag.
4. Notify the surgeon of the condition and ask to terminate surgery.
5. Call for MH Cart, Call for help, different Anesthesia Machine, and MHAUS Hotline: 1-800 -644-9737.
6. Assign roles:
  - a. Student 1: Mix dantrolene/ Runner
  - b. Student 2: Airway management
  - c. Student 3: Administer rescue drugs as needed
  - d. Student 4: Runner/ Cardiopulmonary resuscitation as needed
7. Administer Dantrolene 2.5 mg/kg as quickly as possible. Continue to give dantrolene until all signs of MH have resolved.
8. Administer cold intravenous fluids - use normal saline, not ringer's lactate, and place ice at axillary or groin.
9. Obtain arterial blood gas, electrolytes, and glucose. Treat as needed.
10. Once stable, transfer to ICU.

**DEBRIEFING FORM:**

1. What are the primary concerns in this scenario?
2. What could have been done differently to ensure better outcomes for the patients?
3. How did the group work as a team?
4. What interventions were done and were they appropriate?

**RUBRIC FOR MALIGNANT HYPERTHERMIA CRISIS AND MANAGEMENT**

	<b>TASKS</b>	<b>PASS</b>	<b>FAIL</b>	<b>COMMENTS</b>
	Prepares and selects appropriate equipment			
	Notify surgeon to halt the procedure: Discontinue volatile agents and succinylcholine.			



Administer 100% Oxygen with Ambu and mask.			
Call for help and assign roles. Call the MHAUS hotline.			
Call for malignant hyperthermia cart.			
Reconstitute and give IV dantrolene 2.5 mg/kg rapidly. Repeat as frequently as needed until the patient responds with a decrease in ETCO <sub>2</sub> .			
Administer 1-2 mEq/kg of sodium bicarb.			
Administer calcium chloride 10mg/kg IV			
Cool the patient if the core temperature is >39°C using cooling measures. <ul style="list-style-type: none"> <li>- Cold saline</li> <li>- Apply ice to surface</li> </ul>			
Treat hyperkalemia. <ul style="list-style-type: none"> <li>- Hyperventilation</li> <li>- Glucose 50ml 50% dextrose</li> <li>- Insulin 10 units IV</li> <li>- Calcium chloride 10mg/kg</li> </ul>			
Institute appropriate monitoring including core temperature, urine output with a bladder catheter, and consider arterial and/or central venous			

<p>monitoring if warranted by the clinical severity of the patient.</p> <p>Follow Heart rate, core temperature, ETCO<sub>2</sub>, minute ventilation, blood gases, potassium, creatinine clearance, urine myoglobin, and coagulation studies as warranted by the clinical severity of the patient.</p>			
--	--	--	--

The OSCE by the student demonstrates foundational knowledge and correct use of the ultrasound machine in obtaining IV access: (Circle one) **PASS FAIL**

Does the student need to repeat this OSCE at a later date to satisfy learning requirements? (Circle one) **YES NO** **Date to return for evaluation:** \_\_\_\_\_

EXAMINER: \_\_\_\_\_ DATE: \_\_\_\_\_

APPENDIX D –Evaluation Tool

Educating Student Registered Nurse Anesthetists (SRNAs) on Malignant Hyperthermia

using an Objective Structured Clinical Examination (OSCE) Format

		<b>Comments</b>
Do you consent to this study?	Yes          No	
Do the learning objectives clear?	Strongly agree Agree Somewhat agree Neither agree nor disagree Somewhat disagree Disagree Strongly Disagree	
The scenario provides a realistic model of managing malignant hyperthermia.	Strongly agree Agree Somewhat agree Neither agree nor disagree Somewhat disagree Disagree Strongly Disagree	
The objective structured clinical examination shows evidence of doctoral-level work.	Strongly agree Agree Somewhat agree Neither agree nor disagree Somewhat disagree Disagree Strongly Disagree	
The OSCE Rubric reciprocates guidelines recommended by the Malignant Hyperthermia Association of the United States (MHAUS).	Strongly agree Agree Somewhat agree Neither agree nor disagree Somewhat disagree Disagree Strongly Disagree	
Implementation of this OSCE will be beneficial to student registered nurse anesthetists learning how to manage malignant hyperthermia.	Strongly agree Agree Somewhat agree Neither agree nor disagree Somewhat disagree Disagree Strongly Disagree	
Provide any feedback or suggestions to add to the OSCE.		

## APPENDIX E IRB Approval

Office of  
Research Integrity



118 COLLEGE DRIVE #5125 • HATTIESBURG, MS | 601.266.6576 | USM.EDU/ORI

### NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

The project below has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services regulations (45 CFR Part 46), and University Policy to ensure:

- The risks to subjects are minimized and 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 involving risks to subjects must be reported immediately. Problems should be reported to ORI via the Incident template on Cayuse IRB.
- The period of approval is twelve months. An application for renewal must be submitted for projects exceeding twelve months.

PROTOCOL NUMBER: IRB-20-50

PROJECT TITLE: Educating Student Registered Nurse Anesthetists on Malignant Hyperthermia using an Objective Structured Clinical Examination Format

SCHOOL/PROGRAM: School of LANP, Leadership & Advanced Nursing

RESEARCHER(S): Edhita Fountain, Faith Sherman, Mary Jane Collins

IRB COMMITTEE ACTION: Approved

CATEGORY: Expedited

Category 2.(ii). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording).

Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation.

PERIOD OF APPROVAL: March 25, 2020

A handwritten signature in cursive script that reads "Donald Sacco".

**Donald Sacco, Ph.D.**

**Institutional Review Board Chairperson**

APPENDIX F Standard Online Informed Consent



INSTITUTIONAL REVIEW BOARD  
**STANDARD (ONLINE) INFORMED CONSENT**

**STANDARD (ONLINE) INFORMED CONSENT PROCEDURES**

The Project Information and Research Description sections of this form should be completed by the Principal Investigator before submitting this form for IRB approval. Use what is given in the research description and consent sections below when constructing research instrument online.

Last Edited May 13<sup>th</sup>, 2019



Today's date: 03/24/2020		
<b>PROJECT INFORMATION</b>		
Project Title: Educating Student Registered Nurse Anesthetists on Malignant Hyperthermia using an Objective Structured Clinical Examination Format		
Principal Investigator: Ednita Fountain, RN, CCRN	Phone: 601-947-0366	Email: ednita.fountain@usm.edu
College: Nursing and Health Professions	School and Program: Leadership and Advanced Nursing Practice; Nurse Anesthesia Program	
<b>RESEARCH DESCRIPTION</b>		
<p><b>1. Purpose:</b></p> <p>The purpose of this project is to increase uniformity in the assessment of learning and evaluation of student registered nurse anesthetist management of Malignant Hyperthermia. The overall goal is to improve patient safety in clinical setting. Results will be disseminated at USM Scholarship Day.</p> <p><b>2. Description of Study:</b></p> <p>On Objective Structured Clinical Examination will be developed based on evidence-based practice and peer reviewed literature. The participant population will consist of five individual experts, who will review the proposed Malignant Hyperthermia objective structured clinical examination. The experts who will review the proposed Malignant Hyperthermia objective structured clinical examination will include the graduate nursing faculty members from The University of Southern Mississippi who are currently responsible for clinical education and testing practices for malignant hyperthermia. Participation is via anonymous survey, with no repercussions for nonparticipation. Interaction time will be less than 1 hour, with 1 interaction.</p> <p><b>3. Benefits:</b></p> <p>Potential benefits include: Increase the knowledge base of Malignant Hyperthermia and treatment, promote problem-solving skills necessary for clinical setting, increase confidence levels related to handling stressful clinical scenarios preparing students for real-life crisis, decrease stress levels related to performance in high stressful clinical scenarios, increase in skill efficacy, and improve patient safety in clinical settings.</p> <p><b>4. Risks:</b></p> <p>No known physical, psychological, social, or financial research-related risks, inconveniences, or side effects are expected.</p> <p><b>5. Confidentiality:</b></p>		

→ An anonymous survey link will be used with no identifiers. Electronic data will be destroyed after dissemination of project results at The University of Southern Mississippi Doctor of Nursing Practice scholarship day by deleting the files and emptying the trash FILE on the computer where it was stored.

#### 6. Alternative Procedures:

→ Participation is voluntary with no repercussions for non-participation.

#### 7. Participant's Assurance:

This project and this consent form have been reviewed by the Institutional Review Board, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board, The University of Southern Mississippi, 118 College Drive #5125, Hattiesburg, MS 39406-0001, 601-266-5997.

Any questions about this research project should be directed to the Principal Investigator using the contact information provided above.

### CONSENT TO PARTICIPATE IN RESEARCH

I understand that participation in this project is completely voluntary, and I may withdraw at any time without penalty, prejudice, or loss of benefits. Unless described above, all personal information will be kept strictly confidential, including my name and other identifying information. All procedures to be followed and their purposes were explained to me. Information was given about all benefits, risks, inconveniences, or discomforts that might be expected. Any new information that develops during the project will be provided to me if that information may affect my willingness to continue participation in the project.

**Include the following information only if applicable. Otherwise delete this entire paragraph before submitting for IRB approval:** The University of Southern Mississippi has no mechanism to provide compensation for participants who may incur injuries as a result of participation in research projects. However, efforts will be made to make available the facilities and professional skills at the University. Participants may incur charges as a result of treatment related to research injuries. Information regarding treatment or the absence of treatment has been given above.

#### CONSENT TO PARTICIPATE IN RESEARCH

By clicking the box below, I give my consent to participate in this research project.

Check this box if you consent to this study, and then click "Continue." (Clicking "Continue" will not allow you to advance to the study, unless you have checked the box indicating your consent.)

If you do not wish to consent to this study, please close your browser window at this time.

## APPENDIX G Report of Findings

### Project Purpose

There is a need for a structured method to assess clinical competency in nurse anesthesia students especially for rare, emergent situations such as MH. An objective structured clinical examination (OSCE) is an evaluative tool designed to assess the competence of given topic. It formally assesses skills and knowledge with limited bias and standardizes grading. The purpose of this project is to provide an evidenced based objective structured clinical examination to The University of Sothern Mississippi Nurse Anesthesia Program for the Malignant Hyperthermia Association of the United States' (MHAUS) MH protocol.

### What is Malignant Hyperthermia?

Malignant hyperthermia (MH) is a pharmacogenetic disorder of skeletal muscle that presents as a hypermetabolic response to potent volatile anesthetic gases such as halothane, sevoflurane, desflurane, isoflurane, and the depolarizing muscle relaxant succinylcholine, and rarely, in humans, to stressors such as vigorous exercise and heat (Rosenberg et al., 2015).

The incidence of MH reactions ranges from 1:10,000 to 1: 250,000 anesthetics (2015). However, the prevalence of the genetic abnormalities may be as great as one in 400 individuals (Rosenburg et al., 2015). The classic signs of MH include hyperthermia, tachycardia, tachypnea, increased carbon dioxide production, increased oxygen consumption, acidosis, hyperkalemia, muscle rigidity, and rhabdomyolysis, all related to a hypermetabolic response (Rosenburg et al., 2015).

## What is an Objective Structured Clinical Examination?

Based on various descriptions of OSCE in the literature Khan et al. (2013)

proposed a consolidated definition:

An assessment tool based on the principles of objectivity and standardization, in which candidates' move thorough a series of time-limited stations in a circuit for the purposes of assessment of professional performance in a simulated environment. At each trained station candidates are assessed and marked against standardized scoring rubrics by trained assessors. (p. 1438)

### Available Knowledge

- OSCE usage can enable nursing students to increase the complexity of their understanding and autonomy (Aronowitz et al., 2017).
- OSCE usage has shown a positive impact educationally (Aronowitz et al., 2017).
- A study by Bouriscot (2010) supported that OSCE usage drives learning by creating a realistic recreation of scenarios.
- Studies have shown OSCEs are more reliable and valid than traditional forms of clinical assessments (Brosnan et al., 1979).
- The simulated tasks allow the participant to progress from the “knows” level of competence to the “shows” level on Miller’s pyramid which is the second-highest level of competence (Miller, 1990).



## REFERENCES

- American Association of Nurse Anesthetists (AANA). (2017). *Malignant hyperthermia crisis preparedness and treatment*. Retrieved from:  
[https://www.aana.com/docs/default-source/practice-aana-com-web-documents-\(all\)/malignant-hyperthermia-crisis-preparedness-and-treatment.pdf?sfvrsn=630049b1\\_8](https://www.aana.com/docs/default-source/practice-aana-com-web-documents-(all)/malignant-hyperthermia-crisis-preparedness-and-treatment.pdf?sfvrsn=630049b1_8)
- The American Board of Anesthesiology (ABA). (2016). *Objective structured clinical examination (OSCE), FAQs*. Retrieved from:  
<http://www.theaba.org/PDFs/APPLIED-Exam/OSCE-FAQs>
- Aronowitz, T., Aronowitz, S., Mardin-Small, J., & Kim, B. (2017). Using objective structured clinical examination (OSCE) as education in advanced practice registered nursing education. *Journal of Professional Nursing*, 33(2), 119-125.  
<https://doi.org/10.1016/j.profnurs.2016.06.003>
- Boursicot, K. A. (2010). Structured assessments of clinical competence. *British Journal of Hospital Medicine*, 71(6), 342-344.  
<https://doi.org/10.12968/hmed.2010.71.6.48450>
- Brady, J. E., Sun, L. S., Rosenberg, H., & Li, G. (2009). Prevalence of malignant hyperthermia due to anesthesia in New York State, 2001–2005. *Anesthesia & Analgesia*, 109(4), 1162-1166. <https://doi.org/10.1213/ane.0b013e3181ac1548>
- Brosnan, M., Evans, W., Brosnan, E., & Brown, G. (2006). Implementing objective structured clinical skills evaluation (OSCE) in nurse registration programmes in a centre in Ireland: A utilisation focused evaluation. *Nurse Education Today*, 26, 115–122. <https://doi.org/10.1016/j.nedt.2005.08.003>

- Hackl, W., Mauritz, W., Winkler, M., Sporn, P., & Steinbereithner, K. (1990). Anesthesia in malignant hyperthermia-susceptible patients without dantrolene prophylaxis: a report of 30 cases. *Acta Anaesthesiologica Scandinavica*, *34*(7), 534-537.  
<https://doi.org/10.1111/j.1399-6576.1990.tb03140.x>
- Harden, R. M. (1988). What is an OSCE? *Medical Teacher*, *10*(1), 19-22.  
<https://doi.org/10.3109/01421598809019321>
- Harden, R. M., & Gleeson, F. A. (1979). Assessment of clinical competence using an objective structured clinical examination (OSCE). *Medical Education*, *13*, 41–54.  
<https://doi.org/10.1111/j.1365-2923.1979.tb00918.x>
- Harden, R., Stevenson, M., Downie, W., & Wilson, G. (1975). Assessment of clinical competence using objective structured examination. *British Medical Journal*, *1*, 447–451. Retrieved from: <https://www.bmj.com/content/1/5955/447>
- Khan, K. Z., Ramachandran, S., Gaunt, K., & Pushkar, P. (2013). The objective structured clinical examination (OSCE): AMEE guide no. 81. Part I: an historical and theoretical perspective. *Medical Teacher*, *35*(9), 1437-1446.  
<https://doi.org/10.3109/0142159X.2013.818634>
- Lippincott Nursing Education. (2017). *How formative assessment helps nursing students succeed in the classroom*. Retrieved from: [http://nursingeducation.lww.com/blog.entry.html/2017/02/26/how\\_formative\\_assess-X2Ow.htm](http://nursingeducation.lww.com/blog.entry.html/2017/02/26/how_formative_assess-X2Ow.htm);
- Little, C. (2014). The objective structured clinical examination. *Nursing Times*, *110*, 2-5. Retrieved from: <https://insights.ovid.com/nrtm/201408270/00006203-201408270-00001>

- Mauritz, W., Hackl, W., Winkler, M., Sporn, P., & Steinbereithner, K. (1990). Anesthesia in malignant hyperthermia susceptible patients. *Acta Anaesthesiologica Belgica*, 41(2), 87–94. <https://doi.org/10.1111/j.1399-6576.1990.tb03140.x>
- Malignant Hyperthermia Association of the United States (MHAUS). (n.d.). What is MH/MHAUS? Retrieved from: <https://www.mhaus.org/about/what-is-mh-mhaus/>
- Miller, G. (1990). The assessment of clinical skills/competence/performance. *Academic Medicine*, 65(9), 63-67. Retrieved from: <https://insights.ovid.com/crossref?an=00001888-199009000-00045>
- Murphy, P.J. (2012). Measuring and recording outcome. *British Journal of Anaesthesia*, 109(1), 92-98. <https://doi.org/10.1093/bja/aes180>
- Newble, D. (2004). Techniques for measuring clinical competence: objective structured clinical examinations. *Medical Education*, 38(2), 199-203. <https://doi.org/10.1111/j.1365-2923.2004.01755.x>
- Norman, J. (2012). Systematic review of the literature on simulation in nursing education. *Association of Black Nursing Faculty Journal*, 23(2). Retrieved from: <http://web.b.ebscohost.com/lynx.lib.usm.edu/ehost/pdfviewer/pdfviewer?vid=4&sid=bbef02d9-3346-4464-bba1-c224577dec6f%40sessionmgr103>
- Pugh, D., & Smee., S. (2015). Guidelines for the development of objective structured clinical examination (OSCE) Cases. *Medical Council of Canada*. DOI: 10.13140/RG.2.1.4622.0003
- Riazi, S., Larach, M., Hu, C., Wijeyesundera, D., Massey, C., & Kraeva, N. (2014) Malignant hyperthermia in Canada: characteristics of index anesthetics in 129

malignant hyperthermia susceptible probands. *Anesthesia and Analgesia*, 118(2), 381–387. [https://doi: 10.1213/ANE.0b013e3182937d8b](https://doi.org/10.1213/ANE.0b013e3182937d8b)

Robinson, R., Curran, J., Ellis, F., Halsall, P., Hall, W., & Hopkins P. (2006). Multiple interacting gene products may influence susceptibility to malignant hyperthermia. *Annals of Human Genetics*, 64(4), 307–320. [https://doi: 10.1017/S0003480000008186](https://doi.org/10.1017/S0003480000008186)

Rosenberg, H., Pollock, N., Schiemann, A., Bulger, T., & Stowell, K. (2015). Malignant hyperthermia: a review. *Orphanet Journal of Rare Diseases*, 10, 93. <https://doi.org/10.1186/s13023-015-0310-1>

Smrekar, M., Ledinski Fičko, S., Hošnjak, A. M., & Ilić, B. (2017). Use of the objective structured clinical examination in undergraduate nursing education. *Croatian Nursing Journal*, 1(1), 91-102. [https:// doi:10.24141/2/1/1/8](https://doi.org/10.24141/2/1/1/8)

Strazis, K., & Fox, A. (1993). Malignant hyperthermia: a review of published cases. *Anesthesia and Analgesia*; 77(2), 297–304. [https://doi:10.1213/00000539-199308000-00014](https://doi.org/10.1213/00000539-199308000-00014)

Wallen, G., Mitchell, S., Melnk, B., Fineout-Overhold, E., Miller-Davis, C., Yates, J., & Hastings, C. (2010). Implementing evidence-based practice: effectiveness of a structured multifaceted mentorship programme. *Journal of Advanced Nursing*, 66(12), 2761-2771. <https://doi.org/10.1111/j.1365-2648.2010.05442.x>

Ward, H., & Barratt, J. (2005). Assessment of nurse practitioner advanced clinical practice skills: Using the objective structured clinical examination (OSCE). *Primary Health Care*, 15, 37–41. [https://doi: 10.7748/phc2005.12.15.10.37.c563](https://doi.org/10.7748/phc2005.12.15.10.37.c563)