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Surgical Fire Prevention and Management: An Objective Structured Clinical Examination for Nurse Anesthesia

Tate Fazio

Kaleb Killens

SURGICAL FIRE PREVENTION AND MANAGEMENT: AN OBJECTIVE STRUCTURED CLINICAL EXAMINATION FOR NURSE ANESTHESIA

by

Tate Fazio and Kaleb Killens

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Dr. Nina McLain

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ABSTRACT

Sentinel events in health care are rare events, often corresponding with permanent injury or death. Fires in the operating room (OR) are one type of sentinel event. Although rare due to possible life-threatening injuries to patients and staff, appropriate surgical fire education is critical in nurse anesthesia education, as anesthesia providers play a significant role in surgical fires (Wunder et al., 2020). The development of simulation exercises has the potential for students to experience and become competent in managing high-acuity, low-frequency events, such as surgical fires (Wunder et al., 2020).

The Nurse Anesthesia Program (NAP) at The University of Southern Mississippi (USM) requested the development of a modern method of practicing surgical fire management strategies. The creation of an Objective Structured Clinical Examination (OSCE) regarding surgical fire prevention and management aims to develop a simulation option and an evaluation tool for USM Student Registered Nurse Anesthetists (SRNAs). OSCE creation was guided by evidence-based practice literature and the American Association of Anesthesiologists (2013) Operating Room Fire Algorithm.

The Surgical Fire OSCE was emailed to second and third-year USM NAP students, USM NAP faculty, and local Certified Registered Nurse Anesthetists (CRNAs). They had the opportunity to review the OSCE and provide anonymous feedback via an online evaluation survey. The 51 survey participants either strongly agreed or somewhat agreed that the OSCE displayed relevant, doctoral-level work with a realistic fire scenario that would assist in building SRNA's competence and knowledge in managing surgical fires in clinical practice. The positive feedback demonstrated that the OSCE achieved its desired expectations and objectives. Thus, the Surgical Fire OSCE is a potentially

valuable asset to USM SRNAs, who can transition these high levels of safe patient care into their future professional careers.

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We want to thank our Committee Chair, Dr. Stephanie Parks, for her guidance, support, patience, and reassurance throughout the process of completing this doctoral project. We also want to thank our Committee Member, Dr. Nina McLain, for her support and direction. Their clinical experiences in the field of anesthesia genuinely put their stamp on this project and allowed us to shape this OSCE to be the most efficient method possible to prepare safe-practicing SRNAs for clinical practice. Furthermore, we want to thank those who took the time to participate in our OSCE survey and provided prompt feedback. Again, we want to extend a special thank you to everyone who dedicated their time and efforts to this doctoral dissertation.

DEDICATION

I would like to express extreme gratitude and thank the special people in my life who have constantly supported me throughout the process of completing this doctoral project and throughout my journey through nurse anesthesia school. First, I want to thank my wife, Dayne, for all of the love and support she has shown me. Thank you for constantly pushing me to be the best I can be, supporting our family over the last three years, and showing me unconditional love. I would also like to thank my parents for their support, love, and inspiration. Without your love and support, I would not have had the success in life that I have had thus far. Lastly, I would like to thank my family, friends, doctoral project partner, Kaleb, and classmates for their constant support. Completing this doctoral project and anesthesia school would not be possible without each of you! - *Tate Fazio*

I would like to express my gratitude to the loved ones in my life that had made this journey through the anesthesia program possible. I would like to give a loving thanks to my parents for their support in every aspect of my life. Thank you for your unwavering support. I would like to thank all my friends and family for allowing me to continue this path of life I've chosen and for never showing any doubt in me. Thank you to my doctoral project partner Tate as we continually push each other to produce the greatest quality product possible. Creating any of this would not be possible without every single person I've encountered over this journey, thank you! – *Kaleb Killens*

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LIST OF ABBREVIATIONS

AACN	American Association of College of Nurses
AANA	American Association of Nurse Anesthesiologist
ASA	American Society of Anesthesiologist
COA	Council of Accreditation of Nurse Anesthesia Education
CRNA	Certified Registered Nurse Anesthesiologist
DNP	Doctor of Nursing Practice
EBP	Evidence Based Practice
ETT	Endotracheal Tube
GRS	Global Rating Scale
LMA	Laryngeal Mask Airway
NAP	Nurse Anesthesia Program
OSCE	Objective Structured Clinical Examination
OR	Operating Room
SBL	Simulation Based Learning
SRNA	Student Registered Nurse Anesthetist
TLT	Transformative Learning Theory
USM	The University of Southern Mississippi

CHAPTER I – INTRODUCTION

According to the Emergency Care Research Institute, an average of 650 operating room fires are reported annually (Kishiki et al., 2019). Although Operating Room (OR) fires often are termed 'never events' and occur at relatively low frequencies, they carry high risk and the possibility of life-threatening injuries (Jones et al., 2019; Wunder et al., 2020). Proper training and education are essential to nurse anesthetist education due to their role in managing surgical fires (Wunder et al., 2020). The development of simulation exercises has the potential for students to experience and become competent in managing high-acuity, low-frequency events, such as surgical fires (Wunder et al., 2020).

Due to the rare occurrence of surgical fires and the likelihood that students will not encounter fires during clinical rotations, the nurse anesthesia program (NAP) faculty at The University of Southern Mississippi (USM) recognized the importance of surgical fire education and simulated training. An objective structured clinical examination (OSCE) aimed explicitly at surgical fires was created to meet the NAP's demands. OSCEs permit the evaluation of students' ability to apply skills, judgment, and clinical reasoning in low-risk situations, which may be otherwise difficult to assess via traditional methods (Aronowitx et al., 2017). The OSCE should prepare student registered nurse anesthetists (SRNAs) to confidently deal with surgical fires in the OR if ever encountered and ultimately has the potential to improve patient care and outcomes.

Problem Description

Background

Fires in the operating room consist of three primary components, fuel, ignition, and an oxidizer, otherwise known as the 'fire triad' or 'fire triangle. When discussing OR

fire management, oxygen, which falls under the oxidizer component of the fire triad, receives significant attention. Nurse anesthetists routinely deliver highly concentrated oxygen to patients undergoing surgical procedures (Wunder et al., 2020). While managing surgical fires is not solely the responsibility of anesthesia providers, their use of high oxygen concentrations earns them a crucial role in fire mitigation.

According to Wunder et al. (2020), although surgical fires are rare, all anesthesia personnel should be prepared and competent to manage fires due to their high acuity. Furthermore, Wunder mentions that OR fire simulation is necessary for SRNA training, and high-stakes emergency simulations can best prepare students to later fulfill their role as a Certified Registered Nurse Anesthetist (CRNA).

Statement of the Problem

Advanced simulation training in OR fire management is vital to nurse anesthesia education (Wunder et al., 2020). The NAP at USM requested the development of a simulation option and an evaluation tool for managing surgical fires. The SRNAs and the USM NAP faculty have made an effort to submit a doctoral project to the objective structured clinical examination (OSCE) database on the prevention and management of surgical fires. The Surgical Fire OSCE has been developed according to the 2013 Operating Room Fires Algorithm from the American Society of Anesthesiologists (ASA). According to the Council of Accreditation (COA) of Nurse Anesthesia Educational Programs (2022) standards, simulated clinical experiences must be integrated into programs' curriculums. As stated by Ballister in a 2018 AANA journal article, "The OSCE is one method educators can incorporate to demonstrate compliance with this COA standard because it can be used for both skill reinforcement and evaluation of

SRNAs in multiple areas throughout the curriculum" (Ballister, 2018, p. 60). This doctoral project aimed to enhance the management of fires in the surgical setting. Developing an OSCE for surgical fires is key to achieving this project's goals. An OSCE for surgical fires provided appropriate instruction on how SRNAs can manage fires and apply the ASA's operating room fire algorithm in clinical practice. Nurse anesthesia students' competence and capability to successfully manage surgical fires in the clinical environment is a high-priority goal in developing the OSCE. Ultimately, patient outcomes have the potential to improve as students' competence in managing surgical fires increases.

Significance of the Problem

Barash (2017) states that in the United States, surgical fire risk is possibly greater today than in previous years. As mentioned previously, an average of 650 operating room fires are reported annually (Kishiki et al., 2019). Fires occurring during the interoperative period carry the potential of life-threatening injuries to the patient and healthcare providers (Wunder et al., 2020). Although anesthesia providers no longer use flammable anesthetics, such as ether and cyclopropane, the increased risk of surgical fires today is attributed to a lack of awareness by healthcare providers (Barash, 2017). Simulation-based training, now a standard in healthcare education, creates an environment where students can safely apply skills and knowledge to enhance competence in dealing with complex crisis situations (Wunder et al., 2020).

Stakeholders and Departments. The USM NAP and SRNAs, patients, clinical sites, and employers were the stakeholders affected by the development of the surgical fire OSCE. Students will participate in a surgical fire simulation to successfully address

the needed skills to manage surgical fires. The OSCE also allows students to receive constructive feedback on their performance. Additionally, clinical sites can benefit by re-establishing renewed education and guidelines from incoming SRNAs. Patients have the potential to benefit from the added safety that comes from fire awareness. Additionally, this OSCE served as a foundational building block in developing surgical fire management skills of future SRNAs in the NAP at USM.

Patient Safety. Patient safety is one of the graduate standards outlined by the COA (2022), and they further mention that graduate students must be vigilant in providing patient care. Along with NAP professors and clinical instructors, patients also expect students to provide safe patient care. Ballister (2018) discusses that it is becoming more common for patients to hold providers' performance to higher standards and accountability, causing a shift in educational curriculums. Due to the shift, NAP programs implement more simulation with a stringent clinical skills evaluation. OSCEs are becoming one of the main routes to assess students' clinical skills. According to Ballister (2018), an OSCE is a valuable tool to assess and ensure that students are competent to deliver safe patient care before being placed in the clinical setting. Wunder et al., goes on to state, “Educators in the field of medicine view the OSCE as a gold standard for practitioner competency assessment” (Wunder et al., 2014, p. 420). Patient safety is of utmost importance as educational standards continue to advance and change. Thus, patient safety was pivotal in the Surgical Fire OSCE.

Available Knowledge

Objective Structured Clinical Examination (OSCE)

OSCEs were first introduced in the 1970s in medical education, where they were used to assess the clinical performance of medical students (Aronowitx et al., 2017). OSCEs have gained popularity throughout the years in multiple branches of healthcare education, including nurse anesthesia education (Ballister, 2018). OSCE's popularity is attributed to its ability to assess problem-solving, critical thinking, clinical skills, and communication in various clinical scenarios. Utilizing OSCEs also carries no risk to patients and allows students to experience rare scenarios they otherwise may not experience in clinical practice (Aronowitz et al., 2017; Onwudigwu, 2018). Onwudigwu (2018) identifies five key benefits of OSCEs; facilitating student confidence, preparing students for clinical practice, achieving more meaningful learning, assessing psychomotor skills and attitudes, and OSCEs offer great feedback for students. Students can combine classroom information with clinical skills during simulation scenarios, displaying competence and ability to navigate complex clinical simulations.

OSCE development is based on a needs assessment done by faculty, where areas in the curriculum that would benefit from simulation exercises are selected (Ballister, 2018). After the needs assessment, an OSCE blueprint is created that includes essential concepts and skills, characteristics, specific goals, objectives, and parameters based on the needs assessment. (Ballister, 2018; Onwudiegwu, 2018). Furthermore, Onwudigwu (2018) suggests prioritizing concepts and skills to be assessed based on importance relating to the specific clinical scenario and suggests creating a time limit for the

simulation. Ballister (2018) also suggests matching OSCE objectives to the specific task expected to be performed by participants.

Evaluation methods for the OSCE must also be determined. A comprehensive checklist and global rating scales (GRS) are two of the most commonly used evaluation techniques. The checklist method involves a step-by-step assessment of mandatory skills for the clinical simulation, and the GRS involves a comprehensive assessment of students' performance of identified skills (Ballister, 2018).

The Surgical Fire OSCE utilized the checklist method to evaluate student performance. Checklists typically consist of 10 to 30 items based on specific tasks or points that students are expected to complete throughout the simulation (Onwudigwu, 2018). According to Wunder et al. (2020), checklists have been shown to improve patient outcomes in the perioperative setting. For OR crises, checklists facilitate a rational and decisive strategy for handling crises (Wunder et al., 2020). The checklist items are graded according to student performance and execution of tasks in the correct sequence identified in the OSCE blueprint (Onwudigwu, 2018). Simulation teaching and evaluation can be enhanced by utilizing a checklist involving both mental and technical skills (Wunder et al., 2020).

OSCE Outcomes

The key to establishing a successful professional practice is clinical competency. Safe and effective practice in the clinical setting is present when clinical competence is strong enough to work without direct supervision (Offiah et al., 2019). Simulation-based education is implemented throughout numerous medical programs to meet the increasing demands of a complex medical field. An integrated and longitudinal educational process

is necessary to develop clinical skills (Offiah et al., 2019). The Surgical Fire OSCE objectives were to reach clinical competence through repeated practice, with prompt feedback and reflection.

Fire Triad – The Oxidizer

From an anesthesia standpoint, the oxidizing component of the fire triad receives special attention because of the role oxygen and nitrous oxide play in anesthesia practice. Oxygen is the primary oxidizer in 95% of surgical fires and when ignited and combined with a fuel source, yields fire (Jones et al., 2019; Nagelhout, 2018). Culp and Muse (2021) state that an environment with oxygen levels greater than 23.5% is considered an oxygen-enriched environment. Furthermore, according to Jones and colleagues (2019), when oxygen content reaches 30%, virtually any object can become fire fuel. Oxygen is denser than air, permitting accumulation under surgical drapes, and creating a fire-favored environment (Nagelhout, 2018). Fire risks increase when anesthesia providers use an open oxygen source such as nasal cannulas and oxygen face masks compared to using closed sources such as endotracheal tubes (ETT) and laryngeal mask airways (LMA) (Jones et al., 2019; Nagelhout, 2018). For anesthesia providers maintaining oxygen concentrations of less than 30% is the primary method of reducing the risks of surgical fires (Jones et al., 2019).

Fire Triad – Ignition

In the OR, various surgical tools can ignite a surgical fire. The three primary sources of surgical fire ignition are electrocautery, lasers, and fiberoptic light cords. (Jones et al., 2019). Electrocautery involves using high-energy devices to heat and coagulate tissue and is the most commonly reported ignition source for surgical fires

(Jones et al., 2019). In a systematic review of the risk and prevention of surgical fires by Kezze and colleagues (2018), one study stated that electrocautery was the ignition source in 90% of 103 fire claims. The Bovie is the most common electrocautery tool used in surgery (Jones et al., 2019). When using electrocautery instruments, providers should carefully consider the surgical environment and work with anesthesia providers to reduce fire risk.

The laser is the second most common ignition source of surgical fires (Jones et al., 2019). Lasers are frequently used in surgical procedures above the xiphoid process, such as cosmetic, eye, and oral procedures, which carry a high fire risk (Jones et al., 2019). Lasers can penetrate endotracheal tubes (ETTs) and rapidly ignite a fire (Jones et al., 2019). Surgeons may utilize protected ETTs developed to mitigate fire risk; however, even protected ETTs do not ensure complete surgical fire prevention with lasers use (Jones et al., 2019).

Although a less common ignition source, fiberoptic light cords are becoming more commonly used, and providers should consider surgical fire risk (Jones et al., 2019). Surgeons should place fiberoptic light cords in standby mode when not in use to reduce the risk of fire ignition (Jones et al., 2019).

Fire Triad – Fuel

Within any OR, numerous items are present that can fuel a surgical fire, some more controllable than others. While some items are apparent fuel sources, such as surgical towels and drapes, others are not as obvious. Remaining cognizant of all types of fuel source is crucial for healthcare providers working in surgical settings. Table 1 below lists various fuel sources found in the OR. As outlined by Table 1, many items necessary

for safe surgery also double as fuel sources. Eliminating some fuel sources is impossible; however, many items are modified to decrease or eliminate their likelihood of serving as fuel sources. These interventions are discussed in detail later.

Table 1

Common Fuel Sources of Surgical Fires

Fuel Category	Examples
Patient-Related	Hair Tissue Gastrointestinal Content (methane, hydrogen)
Solutions	Alcohol-based skin preps Wound closure (benzoin, mastazol) Degreasers (acetone, ether) Petrolatum-based dressing/ointments Paraffin, wax
Common materials used in the OR	Drapes Personal protective equipment (gowns, gloves, glasses, caps, etc.) Gauzes, sponges Dressings
Equipment	Anesthesia-related (ETTs, LMAs, mask, tubing) Surgical-related (fiberoptic cables/wires, cuffs, tubing, drains, endoscopes, and others)

Note: Table 1 adapted from (Jones et al., 2019)

Management of Surgical Fires

Management of surgical fires is multifactorial and requires a team-based approach. In 2013 the American Society of Anesthesiologist (ASA) published an algorithm for surgical fire risk assessment and management strategies. The ASA's outline is still being used in operating rooms today and serves as the framework in the Surgical Fire OSCE. The algorithm is pictured below.

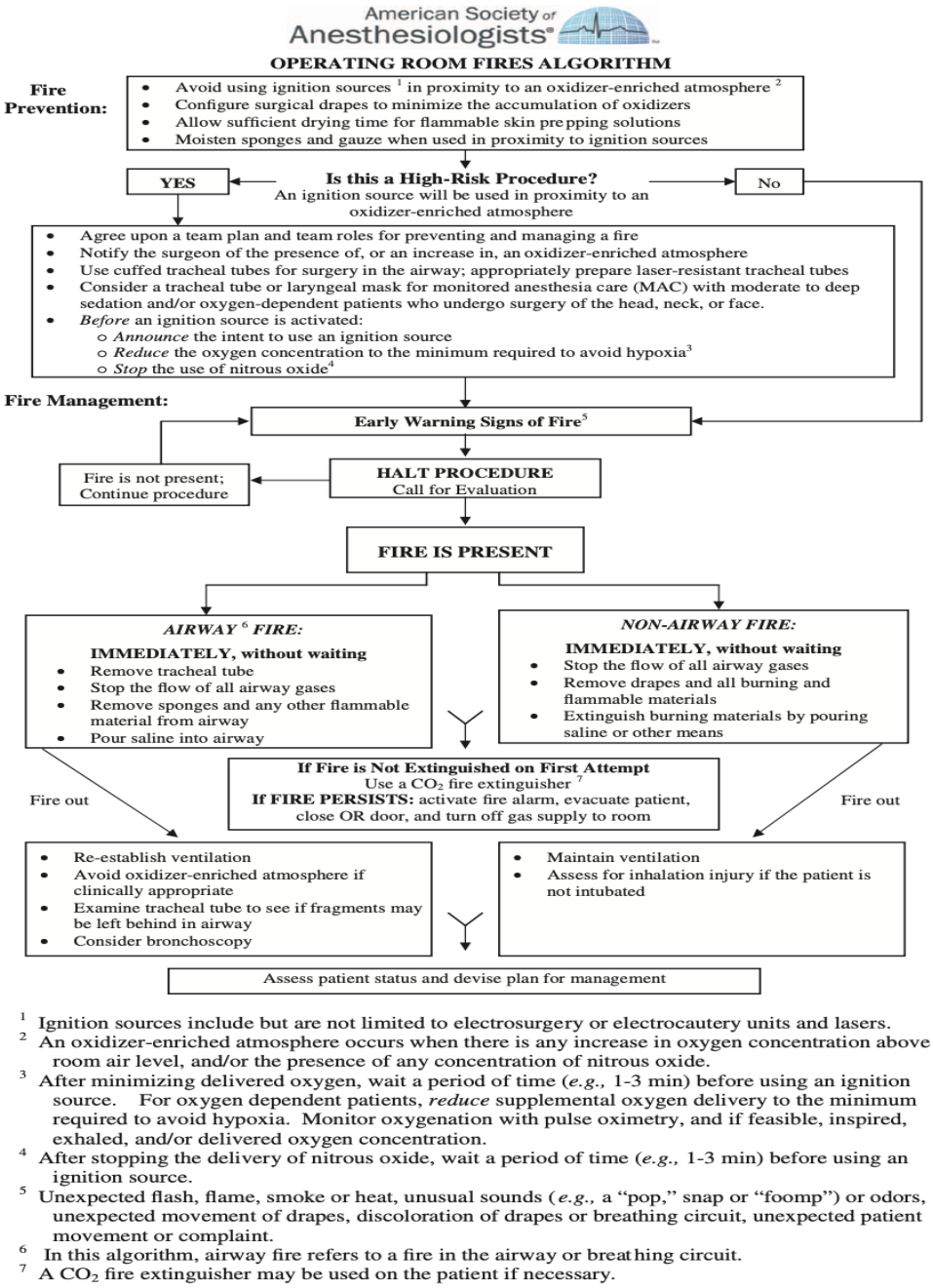


Figure 1. ASA's Operating Room Fires Algorithm

(ASA, 2013)

The ASA's algorithm begins with implementing fire prevention strategies, of which all surgical staff should be cognizant. Identifying and addressing oxidizer-enriched environments is one primary prevention goal and relies on anesthesia providers. The

ASA (2013) defines an oxidizer-enriched environment as one with increased oxygen levels above room air and/or the presence of any nitrous oxide. As mentioned previously, anesthesia providers' primary method to reduce the incidence of surgical fires is to keep local oxygen concentration less than 30% (Jones et al., 2019). Utilizing a closed system, through an ETT or LMA, anesthesia providers can best maintain atmospheric oxygen levels near normal and still safely oxygenate patients.

Configuration of surgical drapes is another primary fire prevention strategy. The presence of an oxidizer-enriched environment dramatically increases the flammability of surgical drapes and allows for a much quicker ignition time (Culp & Muse, 2021). Surgical drapes vary in material, some more permeable to oxidizers than others. Surgeons also place drapes in various configurations for the given surgical procedure. Drape material and configuration require careful attention to prevent under-drape pooling of oxidizers, especially for head and neck surgeries. Because of the proximity of the oxygen source to the ignition source, surgeries involving the head and neck are exceptionally high risk. (Culp & Muse, 2021).

Allowing proper drying times for prepping solutions is a third primary prevention strategy. Alcohol-based prepping solutions frequently are used in the OR and are commonly blamed for fueling surgical fires (Jones et al., 2019). Following the manufacturer's designated drying times after prepping patients for surgery is pivotal. Soaking dry surgical gauze and sponges is the final primary fire prevention strategy. Dry sponges and gauze are excellent fuel sources if a fire emerges. Moistening these materials with saline significantly reduced their flammability, primarily when used close to an ignition source (ASA, 2013; Jones et al., 2019).

After implementing prevention strategies, it is critical to assess the patient's actual risk of surgical fire. The ASA (2013) defines procedures carrying high surgical fire risk as those in which an ignition source is used near an oxidizer-enriched environment. After identifying a high-risk procedure, anesthesia providers should notify the surgical team and discuss clear roles and responsibilities. For surgery inside the airway, utilize cuffed ETTs if clinically appropriate (ASA, 2013). The ASA (2013) also states that with moderate to deep sedation procedures of the head, neck, or face, considering using a closed system such as cuffed ETT or LMA is appropriate. For surgeries using a laser, anesthesia providers should select special ETTs designed for laser surgery (ASA, 2013). During laser procedures, saline or methylene blue dye should be used to fill ETT cuffs to identify cuff perforation quickly. In high-risk procedures, surgeons need to announce their use of an ignition source to allow anesthesia providers to make necessary adjustments. Before using ignition sources, anesthesia providers should reduce oxygen concentrations as much as possible while still preventing hypoxia, and any nitrous oxide delivery should be stopped (ASA, 2013). One to three minutes is an appropriate wait time after making adjustments and before giving surgeons the go-ahead to use ignition sources.

All surgical team members should monitor for early warning signs of fires such as; an unexpected flash, flame, smoke or heat, unusual sounds or odors, and discoloration of drapes or breathing circuits (ASA, 2013). If fire signs are present, immediately stop surgery and assess the situation. Surgical team members should assume their designated roles if a fire is present. Management of airway fires and non-airway fires are similar but have a few distinct differences. To manage non-airway fires, stop the flow of all gasses,

remove all burning materials, and extinguish the fire with saline or other means (ASA, 2013). To manage airway fires, carry out the previously mentioned interventions and immediately remove the ETT and pour saline into the airway. With an airway fire, the anesthetist has approximately six seconds to remove the burning ETT or LMA (Nagelhout, 2018). When coupled with high oxygen concentrations, an ETT or LMA will act like a blowtorch.

A carbon dioxide fire extinguisher is used if the above interventions do not extinguish the fire (ASA, 2013). After fire cessation, carefully monitor and assess the patient. The patient's airway is of utmost concern, and ventilation is re-established or maintained (ASA, 2013). When re-establishing ventilation, avoid an oxygen-enriched mixture until there is no risk of reignition (Nagelhout, 2018). Furthermore, assess the patient for inhalation or bodily injury, assess the airway for ETT fragments in the case of airway fire, and assess airway devices for intactness (ASA, 2013; Nagelhout, 2018). Bronchoscopy may be warranted for airway fires to visualize and assess the airway directly. If the patient needs reintubation, use a smaller ETT and deliver 30%-60% humidified oxygen (Nagelhout, 2018). Other management interventions include chest x-ray, arterial blood gas, carboxyhemoglobin levels, corticosteroids, and ICU admission.

Surgical fires arise quickly and often without notice, and knowledge of the fire triad and surgical fire management strategies is vital for successful surgical fire management. Simulation is a valuable tool for medical professionals to practice and increase competence in managing rare emergencies, such as a surgical fires (Kishiki et al., 2019). The significance of simulation in healthcare education, especially in dealing with rare medical emergencies, led to the Surgical Fire OSCE creation.

Consequences and Complications of Surgical Fires

The most apparent consequence of surgical fires is severe burn injuries. Patients and other OR personnel may experience burn injuries. Additionally, fire combustion and burning of various fuel materials in the OR create toxic products which are potentially more deadly to patients and OR personnel than burn injuries (Barash, 2017). Carbon monoxide, ammonia, hydrogen chloride, and cyanide are some of the most notable toxic products. Toxic byproducts can result in airway and pulmonary damage, which can potentially cause asphyxia (Barash, 2017). OR personnel should always be aware of all consequences of surgical fires and to promptly take action to protect themselves and patients when OR fires arise

Rationale

The Operating Room Fires Algorithm by the ASA is commonly used in clinical practice by all career fields within the OR setting. Poor outcomes associated with airway fires are attributed to a lack of education, judgment, preparation, and communication. Applying evidence-based practice with new research can reduce airway fires and enhance patient safety. Incorporating evidence-based practice guidelines to create an OSCE following the ASA's Operating Room Fires Algorithm outline advanced the knowledge necessary to implement safe surgical fire prevention and management.

Applicable Theory/Framework

Various learning theories are frequently used to design and support simulation-based learning (SBL) settings. While the list of learning theories is relatively abundant, Mezirow's Transformative Learning Theory (TLT) aligned closely with the structure and objectives of OSCEs. Introduced by Dr. John Mezirow in the late 1970s, the TLT

supports various aspects of SBL, including individual simulation experience, self-reflection, and debriefing with peers (Briese et al., 2020). Table 2 lists the defining characteristics of Mezirow's 10 phases of TLT and how they align with different parts of the simulation process.

Table 2

Comparison of TLT Phases to the Simulation Process

Phase	Characteristics	Stage of Simulation
1	A disorienting dilemma	Pre-briefing/ Scenario presentation
2	A self-examination with feelings of guilt or shame	Scenario/Debriefing
3	A critical assessment of epistemic, sociocultural, or psychic assumptions	Scenario/Debriefing
4	Recognition that one's discontent and the process of transformation are shared and that others have negotiated a similar change	Scenario/Debriefing
5	Exploration of options for new roles, relationships, and actions	Debriefing
6	Planning of a course of action	Debriefing
7	Acquisition of knowledge and skills for implementing one's plans	Scenario/Debriefing
8	Provisional trying of new roles	Future experience
9	Building competence and self-confidence in new roles and relationships	Future experience
10	A reintegration into one's life based on conditions dictated by one's perspective	Future experience

NOTE: Table 2 adapted from (Breiese et al., 2020), as summarized by (Ketchenham, 2008)

As the prevalence of SBL and OSCEs continues to grow in settings such as NAPs, it is vital for professors and students to comprehend the process and engage in all aspects to reap the benefits. TLT takes students' expectations and challenges them to

think beyond their initial assumptions, which in turn has the potential to transform the way they view their situation, peers, and even themselves (Breiese et al., 2020). Managing a surgical fire cannot be done alone but requires teamwork. Thus, Mezirow's TLT suits the Surgical Fire OSCE objectives appropriately.

DNP Essentials

The American Association of Colleges of Nurses (AACN) outlines eight core Doctoral of Nursing Practice (DNP) essentials that serve as a foundation for all programs offering a DNP degree (AACN, 2006). All eight essentials are detailed in Appendix A for reference. The following five essentials outlined in Table 3 met the objectives of the Surgical Fire OSCE.

Table 3

Primary DNP Essentials Correlating with Surgical Fire OSCE Objectives

DNP Essential	Clinical Implication
Essential II: Organization and Systems Leadership for Quality Improvement and Systems Thinking.	The goal of the doctoral project is to improve NAP students' ability to competently manage surgical fires.
Essential III: Clinical Scholarship and Analytical Methods for Evidence-Based Practice.	An in-depth literature search was performed to obtain the best EBP to support the development of the Surgical Fire OSCE.
Essential IV: Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care.	The doctoral project utilizes simulation-based learning and the development of a Surgical Fire OSCE.
Essential VI: Interprofessional Collaboration for Improving Patient and Population Health Outcomes.	Managing surgical fires cannot be done alone and must involve teamwork. The surgical fire simulation facilitates interprofessional collaboration and keeps patient safety of utmost importance.
Essential VIII: Advanced Nursing Practice.	CRNAs or SRNAs will play essential roles in mitigating surgical fires.

NOTE: Table 3 outlined by (AACN, 2006).

Specific Aims

Preventing an airway fire requires full awareness in every operation and can be challenging. While possibly challenging to decipher, the 2013 ASA Operating Room Fires Algorithm is the most collective algorithm available for anesthesia providers to follow. All anesthesia providers must acquire new skills and routinely practice, regardless of experience level. Familiarizing oneself with the equipment and algorithms will allow a provider to manage a surgical fire competently. The NAP at USM requested the development of a simulation option and an evaluation tool for surgical fire management and prevention. The Surgical Fire OSCE delivered a pathway for SRNAs to build confidence and allow for deep knowledge and skill, ultimately reducing surgical fires and protecting patient safety.

The doctoral project specifically aimed to provide an OSCE module and trigger film for SRNA education related to surgical fire prevention and management. Following the 2013 ASA Operating Room Fire Algorithm can improve patient outcomes; however, incorporating education and training when prevention fails is pivotal to successfully applying the educational tools provided. Upon creating the OSCE, it was assumed that the SRNA generally understands the fire triad. Furthermore, USM NAP staff can continue to utilize the doctoral project to evaluate SRNAs' clinical knowledge and ability to apply the ASA's fire algorithm in times of crisis.

Summary

The NAP at USM requested the development of a modern method of practicing surgical fire management and prevention strategies. OSCEs are widely used and highly recommended in medical education, and OSCEs support the transition into simulation-

based education. This doctoral project produced an OSCE for preventing and managing surgical fires. The ASA Operating Room Fire Algorithm (2013) is the standard for preventing and managing surgical fires. The OSCE created by the authors follows the algorithm and the ASA standards of care. The OSCE potentially presented an opportunity for SRNAs to obtain the necessary skills and knowledge to navigate the algorithm and maintain patient safety when a surgical fire arises in clinical settings. The OSCE demonstrated hands-on learning and proficiently evaluated the SRNA's competence in surgical fire management.

CHAPTER II – METHODOLOGY

Introduction

The purpose of this doctoral project was to fulfill the USM NAP's request to develop a simulation option and an evaluation tool for managing surgical fires. The surgical fire OSCE aimed to provide current and future USM SRNAs with structured and standardized instruction on managing surgical fires and applying the ASA's operating room fire algorithm. Due to the rare occurrence of surgical fires, students will unlikely encounter fires during their clinical training. The creation of the Surgical Fire OSCE will allow students to participate in an advanced crisis simulation, and OSCE participation should increase students' competence and knowledge in managing surgical fires. Additionally, students will be more confident in fire management as they transition into clinical practice as CRNAs. Ultimately, the Surgical Fire OSCE aimed to increase patient outcomes and safety if an actual surgical fire arises in practice.

Context

The Surgical Fire OSCE will be employed at USM for current SRNAs. Students enrolled in the NAP at USM undergo a rigorous three-year study, resulting in a Doctoral degree. Between all three cohorts combined, the NAP has approximately 60-70 SRNAs. SRNAs in their first year of the program undergo rigorous didactic education and various simulations, preparing them to enter clinical training in year two. Clinical training becomes the program's primary focus in years two and three; however, didactic coursework is still assigned to students during these years. While the Surgical Fire OSCE is designed for SRNAs at all program levels, it will predominantly be used by second-year SRNAs prior to beginning clinical training in year two.

Design

Before initiating the project, the authors discussed the OSCE topic with the USM NAP faculty and attained their approval. Then, an extensive review of available literature regarding surgical fire prevention and management was conducted. Databases used in the literature review included *Google Scholar*, *MEDLINE*, Cochrane Library, *PubMed*, and *CINAHL*. Common keywords used were surgical fire, operating room, fire prevention, fire management, anesthesia, nurse anesthesia, nursing, OSCE, and simulation. Specifically, peer-reviewed, scholarly articles were sought for the project, and most articles used were less than five 5 old. A few articles used were published over five years ago; however, these articles were foundational to surgical fire management and crucial to project development. The project was proposed to the doctoral project committee to confirm clinical relevance following the literature review. After gaining approval from the committee, the authors submitted the project to USM's Institutional Review Board (IRB) for additional approval. After IRB approval (Appendix B), further research was done, and the Surgical Fire OSCE was created (IRB Protocol # 22-1130). An evaluation tool was also created for the OSCE (Appendix D).

A panel of experts voluntarily participated in an anonymous evaluation survey to provide accurate and proficient feedback. There was no repercussion for non-participation in the anonymous, voluntary survey. The panel contained SRNA students in their second and third years of study, USM NAP instructors, and local CRNAs affiliated with USM. The diverse group of experts yielded feedback from different areas of expertise using both didactic and clinical experience. The NAP faculty, SRNAs, and CRNAs were emailed an informed consent document, the Surgical Fire OSCE, and an

OSCE evaluation tool. After reviewing the material, evaluators provided feedback via the OSCE survey, which was strictly voluntary, and feedback was kept anonymous.

After reviewing the anonymous feedback and discussing it with the DNP committee, modifications were made to the OSCE. Once the OSCE was finalized, the project was presented at USM School of Leadership and Advanced Nursing Practice DNP Research and Scholarship Day on September 30, 2022.

Interventions

This Doctoral project's intervention consisted of delivering the OSCE for surgical fires to the panel and the anonymous survey to gain feedback. The Surgical Fire OSCE allows all SRNAs at USM to participate in a complex crisis OR fire simulation. Fires in the operating room are rare, and students may not experience them during clinical training. The USM NAP faculty acknowledged this gap in practice. The survey provided feedback on the efficiency of the OSCE. Thus, the NAP faculty supported the development of the Surgical Fire OSCE to ensure all students are prepared and competent in managing surgical fires. This doctoral project contained an OSCE, a post-OSCE questionnaire, and a survey for constructive feedback. The Surgical Fire OSCE was constructed based on EBP literature and according to the ASA's 2013 Operating Room Fire Algorithm.

Measures

The Surgical Fire OSCE allows SRNAs to practice the necessary skills and knowledge in managing surgical fires and navigating the ASA's Operating Room Fire Algorithm. The OSCE aimed to enhance SRNAs' clinical competence in fire management through educational guidance, repeated hands-on practice, prompt feedback,

and reflection. Additionally, the OSCE aimed to increase students' preparedness to enter clinical training and ultimately improve patient safety and outcomes. After finalizing the OSCE, SRNAs will have access to the OSCE rubric, OSCE goals, a step-by-step process for fire management and essential equipment, the ASA's Operating Room Fire Algorithm, and a patient scenario for simulation practice. A feedback survey was given to USM NAP faculty, current SRNAs, and local CRNAs for constructive criticism and future improvements.

Analysis

An anonymous survey was presented to the USM NAP faculty, current SRNAs in the program, and local CRNAs for OSCE evaluation. The evaluation tool (Appendix D) was created using an online survey tool, *Qualtrics*™, and sent via email. Survey completion yielded pertinent qualitative and quantitative data, which was then analyzed and summarized. The feedback was presented to the project committee members and used to revise and improve the OSCE.

Ethical Considerations

There are no ethical considerations for this study. No participant in this study is being denied access or treated differently. No participants in the anonymous surveys are being abused, forced to participate, or will be within range of fire. The Surgical Fire OSCE allows all USM SRNAs to experience a surgical fire simulation, enhance their competence, and prepare them for fire management. OSCEs allow students to experience complex situations and apply knowledge and skills without risk to a live patient (Aronowitz et al., 2017). The only ethical consideration was the experience of SRNAs between the different classes. Second year SRNAs will have access to the OSCE before

clinical, which could better prepare them compared to the experience of the 3rd year SRNAs going through the experience later. Project submission to the IRB accounted for ethical considerations.

Summary

After recognizing that SRNAs will likely not experience surgical fires during clinical training, the Surgical Fire OSCE was created. SRNAs at USM will partake in a high-risk, low-stakes crisis simulation. The practice of a complex crisis situation in a simulation environment also brings no actual harm to patients. Hands-on repetition and accurate feedback can produce confident and safe SRNAs who can transition these high levels of care into their professional careers. OSCE creation was guided by evidence-based practice literature and the ASA's Operating Room Fire Algorithm. With constant feedback from NAP staff and SRNAs, the OSCE will continue to be modified to best accommodate the needs of the USM Nurse Anesthesia Program.

CHAPTER III - RESULTS

Analysis

Surgical fires are infrequent, and nurse anesthesia students are unlikely to encounter them during clinical rotations. The authors' purpose for this doctoral project was to create an OSCE concerning surgical fire prevention and management. The OSCE provided USM NAP students with an educational tool and a surgical fire simulation scenario for clinical preparation. Evidence-based literature and practice were used to develop the OSCE template. The OSCE was evaluated by second-year USM NAP students, third-year USM NAP students, USM NAP faculty, and local CRNAs.

Report of Findings

Recruitment emails sent by the authors and committee chair of the doctoral project offered participation in this study. The recruitment email included: informed consent, an OSCE template, and a link to the survey concerning the steps and information in the OSCE. The OSCE was evaluated by second and third-year USM NAP students, USM NAP faculty, and local CRNAS. The final participant demographics of the survey consisted of 32 CRNAs, 9 3rd-year USM SRNAs, and 12 2nd-year USM SRNAs. A total of 52 participants consented to participate in the survey, while one chose not to consent. Although 52 participants consented to the survey, only 51 people chose to answer all of the evaluation questions.

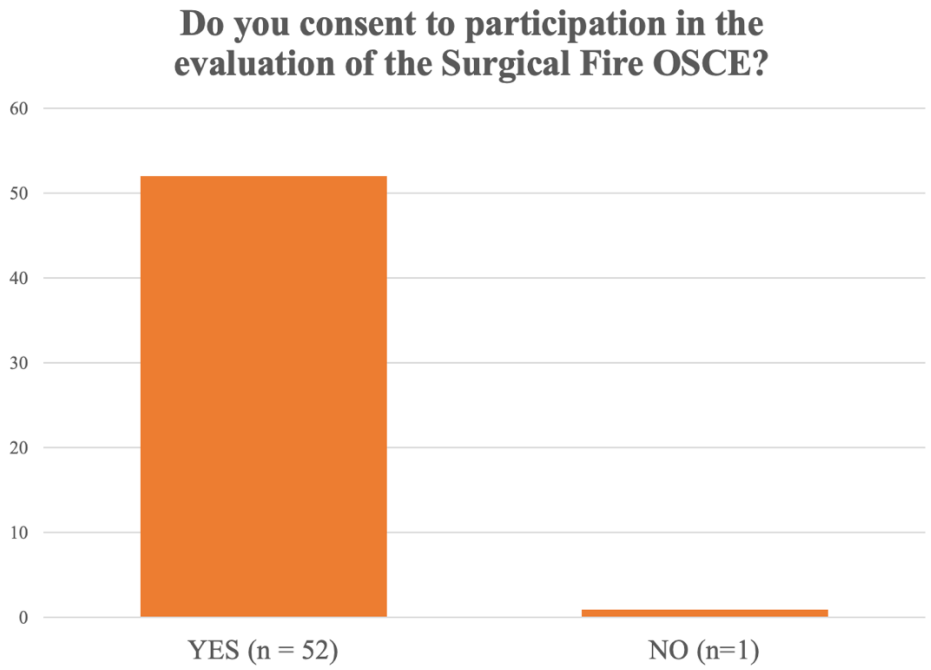


Figure 2. OSCE Survey Consent Statistics.

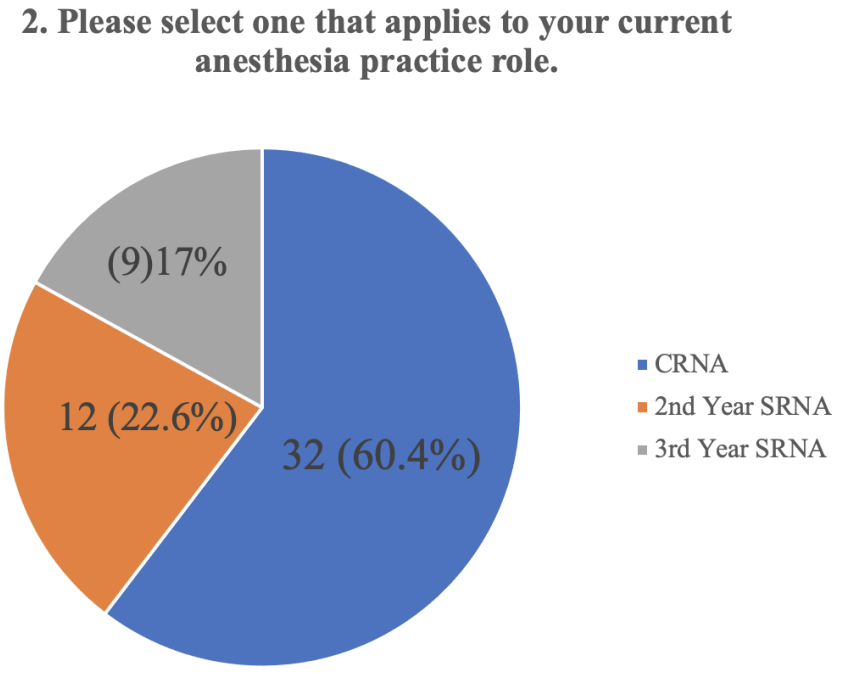


Figure 3. OSCE Survey Participant Demographics.

The survey included nine questions to determine the effectiveness, accuracy, and transparency of the OSCE. The online survey utilized Qualtrics© and was collected anonymously. The questions can be found in Appendix D. The following is a summary of the survey questions: 1) Do you consent to the study? 2) Are you a CRNA or SRNA? 3) Was the information presented clearly? 4) Were the objectives clear? 5) Are the instructions/information relevant? 6) Is the scenario presented realistically? 7) Will the OSCE assist SRNAs in becoming more competent in surgical fire management? 8) Did the OSCE show evidence of doctoral-level work? 9) Do you feel more comfortable managing surgical fires? The end of the survey allowed for additional comments, feedback, and suggestions.

The 51 survey participants either strongly agreed or somewhat agreed that the OSCE displayed relevant, doctoral-level work with a realistic fire scenario that would assist in building SRNA's competence in managing surgical fires in clinical practice. The survey responses to question 7, which concerned how the OSCE would assist in building SRNA competence in surgical fire management, were of utmost importance when determining OSCE success. The results from question 7 showed that 92.16% (47 participants) strongly agreed and 7.84% (4 participants) somewhat agreed. Given these results, it was concluded that the OSCE was 100% successful in meeting outlined objectives. Feedback from the questionnaire was placed into a table; refer to Figure 4 below.

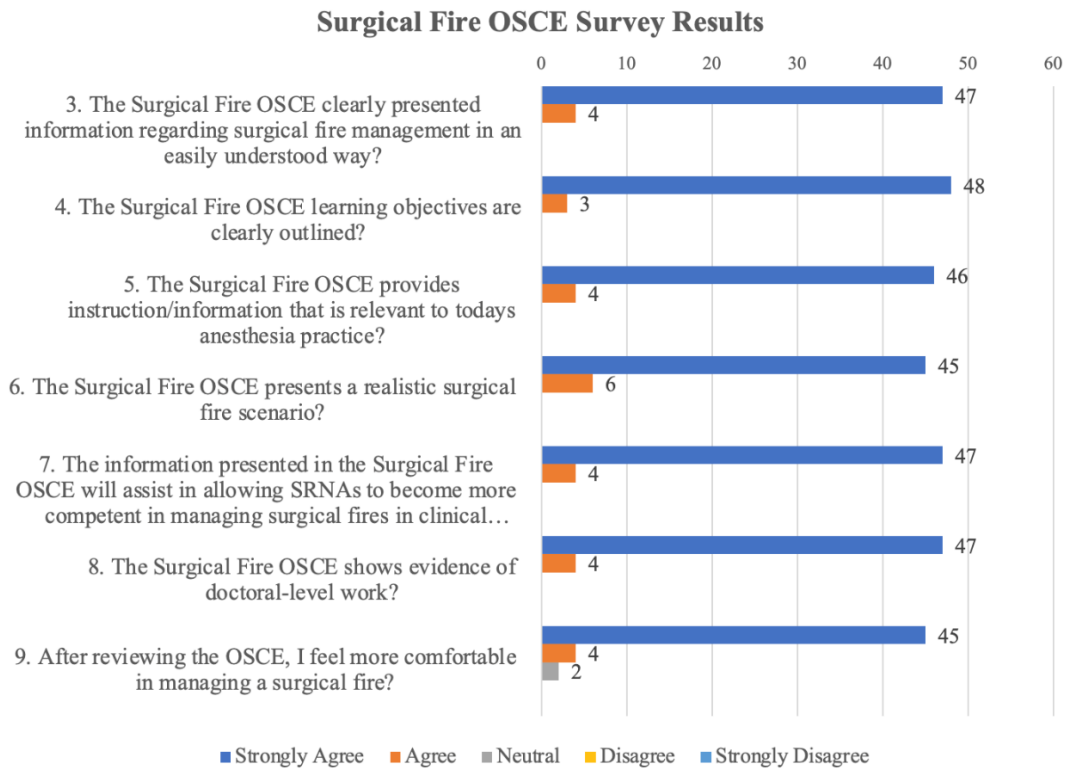


Figure 4. OSCE Survey Results

As mentioned previously, the end of the OSCE survey allowed for additional comments, feedback, and participant suggestions. Table 4 outlines additional comments and suggestions received from participants. Feedback was considered when looking at ways to revise and improve the OSCE.

Table 4

OSCE Participants' Comments, Suggestion, and Feedback

Received Feedback
• "While rarely experienced, Surgical Fire remains a grave threat to patient safety and largely preventable."

Table 4 (continued).

- "As an anesthesia provider, one of your worst fears is an airway fire. This DNP project provided a thorough review of fire safety and management in the operating room."
- "Great work"
- "Reaches targeted goals; emphasizes the "global" preparedness requirements necessary in a concisely, effective manner."
- "The OSCE materials were great! I would suggest adding punctuation to the complete sentences in the OSCE."
- "Great review"
- "You could really improve the delivery of your project with a trigger film in 1080p!"

Implementation into Practice

The results of the OSCE surveys and feedback were used to make changes and improve the OSCE. The OSCE aims to create a safer operating room and improve patient safety as students go into the clinical setting and spread the knowledge about fire prevention and management they gained from the project. Therefore, as data is collected, surgical fire prevention and management steps will be adapted as needed to benefit the students and ultimately benefit patients and healthcare providers.

Ethical Considerations

This project went through the designated IRB approval process and was approved. (Protocol # 22-1130). The survey sent out with this OSCE began with consent from all

participants. No participant in this study is being denied access or treated differently. No participants in the anonymous surveys are being abused, forced to participate, or will be within range of fire.

The Surgical Fire OSCE allows all USM SRNAs to experience a surgical fire simulation, enhance their competence, and prepare them for fire management. OSCEs allow students to experience complex situations and apply knowledge and skills without risk to a live patient (Aronowitz et al., 2017). The only ethical consideration was the experience of SRNAs between the different classes. 2nd year SRNAs will have access to the OSCE before clinical, which could better prepare them compared to the experience of the 3rd year SRNAs going through the experience later. Project submission to the IRB accounted for ethical considerations.

Summary

The OSCE was created to provide an efficient simulation experience for SRNAs to advance the critical skills and knowledge to prevent and manage an operating room fire. An OSCE evaluation survey emailed to CRNAs and USM SRNAs yielded meaningful feedback that was used in determining the effectiveness of the OSCE. The results were largely positive, with most participants selecting either "strongly agree" or "somewhat agree" to the OSCE evaluation questions. Feedback and updated evidence-based literature will continue to be monitored and implemented into practice to revise and further improve the OSCE.

CHAPTER IV – DISCUSSION

Preventing and managing a surgical fire is a clinical skill that should be foundational to every anesthesia provider's knowledge and skill base. The goal of the doctoral project was to create an OSCE that could educate and evaluate nurse anesthesia students on the prevention and management of operating room fires. Results from the OSCE's survey supported outlined goals, indicated that objectives were met, and confirmed doctoral-level work was present.

Due to the lethal consequences of a surgical fire, having hands-on experience in managing and preventing a fire is critical. The ASA's operating room fire algorithm is a staple in maintaining a fire-free operating room and an excellent blueprint to follow in the rare occurrence that a surgical fire arises. The OSCE created in this doctoral project provided a valuable tool for current and future USM SRNAs on surgical fire prevention and management as it is implemented into the nurse anesthesia curriculum. The OSCE was finished and submitted to the School of Leadership and Advanced Nursing Practice administration for adoption into the OSCE curriculum of the USM NAP.

Limitations

Only second and third-year NAP students at USM were provided the OSCEs. First-year SRNAs were excluded since they lack hands-on experience in the OR and are still developing a foundational knowledge base that is needed to safely implement the necessary task in surgical fire prevention and management. The study was limited by the size of the input, which was limited to two classes, NAP faculty, and local CRNAs. Larger sample size would have provided more feedback and allowed for more adjustments to the proposed OSCE and doctoral project.

Future Considerations

Learning the proper skill and knowledge to prevent and manage operating room fires could provide substantial expertise in anesthesia. The OSCE created in the doctoral project will act as an instrument to allow advancement in the SRNA's career. As students complete the OSCE, they will learn the skills and master them through repeated simulation, which creates the potential to become successful and safe providers. A future follow-up study could examine students' performance in the OSCE and post-test results, gather their opinions and look for ways the OSCE can be improved. Also, in the future, a lecture on basic fundamental knowledge could be added to the OSCE, where it could be presented to first-year SRNAs as well. Furthermore, in the future, the OSCE could be modified and implement the roles of the OR nurses in surgical fire management and prevention. With the OR nurse role added, the OSCE could be used in nursing education and simulation.

Summary

After recognizing that SRNAs will likely not experience surgical fires during clinical training, the surgical fire OSCE was created. The doctoral project focused on creating an OSCE that trains, educates, and evaluates USM NAP students on the prevention and management of surgical fires as they partake in a high-risk, low-stakes crisis simulation. Evidence-based research and best practice guided the development of the OSCE template. The OSCE was reviewed by second and third-year USM SRNAs, USM NAP faculty, and local CRNAs. An anonymous survey provided the data necessary to show that the OSCE met the guidelines and expectations set forth by the doctoral project. The NAP faculty was highly supportive of the development of the OSCE and

looked forward to having it as a tool in the USM Nurse Anesthesia curriculum. Thus, the Surgical Fire OSCE serves as a valuable asset in producing confident and safe practicing USM SRNAs who can transition these high levels of care into their future professional careers.

APPENDIX A – DNP Essentials

DNP Essential	Clinical Implication
Essential I: Scientific Underpinnings for Practice	Research and collection of best practice, evidence-based literature related to the management of surgical fires.
Essential II: Organization and Systems Leadership for Quality Improvement and Systems Thinking.	The goal of the doctoral project is to improve NAP students' ability to competently manage surgical fires.
Essential III: Clinical Scholarship and Analytical Methods for Evidence-Based Practice.	An in-depth literature search was performed to obtain the best EBP to support the development of the Surgical Fire OSCE.
Essential IV: Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care.	The doctoral project utilizes simulation-based learning and the development of a Surgical Fire OSCE.
Essential V: Health Care Policy for Advocacy in Health Care	Determining best practice guidelines for surgical fire management and incorporating them into an OSCE. Presenting the information in OSCE format allows SRNAs to practice a crisis simulation, which later assists in the transition to professional practice.
Essential VI: Interprofessional Collaboration for Improving Patient and Population Health Outcomes.	Managing surgical fires cannot be done alone and must involve teamwork. The surgical fire simulation facilitates interprofessional collaboration and keeps patient safety of utmost importance.
Essential VII: Clinical Prevention and Population Health for Improving the Nation's Health	Students are able to practice surgical fire management in a low-risk simulation environment that carries no risk of patient harm. SRNAs exhibit patient safety throughout the simulation.
Essential VIII: Advanced Nursing Practice.	CRNAs or SRNAs will play essential roles in mitigating surgical fires.

NOTE: Table A1 is outlined by (AACN, 2006).

APPENDIX B – IRB Approval Letter

Office *of*
Research Integrity

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

118 COLLEGE DRIVE #5116 • HATTIESBURG, MS | 601.266.6756 | WWW.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 submission on InfoEd IRB.
- The period of approval is twelve months. An application for renewal must be submitted for projects exceeding twelve months.

PROTOCOL NUMBER:	22-1130
PROJECT TITLE:	Surgical Fire Prevention and Management: An Objective Structured Clinical Examination for Nurse Anesthesia
SCHOOL/PROGRAM	Leadership & Advanced Nursing
RESEARCHERS:	PI: Tate Fazio Investigators: Fazio, Tate~Killens, Kaleb~Parks, Stephanie~
IRB COMMITTEE ACTION:	Approved
CATEGORY:	Expedited Category
PERIOD OF APPROVAL:	08-Aug-2022 to 07-Aug-2023

Donald Sacco, Ph.D.
Institutional Review Board Chairperson

APPENDIX C – Surgical Fire OSCE

ANESTHESIA OBJECTIVE STRUCTURED CLINICAL EXAM

Surgical Fire Management

LEARNER OUTCOMES: Students will be able to:

1. Understand and identify strategies to prevent surgical fires.
2. Properly manage a surgical fire.
3. Understand roles in a surgical fire crisis.

DOMAINS:

Cognitive- Understanding the fire triad, analyzing the events of the emergency and recognizing you have a surgical fire, using the fire cognitive aid to perform steps of responding to a surgical fire.
Affective - Asking for help and understanding the value and benefit of teamwork in treating an emergent surgical fire event.
Psychomotor - Executing the steps of the cognitive aid to manage and treat a surgical fire, performing scenarios involving a simulated surgical fire.
Formative evaluation – feedback.

PURPOSE: The purpose of this OSCE is to assess the management of a surgical fire.

LEARNER OBJECTIVES:

1. Identify components of the fire triad and proper preventive techniques.
2. Demonstrate proper management of surgical fires.
3. Appropriately analyze clinical skills in managing surgical fires and self-evaluate the technique.

INDIVIDUAL OR GROUP OSCE: Individual or Group

REQUIRED READING and ASSOCIATED LECTURES:

1. Nagelhout, J., & Elisha, S. (2018) *Nurse Anesthesia* (6th ed.). pg 992-997

2. Jones, T. S., Black, I. H., Robinson, T. N., & Jones, E. L. (2019*).* Operating room fires. *Anesthesiology, 130*(3), 492–501. https://doi.org/10.1097/ALN.0000000000002598

*The 2013 American Society of Anesthesiologists Operating Room Fire Algorithm can be found in both references listed above

REQUIRED PARTICIPANTS: SRNA volunteers, NAP faculty examiner, Simulation lab staff

VENUE: USM NAP simulation lab

STUDENT LEVEL OF OSCE: 2nd-year level SRNAs (Semester 4-6)

TIME ALLOTED: 15 minutes

SEQUENTIAL PRACTICE & TESTING: This OSCE is an evaluation and requires no further testing

RECOMMENDED PRACTICE PRIOR TO EXAMINATION: 60 minutes

CONTEXT: (You are assigned to identify, manage, and treat a surgical fire case)

CONTENT OUTLINE

Mrs. Flame, a 40-year-old female, is scheduled for removal of basal cell carcinoma near her eyebrow. Plans are to perform the surgery under monitored anesthesia care. Her only health history consists of sleep apnea. On a side note, during the preoperative interview, you notice Mrs. Flame appears to have used an abnormally large amount of hair spray when fixing her hair this morning. She is brought to the operating room, moved to the OR table, and placed on the standard monitors. A simple facemask is also placed on the patient at 6 L/min with SpO2 reading 100%. Induction is done with midazolam and propofol. After induction, her SpO2 drops to 92%, and the oxygen flow is

increased to 10 L/min. SpO2 normalizes after increasing the oxygen flow. The patient is prepped with alcohol-based skin prep and draped for the procedure. The surgeon begins the procedure and encounters some bleeding and reaches for the bovie. When the bovie is activated and touches the skin, a flash appears and a fire erupts on the drapes and the patient's hair also catches fire. ***How will you manage this situation?***

EQUIPMENT& SUPPLIES:

- Anesthesia machine with circuit
- Simple face mask
- Simulation man
- Ambu bag
- Monitors: 5 lead EKG, pulse oximeter, blood pressure cuff, ETCO2
- ETT
- Laryngoscope with blade of choice
- Tape
- OR table
- Drug cart
- Basin of saline
- Fire extinguisher
- Phone

SITE SELECTION: USM NAP simulation lab

TASK STATEMENT:

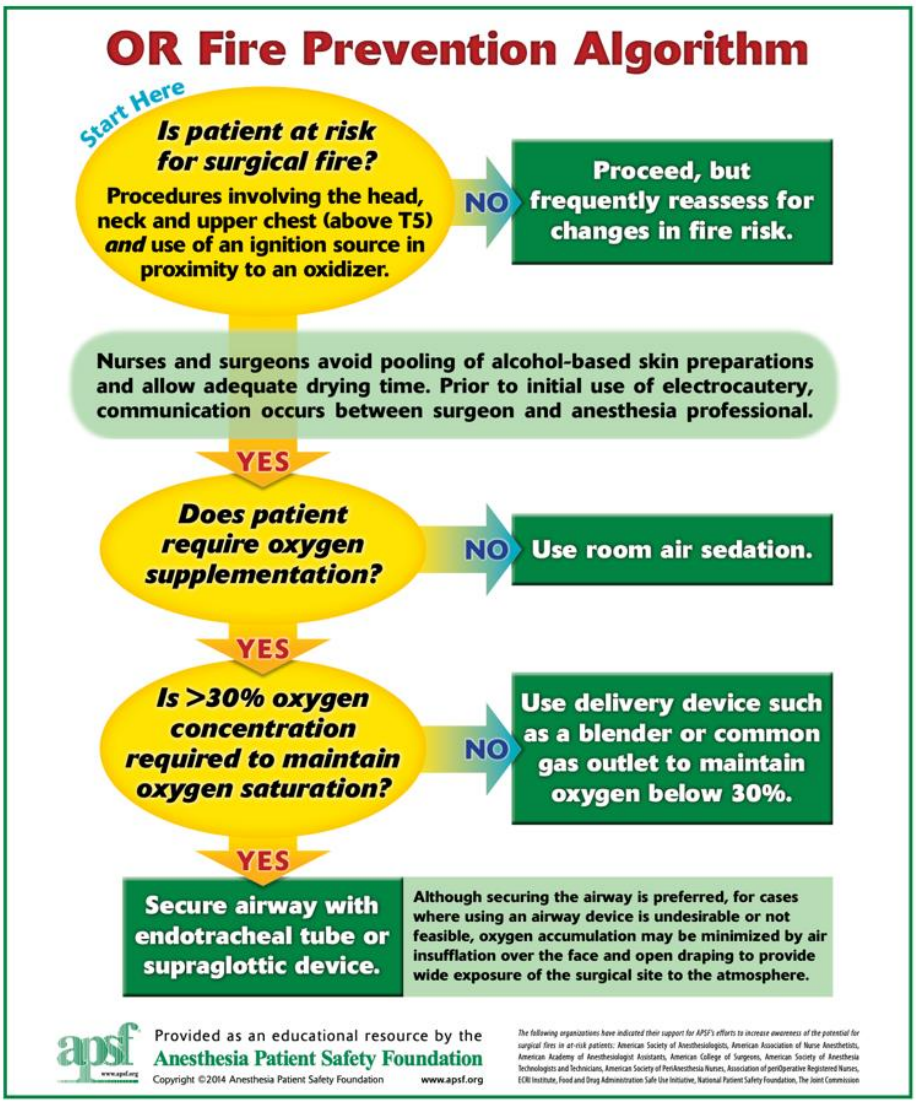
Your task is to demonstrate an understanding of surgical fire risk assessment and proper management of a surgical fire.

PROCESS:

1. Identify that this procedure is high-risk for a surgical fire.
2. Identify and announce that a surgical fire is present.
3. Immediately stop all flow of airway gases.
4. Remove any flammable, burning material (ex. Drapes, pillows, towels).
5. Extinguish the fire by pouring saline over fire.
6. Maintain ventilation for the patient. Intubate the patient if ventilation cannot be maintained.

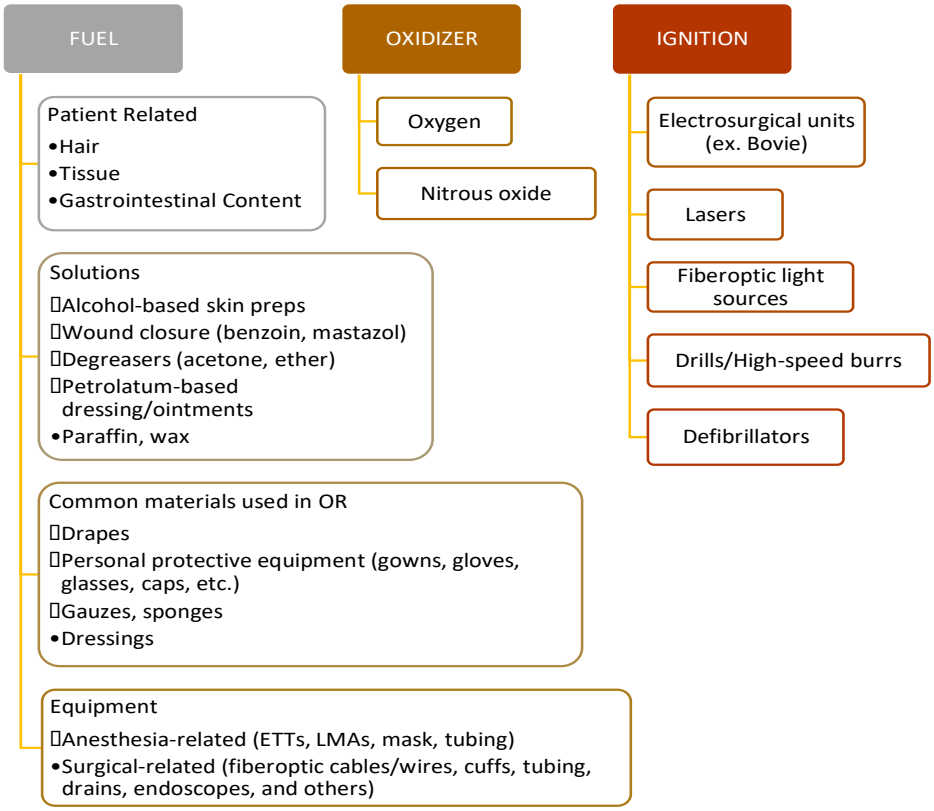
7. Assess the patient for injury, especially inhalation injury.
8. Once the patient is stable and the fire is out, perform other management interventions if appropriate for the patient (CXR, ABG, carboxyhemoglobin levels, corticosteroid administration, ICU admission).
9. Assess self and OR personnel for any evidence of burn or inhalational injury.

IMAGES: *(review prior to OSCE)*



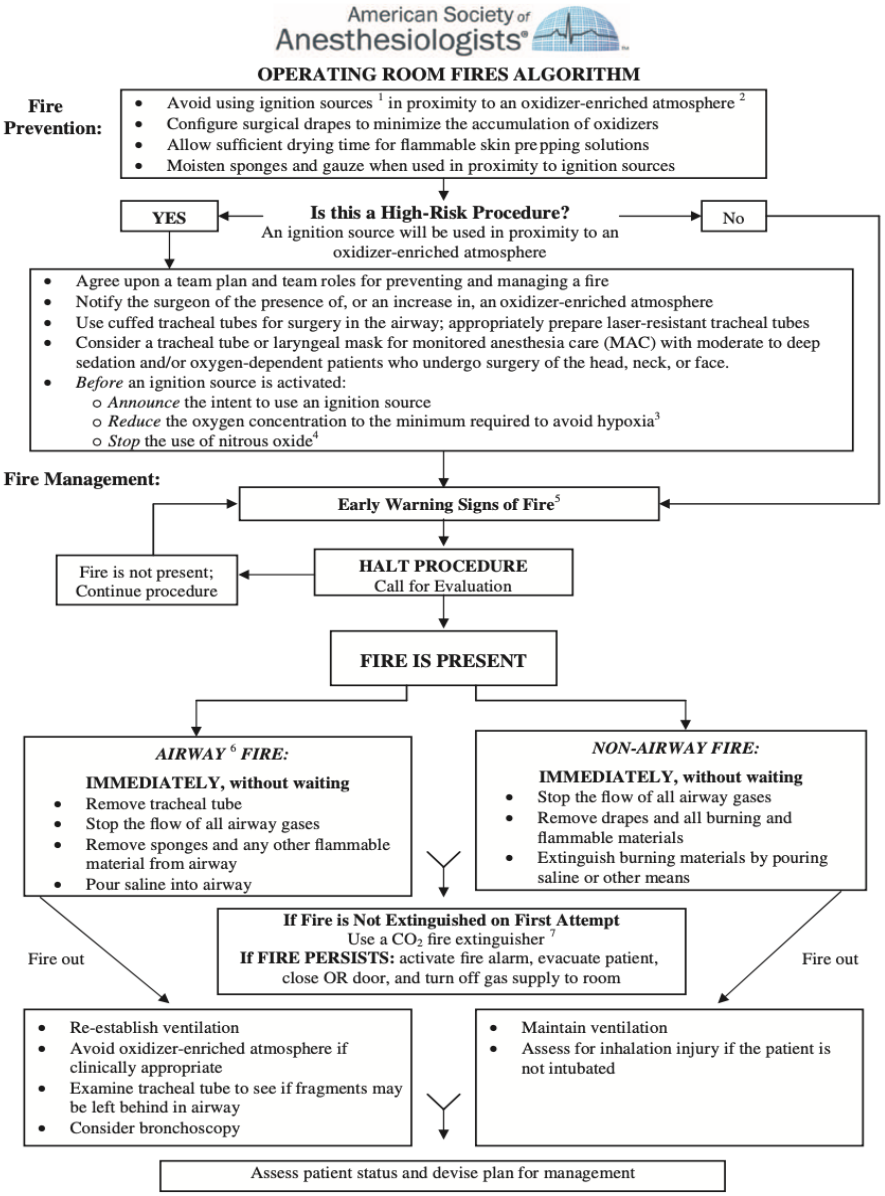
OR Fire Prevention Algorithm

Anesthesia Patient Safety Foundation (2014)



The Fire Triad

Adapted from (Jones et al., 2019)



[1] Ignition sources include but are not limited to electrosurgery or electrocautery units and lasers.
[2] An oxidizer-enriched atmosphere occurs when there is any increase in oxygen concentration above room air level, and/or the presence of any concentration of nitrous oxide.
[3] After minimizing delivered oxygen, wait a period of time (*e.g.,* 1-3 min) before using an ignition source. For oxygen dependent patients, *reduce* supplemental oxygen delivery to the minimum required to avoid hypoxia. Monitor oxygenation with pulse oximetry, and if feasible, inspired, exhaled, and/or delivered oxygen concentration.
[4] After stopping the delivery of nitrous oxide, wait a period of time (*e.g.,* 1-3 min) before using an ignition source.
[5] Unexpected flash, flame, smoke or heat, unusual sounds (*e.g.,* a "pop," snap or "foomp") or odors, unexpected movement of drapes, discoloration of drapes or breathing circuit, unexpected patient movement or complaint.
[6] In this algorithm, airway fire refers to a fire in the airway or breathing circuit.
[7] A CO_2 fire extinguisher may be used on the patient if necessary.

ASA's Operating Room Fires Algorithm

(ASA, 2013)

DEBRIEFING FORM:

1. What are the signs that this patient was at high risk for a surgical fire?
2. What could have been done before the start of the procedure to mitigate the risk of surgical fire?
3. How did the individual/group perform?
4. What interventions were done and were they appropriate for the patient?

ASSESSMENT

RUBRIC FOR SURGICAL FIRE MANAGEMENT

QUESTION & DEMONSTRATION STATION:

	TASKS	PASS	FAIL	COMMENTS
	1. Prepares and selects appropriate equipment.			
*	2. Identifies that this procedure is a high risk for a surgical fire.			
*	3. Identifies and announces that a surgical fire is present.			
*	4. Immediately stops the flow of all airway gases.			
*	5. Properly extinguishes the fire.			
*	6. Maintains ventilation for the patient.			
*	7. Properly assesses the patient for injury, specifically assesses for inhalation injury.			
*	8. Once the patient is stable, properly carries out other management intervention.			
*	9. Assesses self and other OR personnel for injury.			

Steps with * Must be properly completed. All steps must be completed/passed to receive a passing grade.

The OSCE by the student demonstrates foundational knowledge and correct management of a surgical fire: (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 – OSCE Evaluation Tool

Evaluation of the Surgical Fire OSCE is greatly appreciated. Feedback allows for OSCE improvements and assists in SRNA's education at USM. Participation is strictly voluntary, and responses are kept anonymous.

Surgical Fire OSCE Evaluation Survey	
1. Do you consent to participation in the evaluation of the Surgical Fire OSCE	YES NO
2. Please select one that applies to your current anesthesia practice role.	CRNA 2nd Year SRNA 3rd Year SRNA
3. The Surgical Fire OSCE presented information regarding surgical fire management in an easily understood way?	Strongly agree Agree Neutral Disagree Strongly disagree
4. The Surgical Fire OSCE learning objectives are clearly outlined?	Strongly agree Agree Neutral Disagree Strongly disagree
5. The Surgical Fire OSCE provides instruction/information that is relevant to today's anesthesia practice?	Strongly agree Agree Neutral Disagree Strongly disagree
6. The Surgical Fire OSCE presents a realistic surgical fire scenario?	Strongly agree Agree Neutral Disagree Strongly disagree
7. The information presented in the Surgical Fire OSCE will assist in allowing SRNAs to become more competent in managing surgical fires in clinical practice?	Strongly agree Agree Neutral Disagree Strongly disagree
8. The Surgical Fire OSCE shows evidence of doctoral-level work?	Strongly agree Agree Neutral Disagree Strongly disagree
9. After reviewing the OSCE, I feel more comfortable managing a surgical fire?	Strongly agree Agree Neutral Disagree Strongly disagree
10. Please provide any additional comments/feedback/suggestions:	

APPENDIX E – Recruitment Email

Dear SRNA or CRNA participant,

Our names are Tate Fazio and Kaleb Killens, we are current nurse anesthesia students at The University of Southern Mississippi. You are being invited to participate in a survey as part of our research for an Objective Structured Clinical Examination (OSCE) on surgical fire prevention and management.

We ask that you review the attached document containing the OSCE for surgical fire prevention and management. Following the review of the OSCE, we ask that you fill out an anonymous and confidential survey related to the OSCE. In the end, you can provide any additional comments that will be used to guide any future necessary revisions of the OSCE. Participation in this survey is entirely voluntary and should take no more than 10 minutes to complete. All participants require informed consent. There are no repercussions for non-participation.

The feedback you provide is greatly appreciated and will aid in strengthening our study. If you have any questions or concerns, don't hesitate to contact one of us using the contact information below. Thank you for your time and consideration!

Tate Fazio, SRNA, BSN
Tate.fazio@usm.edu

Kaleb Killens, SRNA, BSN
Kaleb.killens@usm.edu

Before beginning the survey, review the attached files:

- **Informed consent**
- **OSCE for surgical fire prevention and management**

Follow this link to the survey:

https://usmuw.co1.qualtrics.com/jfe/form/SV_51mmcmL08kxadbo

The survey presents no more than minimal risk of harm to subjects and involves no procedures for patients or participants. Data being collected is confidential and anonymous, and 100% voluntary with no repercussions for non-participation.

This study has been approved by the USM Institutional Review Board Protocol ID # 22-1130.

APPENDIX F – Literature Matrix

Author/Title	Year of Publication	Type of Evidence/Level of Research	Summary/Findings
AACN, The Essentials of Doctoral Education for Advanced Nursing Practice	2006	Electronic textbook	Outlines and summarizes the essentials of doctoral education for advanced nursing practice.
ASA, Practice Advisory for the Prevention and Management of Operating Room Fires	2013	Journal article	Practice advisory for operating room fires. Discusses prevention and management of OR fires. Includes ASA OR fire algorithm.
Aronowitz et al., Using Objective Structured Clinical Examination as education in Advanced Practice Registered Nursing	2017	Journal article	Discusses the implementation and utilization of simulation in APRN education.
Ballister, Education News: Basics of the Objective Structured Clinical Exam	2018	Journal article	Discusses simulation and OSCEs in nurse anesthesia education.
Briese et al., Application of Mezirow's Transformative Learning Theory to Simulation in Healthcare Education	2020	Journal article	Examines Mezirow's Transformative Learning Theory and its relation and application to simulation-based learning in healthcare education.
Barash, Clinical Anesthesia (8th ed)	2017	Textbook	Includes prevention, management, and anesthesia implications for OR fire prevention and management.
COA, Standards for Accreditation of Nurse Anesthesia Programs	2022	Electronic handbook	Outlines accreditation standards nurse anesthesia program must follow.

Literature Matrix (continued).

Culp et al., Preventing Operating Room Fires: Impact of Surgical Drapes on Oxygen Contamination of the Operating Field	2021	Journal article/Laboratory study	Measured oxygen levels under various surgical drapes in simulated clinical conditions.
Fisher, Prevention of Surgical Fires: A Certification Course for Healthcare providers	2015	Journal article/pilot study	This article outlines a potential certification program for surgical fire prevention and conducted a pilot study with 10 anesthesia providers.
Jones et al., Operating Room Fires	2019	Journal article	Reviewed each component of the fire triad, surgical checklist, team training, and surgical fire management strategies.
Keeze et al., Risk and Prevention of Surgical Fires: A Systematic Review	2018	Systematic review	A systematic review of each fire triad component.
Kishiki et al., Simulation Training Results in Improvement of the Management of Operating Room Fires	2019	A single-blinded randomized controlled trial	Examined the effectiveness of classroom education on performance in an OR fire simulation scenario.
Nagelhout, Nurse Anesthesia (6th ed)	2018	Textbook	Includes prevention, management, and anesthesia implications for OR fire prevention and management.
Offiah et al., Evaluation of Medical Student Retention of Clinical Skills Following Simulation Training	2019	Journal article/observational prospective cohort study	Evaluated med students' retention of clinical skills after participating in simulation-based education.

Literature Matrix (continued).

Onwudiegwu, OSCE: Design, Development, and Deployment	2018	Journal article	Outlines and discusses the design, development, and deployment of OSCEs into medical education.
Wunder et al., Objective structured clinical examination as an educational initiative for summative simulation competency evaluation of first-year student registered nurse anesthetists' clinical skills	2014	Journal Article	Discusses the use of OSCEs for SRNA education.
Wunder et al., Fire in the Operating Room: Use of Mixed Reality Simulation with Nurse Anesthesia Students	2020	A quantitative, descriptive study	Evaluated various skills of SRNAs as they participated in a mixed reality OR fire simulation.

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