

**Introduction of a Novel Quick Reference Guide for Certified Registered Nurse Anesthetists  
to Assist in Perioperative Fire Prevention: A Quality Improvement Project**

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Submitted in partial fulfillment of the requirements for the degree of

Doctor of Nursing Practice

December 7, 2021

### **Abstract**

Perioperative fires are traumatizing events that may lead to patient and staff morbidity and mortality. CRNAs are in a unique position for monitoring, assessing, and intervening to prevent perioperative fires yet fire prevention resources designed specifically for anesthesia providers are not available. In this quality improvement project, a perioperative fire prevention quick reference guide tailored to the distinct role of the CRNA was created. This guide was distributed to CRNAs for use in practice at an ambulatory surgical center and its utility was evaluated via pre- and post-intervention participant surveys. Participants indicated that availability of the reference guide improved confidence in knowledge about perioperative fire prevention and decreased the amount of time it would take to access reference materials on the topic, should the need arise. The quick reference guide represents a cost-effective method of improving patient safety and staff efficiency. For future use, the guide may be tailored to suit the needs of other organizations based on procedures performed or equipment utilized.

*Keywords:* perioperative fire, fire prevention, CRNA

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## Section I. Introduction

### Background

Perioperative fires are traumatic events for patients and staff. In the United States, approximately 650 operating room (OR) fires are voluntarily reported annually (Jones et al., 2019). These fires are thought to contribute to two to three patient deaths per year although the actual number of OR fires, and their impact on patient outcomes, is unclear.

Three components, known as the *triad of fire*, have been identified as essential for a fire to occur: an oxidizer, an ignition source, and a fuel. These three components are present in nearly all surgical procedures (Jones et al., 2019). Despite the risk of fire being commonplace, Coletto et al. (2018) found that 99% of Certified Registered Nurse Anesthetists (CRNAs) and Student Registered Nurse Anesthetists (SRNAs) surveyed self-reported their knowledge of operating room fire risks and prevention was inadequate. This statistic is alarming as anesthesia providers are responsible for the administration and management of the two oxidizers identified as contributing to perioperative fires: oxygen and nitrous oxide.

### Organizational Needs Statement

The partnering organization for this quality improvement project was an ambulatory surgical center in the southeastern United States. At the time of project implementation, this organization had been in operation for over 25 years and performed 12,000 surgeries annually. The organization had an OR fire safety policy that outlined staff responsibility and training, contained a fire risk assessment tool, and provided suggested interventions to prevent or manage a fire. All perioperative personnel at the organization were required to participate in annual perioperative fire prevention and management education and skills validation. The organization also required that a fire risk assessment be performed prior to each operation and documented by

the circulating nurse. The organization did not have fire risk training or resources designed specifically for anesthesia providers.

Anesthesia providers are directly responsible for the management of all oxidizers utilized in the OR, thus their role in OR fire prevention is unique. Fire requires the presence of all three components of the triad of fire—the oxidizer, ignition source, and fuel. The identification and mitigation of just one component, such as the oxidizer, would prevent a fire; therefore, anesthesia providers' management of oxidizers is crucial to preventing OR fires.

Improving the safety and quality of healthcare is a priority for American health professionals and multiple initiatives outline measures to achieve these goals. The Institute of Healthcare Improvement (2020) has created the Triple Aim for Populations, a framework that “describes an approach to optimizing health system performance” by “applying integrated approaches to simultaneously improve care, improve population health, and reduce costs per capita” (para. 1). Additionally, every decade since the 1980s, the U.S. Department of Health and Human Services has produced updates to its Healthy People initiative—a “guide to national health promotion and disease preventions efforts to improve the health of the nation” (Centers for Disease Control and Prevention, 2020, para 1). One of the Healthy People 2030 goals is to “improve health care” as “high-quality health care helps prevent diseases and improve quality of life” (Office of Disease Prevention and Health Promotion [ODPHP], 2020, para 1). The authors of this goal also note that “strategies to make sure health care providers are aware of treatment guidelines and recommended services are also key to improving health” (ODPHP, 2020, para 1). In the spirit of these initiatives, CRNAs should work to improve the health of the surgical patient population by improving the safety and quality of anesthesia care provided. The creation of a

perioperative fire prevention quick reference guide is a strategy to aid CRNAs in this mission by ensuring timely access to fire prevention guidelines.

The unique role CRNAs perform in the prevention of OR fires has been acknowledged by the American Association of Nurse Anesthetists (AANA), the professional organization representing CRNAs nationwide, which has joined as a collaborating partner in the U.S. Food and Drug Administration's (FDA) Preventing Surgical Fires Initiative (AANA, 2020). Having an OR fire prevention resource specifically for anesthesia providers could help ensure the practice of the partnering organization's CRNAs reflects the standards established by the AANA and help ensure the organization performs to the standards established by the FDA.

Not only is operating room safety paramount to the patient and staff, but also to the financial wellbeing of the healthcare organization. The largest share of American health spending, 29%, is sponsored by the federal government, and the Affordable Care Act of 2010 mandated that a value-based purchasing program be implemented for Medicare reimbursement to ambulatory surgical centers (Centers for Medicare and Medicaid Services [CMS], 2020a, 2020b). This value-based purchasing program requires that ambulatory surgical centers report data on identified performance measures and ties Medicare reimbursement to the facility's outcomes. The first performance measure identified by this value-based purchasing program for ambulatory surgical centers was "patient burn" (CMS, 2018, para. 3). This performance measure mandates that ambulatory surgical centers report the number of admissions that experience a burn prior to discharge—this includes not only a burn experienced with a surgical fire, but also chemical, electrical, or radiation burns (CMS, 2018). Facilities with high numbers of patient burns, or those determined to be low-performing based on other performance measures, receive a decreased reimbursement amount from Medicare for all services provided at the facility.

**Problem Statement**

OR fires are traumatizing events that may lead to staff and patient morbidity and mortality. Fire prevention requires constant vigilance of OR staff (Jones et al., 2019). Although the anesthesia provider is in a unique position for monitoring, assessing, and intervening to prevent OR fires, the partnering organization did not have OR fire prevention resources in place designed specifically for anesthesia providers.

**Purpose Statement**

The purpose of the proposed DNP quality improvement project was to create, implement, and assess providers' perception of adequacy of a newly developed quick reference guide designed specifically for anesthesia providers about perioperative fire prevention with the goal of improving ease of access to reference materials tailored to the anesthesia provider's unique role in perioperative fire prevention.



## Section II. Evidence

### Literature Review

To determine the underlying cause of OR fires, and best practice prevention methods, a literature review was performed. The primary concepts utilized for the literature search included “operating room fire prevention” and “cognitive aids in anesthesia.” The term “cognitive aid” was determined to be more inclusive than “reference guide” and thus employed during the literature review. Keywords, PubMed MeSH terms, and Cumulative Index of Nursing and Allied Health Literature (CINAHL) subject headings used are summarized in Appendix A.

Articles related to OR fire prevention as well as the use of cognitive aids in anesthesia were reviewed in PubMed, CINAHL, and ProQuest. Initially resources were excluded if the publication date was not within five years but, due to a lack of relevant articles and professional practice guidelines in that date range, the inclusion criteria was expanded to publication within the last ten years (2010-2020). The search strategy is displayed in Appendix B. Additional resources were gathered through a manual review of references listed in articles determined applicable to the topic as well as through searches of Google Scholar and websites of pertinent organizations.

Articles determined pertinent to this project were appraised for relevancy, currentness, and level of evidence using Melnyk & Fineout-Overholt’s (2019) level of evidence guidelines. Within this system, Level I evidence, systematic reviews and meta-analyses of randomized controlled trials, provide the strongest and most desired level of evidence, but few such resources were available. Additional levels include: Level II evidence: randomized controlled trials; Level III: quasi-experimental or non-randomized controlled trials; Level IV: case control and cohort studies; Level V: systematic reviews of descriptive and qualitative studies; Level VI: qualitative or

descriptive studies; Level VII: opinion of authorities or reports of expert committees (p. 101).

Most articles pertinent to this issue were level IV-VII. Over 400 articles were reviewed during literature searches, ten were used to support the project. Appendix C contains a literature matrix summarizing utilized resources and identifying their level of evidence.

### ***Current State of Knowledge***

Three components are essential for the creation of fire—an oxidizer, an ignition source, and a fuel. Jones et al. (2019) identified common sources of each component found in operating rooms: oxidizers- oxygen, nitrous oxide; fuels- alcohol-based skin preps, drapes, gowns, gauze, sponges, endotracheal tubes, intestinal gasses; and ignition sources- electrosurgical units, lasers, fiberoptic light sources, drills, high-speed Burrs, and defibrillators. Anesthesia providers hold the primary responsibility for the management of the oxidizer component of the fire triad—oxygen and nitrous oxide (Ahmed & Girshin, 2013). It is also noteworthy that objects that may serve as fuel for a fire are influenced by varying oxygen concentrations; nearly all objects can become a fuel source once oxygen content is increased to greater than 30% (Jones et al., 2019; Kezze et al., 2018). A standard endotracheal tube is combustive when oxygen concentration is greater than 25% (Bansal et al., 2013).

Mehta et al. (2013) reviewed closed malpractice claims in the American Society of Anesthesiologists Closed Claims Database between 1985-2013. Oxygen was determined to have served as the oxidizer in 95% of electrocautery-induced OR fires and 100% of OR fires with other ignition sources. Electrocautery in the presence of supplemental oxygen during monitored anesthesia care (MAC) cases was identified as the most common cause of OR fires.

In 2013, the American Society of Anesthesiologists (ASA) task force on operating room fires published their most current *Practice Advisory for the Prevention and Management of*

*Operating Room Fires*. In this report, several key concepts were defined. According to the ASA (2013), “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” (p. 1). High-risk procedures were defined as any procedure where “an ignition source can come in proximity to an oxidizer-enriched atmosphere” (ASA, 2013, p. 2). Tonsillectomy, tracheostomy, removal of laryngeal papilloma, cataract or eye surgery, burr hole surgery, or removal of any lesion of the face, head, or neck were all identified as high-risk procedures (ASA, 2013, p. 2). It was also noted that any time supplemental oxygen is administered in the OR, it is a high-risk situation (ASA, 2013, p. 2). Given the vital role supplemental oxygen plays in the occurrence of perioperative fires, it is recommended that the anesthesia circuit be checked for leaks prior to each case and oxygen should be turned off after each case (Spruce, 2016). ASA (2013) also recommended that each surgery should begin with a fire risk assessment that is communicated to the entire OR team and also provided a number of specific practice recommendations, including:

- Avoid using ignition sources in close proximity to an oxidizer-enriched atmosphere.
- Configure surgical drapes so minimize the accumulation of oxidizers.
- Suction the zone around the head to limit oxygen and nitrous oxide gasses accumulation in that area.
- Scavenge the oropharynx with suction during oral cases
- Allow sufficient drying time for flammable skin prepping solutions.
- Moisten sponges and gauze when used in close proximity to ignition sources.

- Laser resistant endotracheal tubes should be used during laser surgeries and the tube cuff should be filled with saline tinted blue with methylene blue to act as a marker for cuff puncture by laser.
- For surgeries inside the airway, cuffed, rather than uncuffed, endotracheal tubes should be used.
- If the airway is to be accessed with an electrosurgical device, nitrous oxide should be discontinued and oxygen should be reduced to <30% for 1-5 minutes.
- During oral procedures, the oropharynx should be scavenged with suction device during procedure.
- For surgeries around the head/face/mouth, a closed oxygen delivery system should be considered when supplement oxygen is required (ASA, 2013, p. 5-7).

Surgeries of the airway or in the lungs also have high potential for fire. It is recommended that during these surgeries the anesthesia provider ensure there is no air leak from the endotracheal tube and that they consider suctioning the ipsilateral lumen of a dual lumen endotracheal tube to decrease oxygen near electrocautery (Bansal et al., 2013). It is also best practice to discuss oxygen delivery with the surgeon and to ask the surgeon to announce intent to use an ignition source (Di Pasquale & Ferneini, 2017).

In 2018, the FDA Safety Communication, *Recommendations to Reduce Surgical Fires and Related Patient Injury* was produced. According to this communication, “An open oxygen delivery system, such as a nasal cannula or mask, presents a greater risk of fire than a closed delivery system, such as a laryngeal mask or endotracheal tube” (para. 5). It is recommended that anesthesia providers avoid the administration of supplemental oxygen, if possible (Jones et al., 2019; The Joint Commission, 2003; FDA, 2018). If supplemental oxygen is required, it should

be administered with the use of an oxygen blender or via the common gas outlet of the anesthesia machine to avoid administration of 100% oxygen. In surgical cases that are considered high risk for fire where the patient requires greater than 30% oxygen, the anesthesia provider is strongly urged to place a supraglottic airway or endotracheal tube (FDA, 2018; Jones et al., 2019).

Echoing the recommendation of ASA (2013) and Spruce (2016), the FDA (2018) recommended that a fire risk assessment should be performed at the beginning of each surgical procedure, noting that staff should “be aware that the highest risk procedures involve an ignition source, delivery of supplemental oxygen, and use of an ignition source near the oxygen (e.g., head, neck, or upper chest surgery)” (para. 7). The Silverstein Fire Risk Assessment is a risk assessment tool that can be utilized by anesthesia providers to rapidly assess fire risk (Mathias, 2006). The assessment consists of three items that are scored one point each for their presence in the surgery—“open oxygen source,” “presence of an ignition source,” and “surgery at/above the xiphoid.” A score of 0-1 is considered low risk for fire. A score of 2 is considered intermediate risk while a score of 3 should be considered high risk for fire (Mathias, 2006).

### ***Current Approaches to Solving Population Problems***

Multiple researchers have published studies reporting the outcomes of interventions to prevent OR fires. Tola et al. (2018) implemented an OR fire prevention educational session for OR staff, including anesthesia providers, and found that the one-time education session improved staff members’ knowledge and use of prevention strategies. Kishiki et al. (2019) found that healthcare professionals who participated in OR fire simulation scenarios scored significantly higher on an OR fire competency test than healthcare professionals who participated in classroom only training. Coletto et al. (2018) found that CRNAs and SRNAs had “positive and favorable attitudes toward fire risk assessment and the use of checklists in the OR” (p. 106).

According to Stiegler and Tung (2014), external decision support tools are effective ways to reduce errors in anesthesia decision making, noting that, “these tools are commonly used in aviation and include checklists, written algorithms, clinical decision aids built into electronic medical records, and guidelines” (p. 214). McEvoy et al. (2014) found that use of an electronic decision support tool improved anesthesia provider adherence to guidelines in simulated emergency management.

### ***Evidence to Support the Intervention***

Identified evidence showed greatest support for in-person and simulation training, however, this intervention was planned during the novel Corona Virus Disease 2019 (COVID-19) pandemic. In-person gatherings had been limited across the nation in an attempt to slow the spread of the virus, while American healthcare professionals had been called upon to work long hours under extraordinarily difficult conditions. With consideration of these unprecedented circumstances, it was decided that the intervention should be implemented in a remote manner to prevent unnecessary congregation of staff and to allow participation without unnecessary direct contact. The findings of Stiegler and Tung (2014) and McEvoy et al. (2014), supported the creation and electronic delivery of a novel cognitive aid for OR fire prevention tailored to the needs of anesthesia providers.

With consideration of the partnering organization’s needs, results of previously mentioned studies, and pandemic precautions, it was decided that a quick reference guide would be created and distributed to the organization’s anesthesia providers. To tailor this intervention to the anesthesia providers’ role in OR fire prevention, findings from the literature supported inclusion of a brief fire risk assessment tool as well as case-specific tips and guidance from best practice guidelines.

## **Evidence-Based Practice Framework**

### ***Identification of the Framework***

The framework for the intervention was adapted from the “four-element implementation strategy” outlined by Goldhaber-Fiebert and Howard (2013, p. 1153) for the implementation of emergency manuals in anesthesia settings. The four elements are: *create, familiarize, use, and integrate*. First, the cognitive aid was created with consideration of both content and design. Then electronic delivery of the aid and an introduction video were utilized as training to familiarize the target audience with the tool. The third element, use, involved consideration of the accessibility of the cognitive aid for success in the clinical setting. Electronic delivery of the tool provided CRNAs with the flexibility to keep a copy of the tool on a phone or work computer or to print a copy, per their preference. To integrate the tool into the organization, Goldhaber-Fieber and Howard (2013) suggest “practitioner feedback and involvement in the other 3 elements (create, familiarize, and use) ensures more successful implementation both by integrating helpful suggestions and by increasing stakeholder buy-in” (p. 1158). To aid integration, a subject matter expert was consulted and served to evaluate the cognitive aid prior to dissemination.

### **Ethical Consideration & Protection of Human Subjects**

Through the collaboration of East Carolina University’s Institutional Review Board (IRB), the College of Nursing, and the partnering organization, this quality improvement project was deemed exempt from full IRB review, see Appendices D and E. The primary investigator completed the Collaborative Institutional Training Initiative (CITI Program) courses “Human Research” and “Responsible Conduct of Research” in August 2020. The project participants were limited to CRNAs practicing in the OR setting of the partnering organization who

volunteered to participate. No patient information was collected. There was no more than minimal potential for risk to the target population as the information and processes fall within usual practice for the organization. Identified risks included potential for a small amount of added stress and increased time demands on participants.



### **Section III. Project Design**

#### **Project Site and Population**

##### *Description of the Setting*

The project setting was an ambulatory surgical center in the southeastern United States. This facility had a dedicated staff of seven CRNAs. Additionally, three to four CRNAs, from a pool of greater than one hundred, rotated to the facility daily from the local hospital. The facility performs more than 12,000 surgeries annually. The project was implemented primarily in a digital medium.

##### *Description of the Population*

The population of interest in this project was CRNAs who provided anesthesia services exclusively at the partnering organization. These CRNAs are employed by a large, physician-owned anesthesia practice in the southeastern United States. The project's sample was composed of CRNAs from this population who volunteered to participate in this quality improvement project.

#### **Project Team**

The project team included the graduate nursing student, an SRNA, performing the project, a clinical CRNA faculty member who recruited participants, the CRNA faculty member as chair, the Nurse Anesthesia program director, a non-CRNA faculty member who facilitated the process, and a partner from the clinical setting. The quick reference guide was created in collaboration with three other SRNAs in the Doctor of Nursing Practice in Nurse Anesthesia program; however, the implementation, data collection, and data analysis were performed independently.

## **Project Goals and Outcome Measures**

### ***Description of the Methods and Measurement***

After project approval was obtained, a pre-and post-survey methodology was used to complete the “integration” element of the project’s framework, Goldhaber-Fiebert and Howard’s (2013) “four-element implementation strategy.” The goal was to assess CRNA volunteer perceptions of adequacy of a newly developed quick reference guide designed specifically for anesthesia providers. Participants were recruited from the ambulatory surgical center by a CRNA faculty member. Each participant received an email containing the pre-intervention survey, introductory video, and a copy of the quick reference guide. The survey consisted primarily of Likert scale and dichotomous questions as well as a single free-response question. Participants were instructed to complete the survey prior to watching the educational video. A printed, laminated copy of the reference guide was then provided to participants and they were asked to utilize the tool for two weeks in their practice setting. After the two weeks utilization period they were asked to complete a post-intervention survey. Appendix F contains a copy of the tool while Appendices G and H contain the surveys.

### ***Discussion of the Data Collection Process***

The project email (see Appendix I) sent to participants included an anonymous link to the nine-question, pre-intervention survey delivered through Qualtrics survey software. Participants were asked to complete the survey prior to watching the introductory video and utilizing the new reference guide. After a period of two weeks a second email (see Appendix J) containing an anonymous link to the post-intervention survey via Qualtrics was sent to participants for completion. Data was immediately available for viewing on the Qualtrics platform. Data analysis was performed as appropriate to question type.

**Implementation Plan**

Once voluntary participants were recruited, the project survey and tool were sent to the participants at the email of their selection. A copy of the invitation email sent can be found in Appendix I. Participants were to utilize the tool in their practice for a period of two weeks and then complete the post-intervention questionnaire which was emailed to them at the completion of the two-week timeframe (see Appendix J). The lead SRNA completed a clinical rotation at the project's setting during project implementation and was available for participant questions intermittently in-person and otherwise via email.

**Timeline**

Topic exploration began in approximately May 2020 with literature search completion in November 2020. Project design and development was completed in February and March of 2021. Implementation took place over a two-week period from mid-April to early May 2021. Data analysis was completed in June of 2021. The dissemination of findings occurred in the fall of 2021. The project timeline is provided in Appendix K.

## Section IV. Results and Findings

### Results

Seven CRNAs agreed to participate in the project. On April 19, 2021, the initial project description email with links to the introductory video, the novel perioperative fire prevention quick reference guide, and the Qualtrics pre-intervention questionnaire was sent to the participants' work email addresses. Seven anonymous responses were received to the pre-intervention questionnaire. On May 3, 2021, the second email with the Qualtrics post-intervention questionnaire link was sent to project participants. Six participants completed the post-intervention questionnaire. The data collected is displayed in Appendix L.

In the pre-intervention questionnaire, 100% of respondents reported having received education on perioperative fire while only four respondents indicated that they had received continuing education on perioperative fire prevention. On the 1-5 Likert scale question, "how confident are you in your knowledge about perioperative fire prevention?" all participants rated their confidence between 3 and 5 with 5 being "very confident." All respondents indicated that they had participated in a procedure where all elements of the fire triad were present, while only one respondent indicated that they had experienced a fire. On the second Likert scale question (1-5) all seven respondents rated themselves as 4-5 (with 5 being very confident) in their ability to identify a surgical procedure that has a high risk of fire. Four of seven participants indicated that they did not currently have perioperative fire prevention guidelines they could access quickly while at work and indicated it would take them between one and nine minutes to access material to answer a clinical question about perioperative fire prevention. All seven respondents indicated that an easily accessible reference guide would provide them support in decision-making regarding high fire risk procedures.

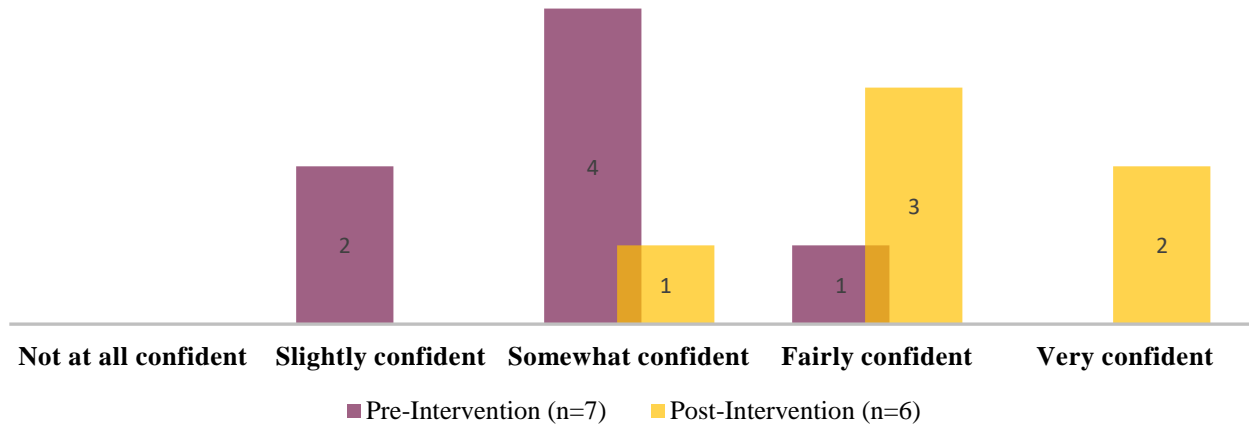
In the post-intervention questionnaire, 4 of 6 respondents indicated that they had participated in 9 or more procedures that were high risk for fire during the two week implementation period. The question regarding usefulness of the guide produced mixed responses. One participant indicated it was “not useful at all,” two indicated it was “very useful,” and three scored it as 3 or 4 on the 1 to 5 Likert scale. Four respondents felt the reference guide was easily accessible in the clinical setting but two did not agree. All seven participants found the guide visually appealing. Two respondents felt the reference guide saved them time while four did not. Of the six respondents, five felt they could access this reference guide within 1-3 minutes while at work while one felt it would take them 10 or more minutes to access it. Fifty percent of respondents thought they would use this reference guide in their work. Confidence in knowledge about OR fire prevention was again rated by all participants as 3-5 on a 1 to 5 Likert scale, with higher scores than in the pre-intervention questionnaire.

### **Analysis**

Despite all CRNA participants indicating that they had received education on perioperative fire prevention, self-reported confidence scores gathered from pre-intervention question 3, *How confident are you in your knowledge about perioperative fire prevention?* and post-intervention question 8, *After reviewing this reference material, how confident are you in your knowledge about perioperative fire prevention?* indicated that reviewing perioperative fire prevention guidelines in the project’s intervention increased CRNA confidence in their own fire prevention knowledge. Responses are displayed in Figure 1.

**Figure 1**

*Self-Reported Confidence Level Pre- and Post-Intervention*

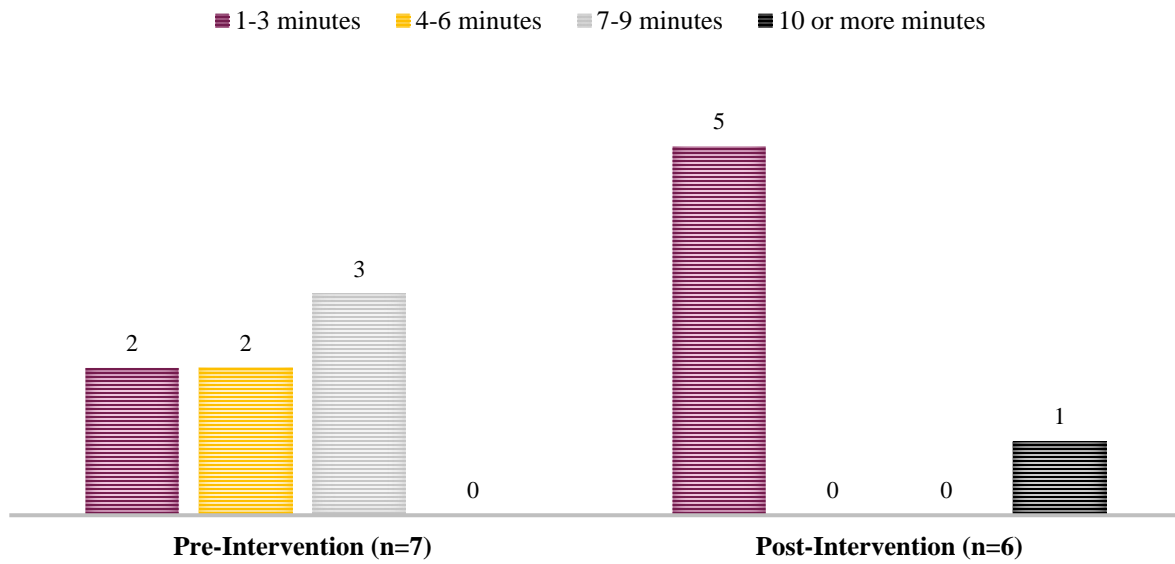


Interestingly, four of six post-intervention questionnaire participants indicated that the reference guide created did not save them time in their practice, yet comparison of pre-intervention question 8, *If you had a question about perioperative fire prevention, approximately how long do you think it would take you to find reference material to answer the question?* and post-intervention question 6, *If saved to your mobile phone or work computer how long would it take you to access this reference guide?* indicated that the participants estimated that it would take them less time to access the provided reference guide than find reference materials.

Participant responses are displayed in Figure 2.

**Figure 2**

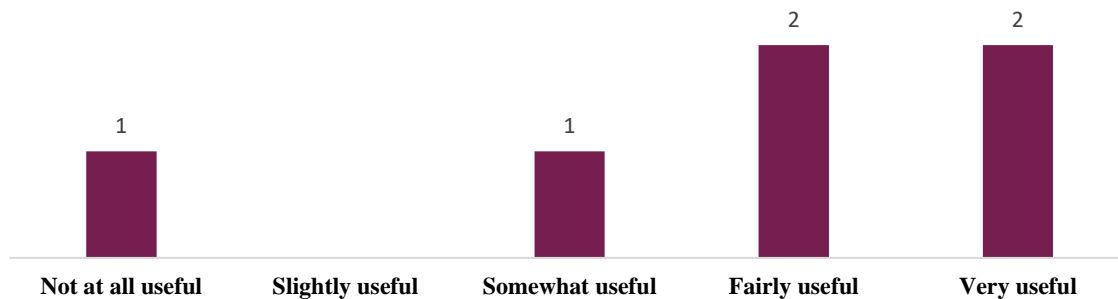
*CRNA Estimated Time to Access Reference Material*



When the project participants were asked about their perception of usefulness of the tool, the majority indicated the tool could be useful for an anesthesia department. Responses to the post-intervention question, *What is your perception of usefulness of this reference guide for an anesthesia department?* are displayed in Figure 3.

**Figure 3**

*Perception of Usefulness of Reference Guide (n=6)*



## **Section V. Interpretation and Implications**

### **Cost Benefit Analysis**

The project and intervention were extremely cost effective. The only costs incurred were related to having the reference guide professionally printed and laminated and purchasing a stand to hold the printed guides for a total cost of approximately \$50. According to Mehta et al., (2013), the median malpractice claims payment to patients after an OR fire was \$120,166; this amount does not reflect the cost of traumatization of staff, which is unquantifiable. If access to the guide prevented one OR fire, the return on investment would be more than \$2,400 per \$1 spent.

The cost-benefit analysis is more complex if the project were implemented by the organization rather than an unpaid student. There would be salary/work hours that would need to be dedicated to the staff member that created the reference guide, prepared the questionnaires, and analyzed the data gathered. The project utilized Qualtrics survey software, a cost that was covered by the university. The project benefits were also difficult to quantify. Saving CRNAs time in accessing reference materials would improve efficiency within the organization but converting that efficiency to a dollar amount was beyond the scope of the project.

### **Resource Management**

The successful outcome of this project was facilitated by the organization having CRNAs that were willing to participate in the project. One barrier to the project was that the organization's anesthesia staff do not utilize computers in their job—all anesthesia records are kept on paper and the anesthesia workstation does not have a computer. This limitation prevented the project from being implemented in an entirely digital medium and necessitated the printing of the reference guide.



### **Implications of Findings**

Goldhaber-Fiebert and Howard (2013) identified four elements of implementation of emergency manuals in anesthesia settings: create, familiarize, use, and integrate. The fire prevention guide was created based on current best evidence as well as a quick view format that allows users to develop familiarity with the tool expending minimal time and effort prior to using the tool in practice. This project included three of the elements identified by Goldhaber-Fiebert and Howard (2013), create, familiarize, and use, but not the final element, integrate.

Half of the CRNAs who completed the post-intervention survey indicated that they would use the reference guide in their practice as a CRNA. This indicates that the organization's CRNAs are receptive to practice aids. The organization is affiliated with more than 100 CRNAs. If the project participants' opinions are representative of the entire practice, then the guide could be provided to all CRNAs, utilized by more than 50, and potentially prevent countless fires.

### ***Implications for Patients***

As discussed previously, improving the quality and safety of healthcare in America is a priority for virtually all healthcare and healthcare-adjacent organizations, including the U.S. Department of Health and Human Services, the AANA, U.S. FDA, and CMS. Despite multiple initiatives to improve patient safety, approximately 650 OR fires still occur each year and two to three patients per year succumb to the injuries they sustain during these fires (Jones et al., 2019). CRNA access to the reference guide could create a medium for achieving the goal of improved patient safety by preventing OR fires.

### ***Implications for Nursing Practice***

Achieving improved patient safety should not only be a priority for organizations, but a priority for every individual healthcare provider. Access to this reference guide will provide

CRNAs with evidence-based reference material that can be accessed quickly and efficiently in the clinical setting to apply to real-world scenarios. The oxidizer component of the triad of fire is primarily managed by the CRNA member of the surgical team. Managing anesthesia equipment to minimize the risk of fire is a component of the AANA's *Standards of Nurse Anesthesia Practice* (AANA, 2019). The reference guide provides CRNAs with reliable information and could save staff time that would otherwise be spent researching guidelines and aids staff in upholding the standards of nurse anesthesia practice.

### ***Impact for Healthcare System***

The healthcare system has a vested interest in improving patient safety—insurance reimbursement is often tied to quality of care. Preventing OR fires improves patient safety and improves the quality of care delivered by the healthcare system. This, in turn, improves the financial wellbeing of the organization. In addition to increasing reimbursement for services rendered, preventing OR fires prevents staff morbidity associated with such events. This could mean the organization has less staff missing days of work or requiring worker's compensation for injuries sustained on the job. Also, having quickly accessible reference material that saves CRNAs time during the workday improves the organizational efficiency.

### **Sustainability**

“Integration” is the final element of the “four-element implementation strategy” framework utilized for this project. The cost effectiveness of this project provides for significant longevity and ease of integration. Once the guide has been created, an annual literature review should be performed to verify information is current. Beyond that maintenance measure, there would be no additional costs to the organization for continuing the project in a digital medium. If

staff were to request a hard copy of materials, there may be a nominal fee associated with printing.

**Dissemination Plan**

The results of this project were presented in a poster format as well as oral presentation both in-person and via digital medium to East Carolina University's College of Nursing faculty, staff, and students as well as the CRNAs of the partnering organization. The project participants were invited but not required to attend. The paper was also posted in East Carolina University's digital archive of scholarly output, The ScholarShip.

## **Section VI. Conclusion**

### **Limitations**

Project sample size was small with only six participants completing the intervention. This small sample size prevented any descriptive statistics of data collected and limits the generalizability of results. It is also of note that the project was implemented in an outpatient surgical center, but CRNA staff members of the same practice are required to work at that facility as well as in inpatient settings. The utility of the tool for inpatient anesthesia care was not evaluated.

### **Recommendations for Others**

For others considering reproducing or continuing the current project, attempts should be made to obtain a larger sample size. In a setting where computer charting is utilized, it may be helpful to send each project participant a copy of the tool and have the tool readily available on the work computers of the facility, such as in the form of a desktop icon. It may also be beneficial to create a smart phone application in addition to a PDF document for dissemination.

### **Recommendations for Further Study**

It would be useful to know the prevalence of OR fires in the partnering organization and the circumstances surrounding the fire events. The tool was created with generic OR fire prevention information but could be customized to the organization's needs if a root cause of fire occurrence were identified.

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[devices/safety-communications/recommendations-reduce-surgical-fires-and-related-patient-injury-fda-safety-communication](#)



**Appendix A**

**Literature Search Concepts**

*Keywords, PubMed MeSH, and CINAHL Subject Headings Used for Literature Searches*

	Concept			
	Operating Room	Fire Prevention	Cognitive Aid	Anesthesia
Keywords	Operating room Operation Surgery Procedure room	Fire prevention Fire elimination Fire precaution Fire avoidance Fire safety	Cognitive aid Reference material Checklist Guide	Anesthesia
PubMed MeSH	Operating room Room, operating Rooms, operating	Fires Fire	Checklist	Anesthesia
CINAHL Subject Terms	Operating rooms Surgery, operative	Surgical fires Fire safety Fires	Checklists	Anesthesia
ProQuest Search	Operating room	Fire	Checklist Cognitive aid	Anesthesia

## Appendix B

### Literature Search Summary

#### *Search Strategy*

Search Date	Database or Search Engine	Search Strategy	Limits Applied	Sorted by	Number of Citations found/kept	Rationale for Inclusion/Exclusion of Items
November 2020	PubMed	Fire AND (operating room OR anesthesia)	English language, publication 2015-2020, abstract available	Best match	Found: 151 Reviewed: 151 Kept: 16	Quality of evidence, relationship to topic
November 2020	PubMed	Anesthesia AND Checklist	English language, publication 2015-2020, abstract available	Best match	Found: 488 Reviewed: 200 Kept: 5	Quality of evidence, relationship to topic
November 2020	PubMed	Anesthesia AND Cognitive Aid	English language, publication 2015-2020, abstract available	Best Match	Found: 56 Reviewed: 56 Kept: 3	Quality of evidence, relationship to topic
November 2020	CINAHL	Surgical fires AND Operating rooms	Boolean/Phrase, Abstract Available, English Language, Published 2010-2020	Newest	Found: 12 Reviewed: 12 Kept: 2	Quality of evidence, relationship to topic
November 2020	CINAHL	Checklists AND anesthesia	Boolean/Phrase, Abstract Available, English Language, Published 2010-2020	Relevance	Found: 38 Reviewed: 38 Kept: 2	Repeated articles, quality of evidence, relationship to topic
November 2020	ProQuest Search	Anesthesia AND checklist	Scholarly journals, last 10 years (2010-2020), English	Relevance	Found 8,281 Reviewed: 200 Kept: 0	No new related articles found
November 2020	ProQuest Search	Anesthesia AND Cognitive aid	Scholarly journals, last 5 years (2015-2020), English, peer reviewed	Relevance	Found: 3,530 Reviewed: 200 Kept: 0	No new related articles found
November 2020	ProQuest Search	Operating room AND fire	Scholarly journals, last 5 years (2015-2020), English, Peer reviewed	Relevance	Found: 6,589 Reviewed: 50 Kept: 1	Repeated articles, quality of evidence, relationship to topic

### Appendix C Literature Matrix

<i>Literature Matrix</i>	Citation	Level of Evidence	Objective	Method	Results/Conclusion
	American Society of Anesthesiologists. (2013). Practice advisory for the prevention and management of operating room fires: An updated report by the American Society of Anesthesiologists task force on operating room fires. <i>Anesthesiology</i> , 118(2), 1-20.	VII	Summarize recommendations for OR fire prevention and management.	Expert panel, literature review.	Multiple recommendations and identification of high-risk scenarios.
	Bansal, A., Bhama, J. K., Varga, J. M., & Toyoda, Y. (2013). Airway fire during double-lung transplantation. <i>Interactive CardioVascular and Thoracic Surgery</i> , 17(6), 1059-1060. <a href="https://doi.org/10.1093/icvts/ivt357">https://doi.org/10.1093/icvts/ivt357</a> .	VII	Clinical scenario discussion	Case description	Recommendations for decreasing fire risk in lung surgery.
	Coletto, K., Tariman, J. D., Lee, Y., & Kapanke, K. (2018). Perceived knowledge and attitudes of Certified Registered Nurse Anesthetists and Student Registered Nurse Anesthetists on fire risk assessment during time-out in the operating room. <i>AANA Journal</i> , 86(2), 99-108.	VI	Examine perceived knowledge and attitudes of CRNAs and SRNAs on fire risk assessment during surgical time-outs	Questionnaires were sent to 1,600 active members of the Illinois Association of Nurse Anesthetists	Positive attitudes towards fire risk assessment, self-reported information needs on OR fire risk assessment.
	Di Pasquale, L., & Ferneini, E. M. (2017). Fire Safety for the Oral and Maxillofacial Surgeon and Surgical Staff. <i>Oral and Maxillofacial Surgery Clinics of North America</i> , 29(2), 179-187. <a href="https://doi.org/10.1016/j.coms.2016.12.004">https://doi.org/10.1016/j.coms.2016.12.004</a>	VII	Review concepts of fire safety important for oral and maxillofacial surgeries.	Literature review	Recommendations for decreasing fire risk in oral/maxillofacial surgical procedures.
	Goldhaber-Fiebert, S. N. & Howard, S. K. (2013). Implementing emergency manuals: Can cognitive aids help translate best practices for patient care during acute events? <i>Anesthesia Patient Safety Foundation</i> , 117(5), 1149-1161.	VII	Identify method for implementation of cognitive aids in anesthesia care.	Literature review/discussion	Outlined the “four-element implementation strategy” for cognitive aids
	Jones, T. S., Black, I. H., Robinson, T. N., & Jones, E. L. (2019). Operating room fires. <i>Anesthesiology</i> , 130(3), 492-501. DOI: 10.1097/ALN.0000000000002598	VII	Review causes/implications of OR fires.	Literature review/discussion	This review analyzes each fire component to determine the optimal clinical strategy to reduce the risk of fire. Surgical checklists, team training, and the specific management of an OR fire are also reviewed.
	Kezze, I., Zoremba, N., Rossaint, R., Reig, A., Coburn, M., & Schalte, G. (2018). Risks and prevention of surgical fires. <i>Anaesthesist</i> , 67, 426-447. <a href="https://doi.org/10.1007/s00101-018-0445-2">https://doi.org/10.1007/s00101-018-0445-2</a>	V	Systematic review of intraoperative fire risks and the impact of each component of the fire triad.	Literature review/discussion	Emphasizes the fatal role of an oxygen-enriched environment. Even “fire-safe” materials may be flammable or at least smoldering in oxygen-rich environments.
	Mehta, S. P., Bhananker, S. M., Posner, K. L., Domino, K. B. (2013). Operating room fires: A closed claim analysis. <i>Anesthesiology</i> , 118(5), 1133-1139.	VII	Assess the patterns of injury and liability associated with OR fires in closed malpractice claims in the ASA Closed Claims Database since 1985	An analysis of fire-related claims was performed to identify causative factors.	Identification of patient payouts after OR fire claims, major causes of OR fires.
	Spruce, L. (2014). Back to basics: Implementing the surgical checklist. <i>AORN Journal</i> , 100(5), 466- 476. <a href="http://dx.doi.org/10.1016/j.aorn.2014.06.020">http://dx.doi.org/10.1016/j.aorn.2014.06.020</a>	VII	Review strategies for surgical checklist implementation.	Review Article	Key strategies for successful checklist implementation are provided.
	Tola, D. H., Jillson, I. A., & Graling, P. (2018). Surgical fire safety: An ambulatory surgical center quality improvement project. <i>AORN Journal</i> , 107(3), 335-344. <a href="http://doi.org/10.1002/aorn.12081">http://doi.org/10.1002/aorn.12081</a>	VI	To improve knowledge and awareness of surgical fire risk and increase practitioners’ use of a fire risk assessment tool during the surgical safety communication process.	Purposive sample of participants that included all surgical team members of a metropolitan ambulatory surgical center.	The findings suggest that a brief educational intervention regarding fire risk assessment contributes to improving staff member knowledge and use of prevention strategies.

*Note. Evidence-based practice in nursing & healthcare: A guide to best practice* (4th ed.) by B. M. Melnyk and E. Fineout-Overholt. Copyright 2019 by Wolters Kluwer Health.

**Appendix D**  
**IRB Waiver Request**



Click "download PDF" to save a copy of this page for your records.  
Note: The IRB Office does not maintain copies of your responses.

Below is a summary of your responses [Download PDF](#)

**Quality Improvement/Program Evaluation Self-Certification Tool**

**Purpose:**

Projects that do not meet the federal definition of human research pursuant to 45 CFR 46 do not require IRB review. This tool was developed to assist in the determination of when a project falls outside of the IRB's purview.

**Instructions:**

Please complete the requested project information, as this document may be used for documentation that IRB review is not required. Select the appropriate answers to each question in the order they appear below. Additional questions may appear based on your answers. If you do not receive a STOP HERE message, the form may be printed as certification that the project is "not research", and does not require IRB review. The IRB will not review your responses as part of the self-certification process. For projects being done at [redacted] site support will be required. Please email [crg.quality@\[redacted\].com](mailto:crg.quality@[redacted].com) to obtain site support from [redacted]

**Name of Project Leader:**

Erin Stevens, SRNA & Maura McAuliffe, CRNA, PhD (Project Chair)

**Project Title:**

Assessing anesthesia providers' perceptions of adequacy of operating room fire prevention

**Brief description of Project/Goals:**

Purpose: The purpose of this quality improvement project is to assess anesthesia providers' perceptions of adequacy of a newly developed Perioperative Fire Prevention Guide. Process: A Quick-Reference Perioperative Fire Prevention Guide, based upon accepted national guidelines, will be developed. Anesthesia providers at Vidant SurgiCenter will be asked several questions (through Qualtrics) about their perceptions of the adequacy of the currently used fire risk assessment tool and preparedness for fire prevention. An educational video about the use of the newly developed Perioperative Fire Prevention Guide will be made available to them, and they will be asked to use the tool for two weeks. Upon completion of the two-week utilization they will be asked to complete a questionnaire about their perceptions of the adequacy of the tool. Qualtrics survey software will be used to deliver the intervention link and gather participant perceptions of acceptability and adequacy of the intervention prior to and post implementation of the project. No patient information will be recorded or maintained during this project.

Will the project involve testing an experimental drug, device (including medical software or assays), or biologic?

- Yes  
 No

Has the project received funding (e.g. federal, industry) to be conducted as a human subject research study?

- Yes  
 No

Is this a multi-site project (e.g. there is a coordinating or lead center, more than one site participating, and/or a study-wide protocol)?

- Yes  
 No

Is this a systematic investigation designed with the intent to contribute to generalizable knowledge (e.g. testing a hypothesis; randomization of subjects; comparison of case vs. control; observational research; comparative effectiveness research; or comparable criteria in alternative research paradigms)?

- Yes  
 No

Will the results of the project be published, presented or disseminated outside of the institution or program conducting it?

- Yes  
 No

---

Would the project occur regardless of whether individuals conducting it may benefit professionally from it?

---

- Yes  
 No
- 

Does the project involve "no more than minimal risk" procedures (meaning the probability and magnitude of harm or discomfort anticipated are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests)?

---

- Yes  
 No
- 

Is the project intended to improve or evaluate the practice or process within a particular institution or a specific program, and falls under well-accepted care practices/guidelines?

---

- Yes  
 No
- 

Based on your responses, the project appears to constitute QI and/or Program Evaluation and IRB review is not required because, in accordance with federal regulations, your project does not constitute research as defined under 45 CFR 46.102(d). If the project results are disseminated, they should be characterized as QI and/or Program Evaluation findings. Finally, if the project changes in any way that might affect the intent or design, please complete this self-certification again to ensure that IRB review is still not required. Click the button below to view a printable version of this form to save with your files, as it serves as documentation that IRB review is not required for this project. 11/15/2020

---

**Appendix E  
Organizational Approval Form**



**Quality Assurance/Quality Improvement Project vs. Human Research Study  
(Requiring IRB approval) Determination Form**

This worksheet is a guide to help the submitter to determine if a project or study is a quality assurance/quality improvement (QA/QI) project or research study and is involving human subjects or their individually identifiable information and requires IRB approval as defined by the Health and Human Services (HHS) or Food and Drug Administration (FDA). Once completed, please email the form to the [redacted] Center for Research and Grants (CRG) [CRG.Quality@\[redacted\].com](mailto:CRG.Quality@[redacted].com). A CRG team member will contact you with the results of their review and may request additional information to assist with their determination. The determination will be made in conjunction with the UMCIRB office.

Please contact the [redacted] CRG with any questions at [redacted] or [CRG.Quality@\[redacted\].com](mailto:CRG.Quality@[redacted].com).

For more guidance about whether the activity meets the definition of Human Subjects Research see <http://rede.ecu.edu/umcirb/irb-faq/s/definitions/> or <http://www.hhs.gov/ohrp/regulations-and-policy/decision-charts-2018/index.html#c1>

<b>Project Title:</b> Assessing anesthesia providers' perceptions of adequacy of operating room fire prevention		
<b>Funding Source:</b> None		
<b>Project Leader Name:</b> Erin Stevens/Angela Ciuca	<input type="checkbox"/> Ed.D.	<input type="checkbox"/> J.D.
	<input type="checkbox"/> Pharm.D.	<input checked="" type="checkbox"/> R.N.
	<input type="checkbox"/> M.D.	<input type="checkbox"/> Ph.D.
	<input type="checkbox"/> Other(specify):	
<b>Job Title:</b> ECU SRNA/ECU CRNA faculty	<b>Phone:</b> [redacted]	<b>Email:</b> ciucaa18@ecu.edu
	<b>Primary Contact (if different from Project Leader):</b> Erin Stevens, SRNA	
	<b>Phone:</b> [redacted]	<b>Email:</b> stevens18@students.ecu.edu

**Key Personnel/ Project Team members:**

Name and Degree:	Department: (Affiliation if other than [redacted])	Email:
Erin Stevens, SRNA	ECU Nurse Anesthesia Program	stevens18@students.ecu.edu
Angela Ciuca, DNAP, CRNA	ECU Nurse Anesthesia Program	ciucaa18@ecu.edu
Maura McAuliffe, PhD, CRNA	ECU Nurse Anesthesia Program	mcauliffem@ecu.edu

**QI/QA Assessment Checklist:**

Consideration	Question	Yes	No
<b>PURPOSE</b>	Is the PRIMARY purpose of the project/study to: <ul style="list-style-type: none"> <li>• IMPROVE care right now for the next patient?</li> <li>OR</li> <li>• IMPROVE operations outcomes, efficiency, cost, patient/staff satisfaction, etc.?</li> </ul>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>RATIONALE 1</b>	The project/study falls under well-accepted care practices/guidelines or is there sufficient evidence for this mode or approach to support implementing this activity or to create practice change, based on: <ul style="list-style-type: none"> <li>• literature</li> <li>• consensus statements, or consensus among clinician team</li> </ul>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>RATIONALE 2</b>	The project/study would be carried out even if there was no possibility of publication in a journal or presentation at an academic meeting. (**Please note that answering "Yes" to this statement does not preclude publication of a quality activity.)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>METHODS 1</b>	Are the proposed methods flexible and customizable, and do they incorporate rapid evaluation, feedback and incremental changes?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>METHODS 2</b>	Are patients/subjects randomized into different intervention groups in order to enhance confidence in differences that might be obscured by nonrandom selection? (Control group, Randomization, Fixed protocol Methods)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>METHODS 3</b>	Will there be delayed or ineffective feedback of data from monitoring the implementation of changes? (For example to avoid biasing the interpretation of data)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>METHODS 4</b>	Is the Protocol fixed with fixed goal, methodology, population, and time period?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>RISK</b>	The project/study involves no more than minimal risk procedures meaning the probability and magnitude of harm or discomfort anticipated are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>PARTICIPANTS</b>	Will the project/study only involve patients/subjects who are ordinarily seen, cared for, or work in the setting where the activity will take place?	<input type="checkbox"/>	<input type="checkbox"/>
<b>FUNDING</b>	Is the project/study funded by any of the following? <ul style="list-style-type: none"> <li>• An outside organization with an interest in the results</li> <li>• A manufacturer with an interest in the outcome of the project relevant to its products</li> <li>• A non-profit foundation that typically funds research, or by internal research accounts</li> </ul>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If all of the check marks are inside the shaded gray boxes, then the project/study is very likely QI and not human subject research. Projects that are not human subject research do not need review by the IRB.



**In order to assess whether your project meets the definition of human subject research requiring IRB review or may qualify as a quality improvement/assurance activity, please provide the following information:**

**1. Project or Study Summary:**

**As a separate attachment, please provide a summary of the purpose and procedures as well address all of the following:**

- a) The project question/hypothesis.
- b) The project design.
- c) Any interaction or intervention with humans.
- d) A description of the methods that will be used and if they are standard or untested.
- e) Specify where the data will come from and your methods for obtaining this data -please specify who/where (i.e. CRG will provide you with the data, or someone from a specific department will provide you with the data, or you will pull it yourself).
- f) Specify what data will be used and any dates associated with when that data was originally collected (i.e Patient Name, Diagnosis, Age, Sex), *if applicable, please attach your data collection sheet.*
- g) Where will the data (paper and electronic) for your project be stored? Please specify how it will be secured to protect privacy and maintain confidentiality. For paper data, please provide physical location such as building name and room number and that it will be kept behind double lock and key. For electronic data, please provide the file path and folder name network drive where data will be stored and specify that it is secure/encrypted/password protected. If using other storage location, please provide specific details.
- h) Please specify how long data will be stored after the study is complete? (Keep in mind that data collected/generated during the course of the project that includes protected health information (PHI) should have identifiers removed at the earliest opportunity.)
- i) Please specify how the collected data will be used (internal/external reports, publishing, posters, etc).

**Please attach a summary and/or any other additional documentation describing your project**

**2. If the Primary purpose of your project/study is for QA/QI, have you obtained approval from the operational leader within your department or health system:**

- Yes** [Please specify here whom and obtain their signature in the signature section below]: [REDACTED] MSN, CRNA
- No** [Contact the appropriate operational leader for approval.]

**Please note:**

- By submitting your proposed project/study for QA/QI determination you are certifying that if the project/study is established to qualify as QA/QI project, you and your Department would be comfortable with the following statement in any publications regarding this project: "This project was reviewed and determined to qualify as quality improvement by the [REDACTED] Center for Research and Grants."
- If you are submitting a Poster to Media Services for printing, you will need to also submit this Quality Improvement Worksheet or proof of your IRB Application and IRB Approval.
- If the [REDACTED] CRG determines the activity is not human subject research, then any presentation, publication, etc. should not refer to the activity as "human subject research," "exempt research," or "expedited research."
- If you would like the [REDACTED] CRG to verify that a project/study is not human subject research, please provide this form completed with the summary of your activity and any additional information to the [REDACTED] CRG at [CRG.Quality@\[REDACTED\].com](mailto:CRG.Quality@[REDACTED].com) and the following will be completed and returned to you for your records.

**NHSR vs. HSR Determination:**

- Not Human Subject Research:** The [redacted] CRG has determined that based on the description of the project/study, approval by the IRB is not necessary. Any changes or modifications to this project may be discussed with the [redacted] CRG at that time to ensure those changes do not elevate the project to human research that would need IRB approval.
- Human Subject Research:** This project/study requires review by the IRB prior to initiation. An application in the electronic IRB submission system should be submitted.

**Approval Signatures:**

Department (Site) Manager: [redacted]

Date: 2/24/2021

CRG Reviewer: [redacted] Digitally signed by [redacted]  
Date: 2021.03.08 05:56:29 -05'00'

Date: \_\_\_\_\_

UMCIRB Office Staff Reviewer: [redacted]

Date: 3-10-21

Appendix F

Surgical Fire Prevention Reference Guide



Case Specific Tips

Monitored Anesthesia Care

- Avoid supplemental O<sub>2</sub><sup>6,7,8</sup>
- Do not deliver 100% FiO<sub>2</sub><sup>6,8</sup>
- Use O<sub>2</sub> blender or CGO to deliver O<sub>2</sub> ≤ 30%<sup>6,8</sup>
- Consider ETT/LMA in high-risk cases requiring ≥ 30% FiO<sub>2</sub><sup>6,8</sup>
- Position drapes and forced air warming equipment to prevent tenting and trapping of O<sub>2</sub><sup>8,9</sup>
- Suction the zone around the head to limit O<sub>2</sub> and N<sub>2</sub>O gases in the area<sup>9</sup>

Head and Neck Surgery

- Scavenge oropharynx with suction during oral cases<sup>9</sup>
- Discuss O<sub>2</sub> delivery with surgeon during case<sup>10</sup>
- Ask the surgeon to announce intent to use an ignition source<sup>10</sup>
- Saline available if surgery in oral cavity<sup>10</sup>

Airway and Lung Surgery

- Stop N<sub>2</sub>O, decrease O<sub>2</sub> to ≤30% for 1-5 minutes before activating ignition source in airway<sup>9</sup>
- Ensure no air leak from ETT<sup>3</sup>
- Consider suctioning ipsilateral lumen of DLT to decrease O<sub>2</sub> near electrocautery<sup>3</sup>

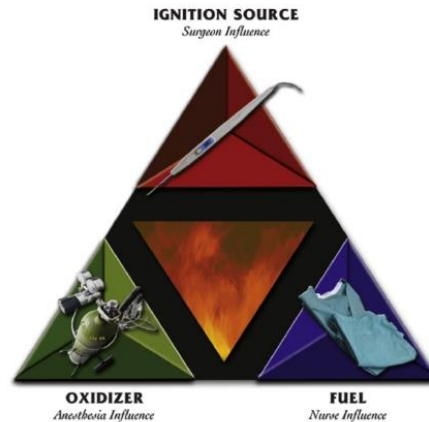
Laser Surgery/ENT

- Use appropriate laser resistant ETT<sup>9</sup>
- Fill ETT cuff with saline and indicator dye<sup>9</sup>

Other

- Check anesthesia circuit for leaks<sup>5</sup>
- Ensure O<sub>2</sub> off after every case<sup>5</sup>

# Surgical Fires



**Anesthesia is primarily responsible for managing the oxidizer component of the fire triad (O<sub>2</sub> and N<sub>2</sub>O)<sup>1</sup>**

O<sub>2</sub> was the oxidizer in 95% of electrocautery-induced OR fires and 100% of fires with other ignition sources<sup>2</sup>

Standard ETT is combustive when O<sub>2</sub> >25%<sup>3</sup>

**Silverstein Fire Risk Assessment<sup>4</sup>**

Score one point for each item below

- Open oxygen source
- Presence of an ignition source
- Surgery at/above the xiphoid

Total _____

**Scoring**

- 0-1: Low risk
- 2: Intermediate risk
- 3: High risk

**Communicate fire risk with all staff<sup>5</sup>**

<sup>1</sup>Ahmed OI, Girshin M. Fire safety in the operating room. *APSF*. 2013; 28(1):17. <sup>2</sup>Mehta SP, Bhananker SM, Posner KL, Domino KB. Operating room fires: A closed claim analysis. *Anesthesiology*. 2013; 118(5):1133-1139. <sup>3</sup>Bansal A, Bhama JK, Varga JM, Toyoda Y. Airway fire during double-lung transplantation. *Interact Cardiovasc Thorac Surg*. 2013; 17(6):1059-1060. <sup>4</sup>Mathias JM. (2006). Scoring fire risk for surgical patients. *OR Mgr*. 2006; 22(1): 1-3. <sup>5</sup>Spruce L. Back to basics: Preventing surgical fires. *AGRN J*. 2016; 104(3): 217-224.e2. <sup>6</sup>Jones TS, Black IH, Robinson TN, Jones EL. Operating room fires. *Anesthesiology*. 2019; 130(3): 492-501. <sup>7</sup>(2003). Sentinel event alert: Preventing surgical fires. The Joint Commission. [https://www.jointcommission.org/-/media/jtc/documents/resources/patient-safety-topics/sentinel-event/ssa\\_29.pdf](https://www.jointcommission.org/-/media/jtc/documents/resources/patient-safety-topics/sentinel-event/ssa_29.pdf). Published 2003. Accessed November 3, 2020. <sup>8</sup>USFDA. Recommendations to reduce surgical fires and related patient injury: FDA safety communication. <https://www.fda.gov/medical-devices/safety-communications/recommendations-reduce-surgical-fires-and-related-patient-injury-fda-safety-communication>. Published 2018. Accessed November 3, 2020. <sup>9</sup>ASA. Practice advisory for the prevention and management of operating room fires: An updated report by the ASA task force on operating room fires. *Anesthesiology*. 2013; 118(2):1-20. <sup>10</sup>Di Pasquale L, Fermeini EM. Fire Safety for the Oral and Maxillofacial Surgeon and Surgical Staff. *Oral Maxillofac Surg Clin North Am*. 2017; 29(2): 179-187.

**Appendix G**

**Pre-Intervention Questionnaire**



Have you **ever** received education on perioperative fire prevention?

---

- Yes
  - No
- 

Have you received continuing education on perioperative fire prevention?

---

- Yes
  - No
- 

How confident are you in your knowledge about perioperative fire prevention?

---

- |                       |                       |                       |                       |                       |                       |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Not at all confident  |                       |                       |                       |                       | Very confident        |
| 1                     | 2                     | 3                     | 4                     | 5                     |                       |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
- 

Have you participated in a procedure where all the elements of the fire triad were present?

---

- Yes
  - No
- 

Have you ever experienced a perioperative fire?

---

- Yes
- No

How confident are you in your ability to identify a surgical procedure that has a high risk of fire?

---

Not at all confident

1

2

3

4

Very confident

5

Do you currently have perioperative fire prevention guidelines that you can quickly access while at work?

---

Yes

No

---

If you had a question about perioperative fire prevention, approximately how long do you think it would take you to find reference material to answer the question?

---

1-3 minutes

4-6 minutes

7-9 minutes

10 or more minutes

Would an easily accessible reference guide provide you support in decision making regarding high fire risk procedures?

---

Yes

No

**Appendix H**  
**Post-Intervention Questionnaire**



Approximately how many procedures did you participate in over the last two weeks that qualified as high-risk for fire?

---

0-2	3-5	6-8	9 or more
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

What is your perception of the usefulness of this reference guide for an anesthesia department?

---

Not at all useful				Very useful
1	2	3	4	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

Was this reference guide easily accessible in the clinical setting?

- Yes
  - No
- 

Did you find this reference guide visually appealing?

- Yes
- No

Did this reference guide save you time?

- Yes
- No

If saved to your mobile phone or work computer, how long would it take you to access this reference guide?

- |                       |                       |                       |                       |
|-----------------------|-----------------------|-----------------------|-----------------------|
| 1-3 minutes           | 4-6 minutes           | 7-9 minutes           | 10 or more minutes    |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Do you think you will use this reference guide in your practice as a CRNA?

- Yes
- No

After reviewing this reference material, how confident are you in your knowledge about perioperative fire prevention?

- |                           |                       |                       |                       |                       |
|---------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Not at all confident<br>1 | 2                     | 3                     | 4                     | Very confident<br>5   |
| <input type="radio"/>     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Do you have any recommendations to improve this reference guide? (i.e. is something missing?)

## Appendix I

### Email Invitation to Participate in Quality Improvement Project

Dear CRNA,

Thank you for considering participating in a quality improvement project titled "Assessing Anesthesia Providers' Perceptions of Adequacy of Perioperative Fire Prevention." The purpose of this project is to assess anesthesia providers' perceptions of adequacy of a newly developed Perioperative Fire Prevention Guide at [REDACTED]

Participation is voluntary and will involve completing a short pre-intervention questionnaire, reviewing the materials provided, utilizing the perioperative fire prevention guide in your CRNA practice for two weeks, and completing a short post-intervention questionnaire regarding your perceptions of the adequacy or usefulness of the perioperative fire prevention guide.

Each questionnaire should take less than 5 minutes to complete and will be provided via email using Qualtrics survey software. The perioperative fire prevention guide falls within currently accepted practice in your work area. Your participation is voluntary and confidential. We will share the results of this QI project with you upon completion.

#### How to Participate:

1. Complete the anonymous pre-intervention questionnaire: [Pre-Intervention Questionnaire](#)
2. Watch our short video with information about the quality improvement project: [https://prezi.com/v/qc-l\\_u954\\_li/perioperative-fire-prevention/?preview=1](https://prezi.com/v/qc-l_u954_li/perioperative-fire-prevention/?preview=1)
3. Utilize the tool attached to this email in your practice for two weeks
4. Complete the anonymous post-intervention questionnaire that will be emailed to you in 2-3 weeks

For your convenience, a laminated copy of the guide can be found on the right-hand side of the anesthesia workroom next to the telephone.

Again, thank you for your participation in our quality improvement project. If you have any questions, you may contact me at the following:

Sincerely,

Erin Stevens, BSN, SRNA  
stevens18@students.ecu.edu

Angela Ciuca, DNAP, CRNA  
ciuca18@ecu.edu

Link to introductory video: [https://prezi.com/v/qc-l\\_u954\\_li/perioperative-fire-prevention/?preview=1](https://prezi.com/v/qc-l_u954_li/perioperative-fire-prevention/?preview=1)



## Appendix J

### Second Email to Project Participants

Dear CRNA,

Thank you for your participation in the first part of our quality improvement project titled "Assessing Anesthesia Providers' Perceptions of Adequacy of Perioperative Fire Prevention." To complete the project, we are requesting that you participate in the second and final anonymous survey about the usefulness of the Perioperative Fire Prevention Reference Guide previously provided.

[Post-Intervention Questionnaire](#)

Again, thank you for your participation in our quality improvement project. If you have any questions, you may contact me at the following:

Sincerely,

Erin Stevens, BSN, SRNA  
[stevense18@students.ecu.edu](mailto:stevense18@students.ecu.edu)

Angela Ciuca, DNAP, CRNA  
[ciucaa18@ecu.edu](mailto:ciucaa18@ecu.edu)

**Appendix K**  
**DNP Project Timeline**

*Timeline of DNP Project*

May-August 2020	Explored existing literature pertinent to topic
August-December 2020	Completed literature review, created cognitive aid
January 2020	Recorded video to introduce tool
April-May 2020	Implemented intervention, data collection
June 2020	Data analysis
November 2021	Public presentation and upload to digital repository

**Appendix L**  
**Summary of Results**

**Table L1**

<i>Summary of Pre-Intervention Survey Data</i>			
<b>Question</b>	<b>Total Number of Responses</b>	<b>Answer Choices</b>	<b>Responses Received</b>
Have you ever received education on perioperative fire prevention?	7	Yes	7
		No	--
Have you received continuing education on perioperative fire prevention?	7	Yes	4
		No	3
How confident are you in your knowledge about perioperative fire prevention?	7	(Very confident) 5	1
		4	4
		3	2
		2	--
		(Not at all confident) 1	--
Have you participated in a procedure where all the elements of the fire triad were present?	7	Yes	7
		No	--
Have you ever experienced a perioperative fire?	7	Yes	1
		No	6
How confident are you in your ability to identify a surgical procedure that has a high risk of fire?	7	(Very confident) 5	4
		4	3
		3	--
		2	--
		(Not at all confident) 1	--
Do you currently have perioperative fire prevention guidelines that you can quickly access while at work?	7	Yes	3
		No	4
If you had a question about perioperative fire prevention, approximately how long do you think it would take you to find reference material to answer the question?	7	1-3 minutes	2
		4-6 minutes	2
		7-9 minutes	3
		10 or more minutes	--
Would an easily accessible reference guide provide you support in decision making regarding high fire risk procedures?	7	Yes	7
		No	--

**Table L2**

<i>Summary of Post-Intervention Survey Data</i>			
<b>Question</b>	<b>Total Number of Responses</b>	<b>Answer Choices</b>	<b>Responses Received</b>
Approximately how many procedures did you participate in over the last two weeks that qualified as high-risk for fire?	6	0-2	2
		3-5	--
		6-8	--
		9 or more	4
What is your perception of the usefulness of this reference guide for an anesthesia department?	6	(Very useful) 5	2
		4	2
		3	1
		2	--
Was this reference guide easily accessible in the clinical setting?	6	(Not at all useful) 1	1
		Yes	4
Did you find this reference guide visually appealing?	6	No	2
		Yes	6
Did this reference guide save you time?	6	No	--
		Yes	2
If saved to your mobile phone or work computer, how long would it take you to access this reference guide?	6	No	4
		1-3 minutes	5
		4-6 minutes	--
		7-9 minutes	--
Do you think you will use this reference guide in your practice as a CRNA?	6	10 or more minutes	1
		Yes	3
After reviewing this reference material, how confident are you in your knowledge about perioperative fire prevention?	6	No	3
		(Very confident) 5	2
		4	3
		3	1
		2	--
Do you have any recommendations to improve this reference guide? (i.e. is something missing?)	6	(Not at all confident) 1	--
		Free response	Make it available in every OR. If it was in the OR I didn't see it
			No
			No