Effectiveness of a Multimedia Educational Module for Anesthesia Providers: Integrating Best Practices to Prevent Corneal Abrasion.

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Author Note

This paper is based on data from the DNP Project completed as partial fulfilment of the Doctor. of Nursing Practice degree with the guidance and supervision of the following:

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Abstract

Corneal abrasions (CAs) are the most common eye injury in patients undergoing general anesthesia for non-ocular surgery. Based on current literature, early initiation of ocular protection after induction and educating providers on corneal abrasion risk factors can reduce CA incidence. Simulation-based education is an effective and convenient educational platform to improve providers' knowledge on corneal abrasion and willingness to change clinical practice. This DNP project was aimed to improve providers' knowledge and willingness to implement evidence-based corneal abrasion prevention measures in clinical practice. By integrating existing evidence into the CTML framework, a robust simulation-based educational module was developed. Assessment of provider knowledge acquisition and willingness to incorporate evidence-based practices was measured using pre/post surveys. Data were obtained over two weeks. Survey analysis was completed using descriptive statistics, McNemar's test, odds ratio statistics, and standard t-test. The project was disseminated virtually at the Eastern Nursing Research Society's (ENRS) 33rd Annual Scientific Sessions conference and to Cedar Crest College students and faculty. Descriptive statistics were utilized for the collected data points. McNemar's test was employed to analyze individual knowledge-based questions. A standard t-test was used to evaluate the module's collective data and to evaluate the relationship between the pre- and post-implementation data. The project demonstrated clinical significance and positive impact on anesthesia professionals who participated in the project.

Keywords: corneal abrasion, educational module, anesthesia providers, knowledge, willingness

Title

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Population, Intervention, Comparison and Outcomes (PICO)

In anesthesia providers, does a multimedia simulation-based educational intervention increase knowledge about current best practice for patient safety, monitoring and administering medications in accordance with evidence-based practice guidance?

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Chapter One

Corneal abrasions are the most common eye complications during general anesthesia and are well reported in the literature. Although the incidence of corneal abrasion is relatively low, the probability of injury can be exceptionally high in the presence of specific patients and surgical risk factors (Malafa et al., 2015; Papp et al., 2019). With adequate protection, its prevalence ranges as low as 0% and up to 44% without evidence-based prophylactic measures (Grixti et al., 2013). In rare cases, deep corneal abrasions can lead to permanent damage or corneal scarring to the point where a corneal transplant is needed to restore vision (Morris et al., 2018). Corneal abrasion incidence continues to rise based on numerous anecdotal conversations with key stakeholders at the DNP student clinical sites and has been shown to increase the length of stay, anesthesia-related malpractice claims, ophthalmology consult, and decrease in patient satisfaction (Segal et al., 2014; Papp et al., 2019). To decrease corneal abrasion incidence, a simulation-based educational module was developed to increase providers' knowledge and willingness to implement evidence-based corneal abrasion preventive measures.

Background

The cornea acts as a mechanical barrier against trauma or chemical injury. Patients undergoing general anesthesia are prone to corneal abrasion due to loss of corneal protective reflexes, lagophthalmos (incomplete eyelid closure), decreased tear production, and loss of Bell’s phenomenon (failure of the eye globe to rotate upward during general anesthesia) (Nair & White, 2014). The absence of these protective components increases the cornea's susceptibility to chemical and direct injury. Chemical injury to the cornea usually occurs when the provider fails

to provide uniform closure during orogastric and nasogastric tube removals. (Malafa et al., 2015). According to Grixti et al. (2013), direct trauma has been cited as a principal offender. Carniculi et al., (2017) and Gandhi et al., (2016) found oxygen face masks, surgical drapes, dangling ID badges, and wristwatches during induction and intubation to be a significant hazard factor. In addition, prone and Trendelenburg position, eye goggles, and bio-occlusive dressings are contributing factors for corneal abrasions (Grixti et al., 2013; Martin et al., 2009). Injury to the cornea usually heals within 72 hours. However, during this time, patients experience extreme discomfort, pain, and blurry vision, which has been associated with decreased patient satisfaction and an increase in ophthalmology consult (Papp et al., 2019). As a result of these findings, many institutions are searching for various ways to improve providers' knowledge and compliance with evidence-based ocular protection while aiming for a zero corneal abrasion rate.

Significance

To reach the goal of a zero corneal abrasion rate and improve patient satisfaction, many hospitals have initiated a corneal abrasion prevention educational initiative. The Mayo Clinic and Hershey Medical Academic Center initiated educational intervention geared towards anesthesia providers with an emphasis on risk factors and evidence-based preventive measures (Ely et al., 2019; Martin et al., 2009). The educational initiatives were associated with a significant decrease in corneal injury. The original DNP student's project was designed to follow and adopt the same educational initiative. However, the COVID-19 pandemic interrupted the DNP student's ability to implement it in a clinical setting. E-learning is a novel methodology powered by technology and videos to translate evidence-based findings into viable clinical practice (Elkman, 2018). E-learning offers a unique opportunity to enhance knowledge and disseminate evidence-based corneal abrasion prevention practices to anesthesia providers, particularly in this unconventional

time (Rouleau et al., 2019). Most anesthesia providers are familiar with this approach and have expressed greater knowledge and satisfaction with the platform (Rouleau et al., 2019). Due to COVID-19 restrictions, and to ensure that best practices are continued even in this unprecedented time, four senior SRNAs worked together to develop a simulation-based educational module that integrates education on their original DNP projects. This method has the potential to optimize knowledge synthesis on the four DNP topics and the potential to increase the number of participants because it is not constrained by time or clinical site – thus representing true population-based intervention.

System and Population Impact

Corneal abrasions are frequent perioperative complications that cause severe discomfort, stress, pain, and blurry vision. These negative effects are frightening to both patients and anesthesia providers. Increased medical costs from ophthalmology consultations and treatment due to increased length of stay has been reported in the literature (Segal et al., 2014). The increased financial strain on various institutions has also been linked to anesthesia-related malpractice claims from corneal abrasions. Many institutions are currently implementing educational interventions to improve providers' knowledge and reduce patient dissatisfaction related to corneal abrasions. When anesthesia providers are educated and involved in eye care, prevention is optimized. Anesthesia providers can effectively eradicate perioperative corneal abrasion by simply imparting proven knowledge. It is anticipated that the knowledge that providers will acquire from the simulation-based educational module will ultimately reduce financial strain, liability, corneal abrasions, length of stay, and patient dissatisfaction.

Needs Assessment.

Anesthesia providers have an obligation to protect patients' eyes by utilizing best practices. The prevention of corneal abrasions falls on anesthesia providers. Therefore, a need assessment was conducted. A needs assessment is a systematic way of analyzing stakeholders' priorities and concerns (Lamb & Lamb, 2011). The needs assessment was conducted by direct observation of anesthesia providers at the DNP student's clinical site and anecdotal conversations with key stakeholders. The assessment revealed inconsistencies in the timing, and initiation of ocular protection varied among providers, contributing to the rise of corneal abrasions. Based on the literature review, there is a lack of systematic approach among anesthesia providers for protecting the eyes (Papp et al., 2019). These include when to initiate ocular protection, how to tape the eyes, and remove the tape (Segal et al., 2014). Some anesthesia providers are unaware of patient profiles and surgical procedures that increase the risk of developing corneal abrasions during induction (the transition from the normal awake state to the sleepy state), procedure, and emergence (the transition from the sleep state to full consciousness) (Malafa et al., 2014; Martin et al., 2009). Studies have shown that early initiation of ocular protection following induction and before mask ventilation substantially decreases corneal abrasions' incidence (Grixti et al., 2013; Papp et al., 2019). Implementing an educational initiative can lead to significant patient care improvement and may reduce the potential antecedents to corneal abrasion (Ely et al., 2019; Martin et al., 2009).

Problem Statement

Corneal abrasion has been documented in the literature since 1965 in patients undergoing general anesthesia. Although corneal abrasion incidence is low, it has been shown to increase the length of stay, anesthesia-related malpractice claims, ophthalmology consult, and patient

dissatisfaction. The four best practices on anesthesia patient safety topics identified by the DNP students include (1) prevention of ocular injury, (2) intraoperative multimodal opioid-sparing management with lidocaine infusions, (3) quantitative neuromuscular monitoring (QNM) for neuromuscular blocking agents (NMBAs), and (4) timing and doses of reversal agents. The DNP students created a group PICO question to investigate the research question: In anesthesia providers, does a multimedia simulation-based educational intervention increase knowledge about current best practices for patient safety, monitoring, and administering medications in accordance with evidence-based practice guidance?

Goals and Objectives

This project aims to increase providers' knowledge and willingness to implement evidence-based corneal abrasion preventive measures in clinical practice. The two goals will be addressed by providing education on risk factors and evidence-based corneal abrasion prevention measures. Improvements in these areas will be measured using pre-and post-tests to determine clinical significance and whether provider knowledge and willingness improved due to the simulation-based educational module.

Chapter Two

Literature Search Process

Thirteen databases were utilized for the literature including, PubMed, PubMed Central, Cumulative Index to Nursing and Allied Health Literature (CINAHL), EBSCO host, Oxford University Press, Ovid, SpringerLink, BioMed Central, ScienceDirect, Evidence-Based Medicine Reviews, Frontiers, Google Scholars, and Wiley. The keywords "corneal injuries," "non-ocular surgical patient," "corneal abrasion," "perioperative period," "general anesthesia," "corneal abrasion risk factors," "eye care algorithm," "lubricant," and "adhesive tape," were used and separated by the Boolean (OR, AND NOT) to broaden the search. The alternative words used were "eye care," "eyelid tape," "corneal laceration," "incidence of corneal abrasion," "intraoperative period," "bio-occlusive dressing," "eye care flowchart," "ointment," and "anesthesia."

The search criteria consisted of studies published between 2009 to 2019. The search yielded one systematic review, one clinical practice guideline, and 98 studies for review. Initially, high-level evidence from meta-analysis, systematic review, and randomized controlled trials that explored the relationships of "cause and effect" between different ocular protection were pursued. However, only one systematic review and one randomized controlled trial were found. Lower-level evidence such as prospective and retrospective studies were reviewed. Studies were excluded if they included patients with preexisting eye trauma and eye surgery. Furthermore, studies with contradictory findings with low-quality evidence were filtered out. Overall, six studies were relevant for critical appraisal.

Study Assessment and Strength

The included studies were conducted in the United States, except for the French society of Anesthesia clinical practice guidelines (SFAR et al., 2017) and the Systematic Review (Papp et al., 2019). Melnyk & Fineout-Overholt's (2018) rating system was employed to rate the strength of the evidence. Overall, the strengths of the evidence consisted of level I (Grixti, Sadri & Watt, 2013; Papp et al., 2019; SFAR et al., 2017), and level II studies (Carniculi et al., 2017; Ely et al., 2019; Gandhi et al., 2016). The included studies comprise randomized controlled studies, non-randomized controlled trials, prospective, retrospective studies, clinical practice guidelines, systematic reviews, and meta-analysis that employed various designs based on rigorous methodologies to address clinical outcomes (Melnyk & Fineout-Overholt, 2018).

Study Overview

Appendix A offers a summary of the findings, limitations, methodology, and quality of evidence. The included studies analyzed potential corneal abrasion risk factors, when to initiate ocular protection, and compared different ocular protective methods during general anesthesia. Below, the studies' results are summarized, synthesized, and compared based on trends, patterns, and gaps.

Adhesive Tape vs. Tegaderm

Incomplete lid closure during general anesthesia exposes the cornea, rendering it vulnerable to desiccation. Grixti et al. (2013) integrated review of various corneal abrasions preventive measures reported that lid taping and vigilance are the best protective method. Papp et al., (2019) and SFAR et al., (2017) concurred with these findings that eyelids should be secured by opposing the upper over the lower eyelid immediately after induction and before mask ventilation. Previous studies suggested that bio-occlusive (Tegaderm) dressings may be preferred

over the traditional adhesive tape. However, Tegaderm has been associated with adverse effects, especially during removal of the dressing; these include trauma to the eyelid, lashes, eyebrows, and cornea (Grixti et al., 2013; SFAR et al., 2017).

Preservative-free Ointments

Ointments and lubricants prevent desiccation but may promote corneal abrasion (Malafa et al., 2016). The use of ointments and lubricants may increase the incidence of corneal abrasions, especially during emergence from anesthesia, when the patient wakes up and attempts to rub the lubricant away. Blurry vision, eye irritation, and a sensation of having a foreign object in the eyes are associated with ointments. Grixti et al. (2013) and SFAR et al. (2017) concluded that ointment should be avoided unless necessitated in specific cases (facial burns, prone cases) that preclude taping the eyelids.

Risk Factors

Contributing risk factors to corneal abrasion have several different mechanisms, many of which can be prevented with intentional care. Papp et al. (2019), Carniculi et al. (2017), and Gandhi et al. (2016) found that oxygen face masks, surgical drapes, dangling ID badges during induction, and intubation to be significant risk factors. Prone and Trendelenburg position, and surgical instruments are also contributing factors (Grixti et al., 2013). Therefore, vigilance and meticulous attention are vital to reduce the potential antecedents to corneal abrasions.

Eye Goggle

Protective eye goggles are an alternative method and may be preferred in exceptional cases to protect the cornea against mechanical damage. However, goggles may be detrimental to patients undergoing general anesthesia and may augment the incidence of corneal abrasions. Grixti et al. (2013) emphasized that eye goggles might “become displaced and cause pressure on

the globe resulting in blindness" (P.116), especially during positioning and induction. Therefore, eye goggles are not as feasible as an alternative eye protection method for most surgical cases.

Educational Initiative

Educational initiatives for anesthesia providers can help increase knowledge of potential risk factors and decrease corneal abrasions' incidence (Papp et al., 2019; SFAR et al., 2017). Ely et al. (2019) evaluated the effectiveness of educational initiatives to decrease corneal abrasion incidence. The program was associated with a significant decrease in the incidence of perioperative corneal injury. Ely et al. (2019) concurred with Papp et al.'s (2019) systematic review of international studies that educational initiatives should be implemented to increase providers' knowledge and risk factors. The use of e-learning, such as simulation-based educational modules, has steadily increased among providers and offers a unique opportunity to deliver the educational initiative and enhance providers' knowledge (Rouleau et al., 2019). Simulation-based education may be vital in these unconventional times for disseminating evidence-based corneal abrasion prevention methods to anesthesia providers.

Study Limitations

During the literature review, few limitations were noted. The integrated review conducted by Grixti et al. (2013) included seminal studies. Most of the included studies were dated two decades ago, and generalizability may be limited. However, they are seminal studies that examined taping the eyes in relation to corneal abrasions and concluded that eyelids should be taped closed when the patient is undergoing general anesthesia. The systematic review of international studies by Papp et al. (2019) highlighted that the incidence of corneal abrasions is not uncommon, as demonstrated by studies from Turkey, the United States, and many more, which affirm the generalizability of the study results.

Evidence-based Summary

Based on the comprehensive literature review, meticulous vigilance and taping the eyelid horizontally provide the best ocular protection from chemical injury and trauma (Grixti et al., 2013; Papp et al., 2019; SFAR et al., 2017). Other protective methods such as eye goggles, ointments, bio-occlusive dressings have been associated with an increased incidence of corneal abrasions (Grixti et al., 2013; SFAR et al., 2017). Overall, the literature review accentuated that eyelid tape and meticulous vigilance are the best methods for ocular protection in patients undergoing general anesthesia.

Chapter Three

Conceptual Definitions of Theory and Framework

In a technology-driven era, the rapid advances in technology and accessibility enable the development of a broad range of instructional multimedia (Rudolph, 2017). Instructional designers, multimedia designers, and instructors are challenged with finding a balance between technology and multimedia that fosters meaningful learning (Mayer, 2005; Rudolph, 2017). The Cognitive Theory of Multimedia Learning (CTML) (Appendix B) is a theoretical framework that helps to create meaningful learning by structuring multimedia "in light of how the human mind works (Mayer, 2005)."

The three major assumptions of how the human mind works in CTML are: dual channels, limited capacity, and active processing (Mayer, 2005; Rudolph, 2017). Mayer (2005) noted that humans process information presented in dual channels as auditory/verbal channels and a visual/ pictorial channel. With this information, the learner integrates the new information into working memory (Rudolph, 2017). Since these channels' capacity is limited, learners are forced to allocate their cognitive resources to build connections between pieces of new information and existing knowledge (Mayer, 2005). Active processing involves selecting, organizing, and incorporating information with previous experience and filtering extraneous details not relevant to core materials presented. Through active processing, people learn and convey information more efficiently from a combination of words, animations, audio, and pictures than words alone (Mayer, 2005; Rudolph, 2017).

To build an effective multimedia module, it is essential to balance the visual and verbal information to engage the learner and minimize extraneous distractions (Rudolph, 2017). The presented material should have a coherent structure and reflect guidance for the learner on

building the structure (Mayer, 2005). Learning outcomes can be measured through retention, recall of information presented, and the ability to understand the information presented to solve new problems (Mayer, 2005). The combination of words and images forms the theoretical basis for CTML because it captures the learners' interest, engages memory, prevents cognitive overload, and stimulates reflection (Rudolph, 2017). The goal of CTML is to demonstrate how sounds, animation, words, and pictures contribute to a meaningful learning experience.

Framework to Scholarly Project

The DNP project incorporated the principles of CTML into the design of the multimedia educational module and outcome assessment. The content was delivered in a format that encompassed the dual-channel processing system of the human mind by combining animation, sounds, images, and words (multimedia principles) to reduce cognitive loads and to make the four evidence-based topics presented understandable to anesthesia providers. The educational module was designed to capture anesthesia providers' attention focused on the four topics and engage them in cognitive processing while integrating it with prior knowledge activated from long-term memory.

The presentation incorporated the fundamental principles of effective instructional multimedia elements, such as (1) redundancy, (2) signaling, (3) segmentation, (4) animation vs. static images, (5) control, (6) interactivity, and (7) engagement/feedback (Rudolph, 2017). The information was succinctly presented to avoid redundancy and was segmented into individual patient safety topics. Signaling was used to highlight key points to help facilitate the learner's allocation of cognitive resources. Patient safety points were animated to facilitate a mental representation of the content (Rudolph, 2017). The control element was incorporated by allowing the viewer to go back, pause, and advance to the next topic at their own pace. Participants were

also asked to answer questions related to key points and advance to the next topic to incorporate the elements of interactivity and engagement. The integration of content into a patient scenario was used to help the learner build a coherent example of topics that would be experienced within clinical practice. The outcomes assessment was employed to evaluate the learner's retention and transfer of information presented in the module to demonstrate the effectiveness of a multimedia educational module on best practices of anesthesia patient safety.

With recent studies showing cohesive moderate-to-large-effect sizes, each of these principles has been shown to have a significant impact on knowledge and willingness to adopt evidence-based findings (Muhammad, 2018; Unk & Brasington, 2014). Because of its foundation in fostering meaningful learning, CTML principles were employed as a heuristic guide for the simulation-based education module.

Chapter Four

Project Design

Using CTML principles as a heuristic guide, the project aims to facilitate knowledge transfer and improve providers' knowledge and willingness to change their clinical practice. To help with the design, WIX (website builder) and Davinci-Resolve 16 (film editor) were employed to develop the project. Two CRNA experts validated the module for educational content, format, and accuracy before disseminating the content to the participants. The participants were required to take the pre-test before viewing the module to assess current knowledge. The module consists of each DNP student's brief introduction, accompanied by individual presentations and the simulation module. A recap of the main points was provided before taking the post-test.

Implementation Plan

An evidence-based approach enables healthcare professionals to close the gap between basic research and its translation into clinical practice to optimize patient outcomes. Without translational research, existing practice becomes obsolete and may impact patient outcomes. The purpose of this chapter is to provide an overview of the implementation plan, which is broken down into four phases: (1) creating awareness and interest, (2) building knowledge and commitment, (3) promoting action and adoption, and (4) pursuing integration and sustained use (Iowa Model Collaboration, 2017; Cullen et al., 2018).

Creating Awareness and Interest

Creating awareness and interest is also known as the pre-planning phase because it involves cultivating a spirit of inquiry, identifying clinical problems/conducting a needs assessment, and collecting and/or appraising the best evidence that supports a practice change.

These three subphases were operationalized pre-COVID-19 within each DNP student's clinical site. The need assessment was conducted by direct observation of anesthesia providers at the DNP students' clinical site and anecdotal conversations with key stakeholders. To overcome barriers in implementing the practice change, the principal investigators employed change agents and champions to spread the word about the EBP's advantages and its impact on healthcare. Utilizing this strategy helped highlight the institution's unique culture and impetus for change amongst stakeholders, organizational leaders, and clinicians (Cullen et al., 2018). The use of journal clubs, attendance to quality improvement (QI) meetings, and placement of existing EBP's within the break rooms helped raise awareness and a sense of personal responsibility to bring about change. Lastly, the investigation into utilizing knowledge brokers (Chief anesthesiologists and Chief CRNAs) at each clinical site helped highlight the institution's support for EBPs, available resources, institutional barriers, and the necessary partnerships required to bring about a sustainable institutional change.

Building Knowledge and Personal Commitment

After the awareness and interest phase has been established, the second phase of implementation began. Building knowledge and personal commitment were orchestrated via teamwork after a gap analysis was conducted, and an action plan was developed. In this phase, education was delivered via a multimedia simulation-based module and dissemination of credible evidence with a clear implication for clinical practice. The educational module was designed to obtain clinician input and inform today's clinicians on contemporaneous EBP recommendations that are not implemented within the DNP students' clinical setting. Since the clinical problem and needs assessment was conducted at the DNP students' primary clinical site, it was concluded that anesthesia providers at each of these institutions should be invited to

participate in the module. Adopting this approach helps secure buy-in, stimulates their commitment, promotes action and adoption, and provides an essential foundation for optimizing knowledge synthesis on four different EBP's.

Promoting Action and Adoption

After building knowledge and personal commitment, the third phase of implementation (promoting action and adoption) began. Given this research's project design, it is limited by the number of interventions that can be operationalized to promote action and adoption within the clinical setting without developing a protocol or purchasing equipment. However, it is imperative to adopt implementation strategies that promote the adoption of the EBP project. Within the clinical setting, reminders (visual aids) and practice prompts (one to one educational session with anesthesia providers) were implemented to encourage clinicians to adopt the presented EBP's. Implementation strategies adopted to promote action and adoption include DNP students functioning as role models at various clinical sites, advocating for practice change, reporting updates on the study findings, and emailing educational handouts to providers. These strategies created awareness, promoted adoption, enthusiasm, and garnered support for the practice change (Melnyk, & Fineout-Overholt, 2018).

Pursuing Integration and Sustained Use

The final phase of the implementation processes and procedures includes pursuing integration and harnessing the sustained use of EBPs. To promote the sustained integration of practice change, the post-test survey included questions related to the participant's willingness to change their clinical practices and provided feedback related to the educational intervention. The principal investigators also served as peer influencers and transformational leaders throughout the project's development to deter providers from non-evidence-based practices. To promote

integration and sustained use, educational handouts were placed in the staff lounge and locker rooms to facilitate compliance and continued forward momentum. Furthermore, the project result and findings were not only disseminated within the proposed institutions, but they were also disseminated to a wider audience via the Eastern Nursing Research Society virtual conference in order to support the growth of EBP culture, serve as a breeding ground for innovation, and enhance nursing knowledge.

Data Collection Tool

Convenience sample was employed, and data were collected using a pre/post-test method. The tool was appropriate to assess how the educational module influences participant learning (Polit & Beck, 2017). Due to its ease of accessibility, inexpensiveness, and ability to reach a broad audience, a 10-question pretest and post-test survey was developed using SurveyMonkey©. Melnyk and Fineout-Overholt's (2018) principles for instrument development were followed to develop the questionnaire and the content were evaluated by expert. The DNP team thoroughly reviewed the survey test to ensure that it was clear, and comprehensible. The DNP team concluded that the pre/post-test measures what it purported to measure. In addition, the questioned were formatted either dichotomously or in a multiple-choice format, and the director of the DNP program and Institutional Review Board (IRB) gave approval for its use for the project.

Resources and Budget Justification

To operationalize this DNP project, a multitude of resources was required. First and foremost, The Cedar Crest College (CCC) simulation center was designed to replicate the operating room environment. Prudent consideration was given to room configuration, including bed orientation, placement of high-fidelity mannequin, anesthesia machine, quantitative monitor,

bedside monitors, and the mayo stand. In a joint effort with the DNP team, the DNP student worked through these nuances meticulously to maximize the simulation's fidelity. Secondly, CCC's simulation IQ technology was used to film and acquire different camera angles. A handheld Canon VIXIA HF R5000 camcorder was required to get different viewpoints and highlight aspects of the simulation. Lastly, to simulate the QNM technique, collaboration with the Blink Device Company® was needed to acquire the TwitchView™ EMG-based monitor.

Personal expenses of shipping and handling from the state of Washington were required. Other financial resources included a membership to the WIX® website builder and Davinci Resolve® software to edit the film. Fortunately, most of the resources were provided by CCC, free of charge, personally owned, and if expenses were incurred, they were split between the group members to minimize any individual out-of-pocket costs.

Chapter Five

Implementation Procedures and Processes

This project's implementation took place via email recruitment (See Appendix C) of prospective and voluntary anesthesia professionals (i.e., MDA, CRNA, SRNA) from established clinical sites and a peer-network of professional contacts. The recruitment email contained a transmittal heading of "Evidence-Based Practices of Anesthesia Patient Safety." It consisted of a brief description of the project and instructions for participation, informed consent to participate in the project, instructions to complete the pre/post-surveys via SurveyMonkey© (See Appendix D), link to the educational module website, and contact information of the authors. Participants were notified that their participation in the project was anonymous. The educational module website was available to participants for a one-month period. Participants had the option to decline participation in the project until the final submission of the post-test survey.

The educational module was delivered in an online on-demand format with an estimated completion time of one hour. The module consisted of an introduction, four 10-minute EBP presentations on each anesthesia patient safety topic, a 12-minute-high fidelity simulation scenario, and a conclusion. Participants were instructed to view each of the four EBP topics prior to viewing the simulation. Materials for each topic were available for download from the educational module website to supplement the module's content and future reference.

After completion of the educational module, participants were instructed to complete the post-survey. Data collected from the pre/post-surveys were tracked via SurveyMonkey©. Statistical Package for the Social Sciences (SPSS) v.25 was used to further analyze the data and acquire statistics. A descriptive statistic was used to measure the change in knowledge by

comparing each participant's pre-survey and post-survey. Based on the methodology of the project, a paired t-test was utilized to analyze the data.

Chapter Six

The DNP project had an implementation period that traversed over two weeks (January 23, 2021, to February 5, 2021). This provided a unique opportunity for the principal investigator to acquire more data. During these two weeks, participants had ample time to view the educational module and answer the pre/post survey questions. While contact details for the principal investigators were listed in the recruiting e-mail and project webpage, no questions or complaints were posed by participants at any point during the implementation phase.

Demographics

The recruitment e-mail was sent to 40 anesthesia providers. Out of the 40 providers invited, 24 providers (60%) were full participants in the project. In the pre-test, two demographic-based questions gathered a basic understanding of the participating anesthesia provider's role and their years of experience. Four (16.67%) out of the 24 participants were MDAs, eight (33.33%) were CRNAs, and 12 (50%) were SRNAs (See Appendix E). The pre-survey results also revealed that 16 (66.67%) participants had an average experience of 0-5 years, five (20.83%) had 6-10 years of experience, and three (12.50%) had 11-15 years of anesthesia experience in the anesthesia field (Appendix F).

Evaluation and Outcome

The DNP project's overall goal was to increase providers' knowledge of corneal abrasions and willingness to change clinical practice through a simulation-based educational intervention. Two outcomes were measured: 1) increase in knowledge on prevention of corneal abrasion and; 2) willingness to adhere to best practice based on the evidence provided in the module.

In order to gather a general understanding of individual clinician knowledge on evidence-based corneal protective methods and corneal risk factors, the pre-test included two questions:

"Do you implement eye protection to patient's corneas' prior to or post mask ventilation and/or laryngoscopy" and “Which of the following is not a risk factor for corneal abrasions?” To examine willingness to adhere to the evidence presented in the module, another question on the post-survey asked, "Are you willing to change your practice based on the information you were presented about corneal abrasion prevention?". This question determined the anesthesia providers' ability to integrate the evidence into their daily practice.

Knowledge

The first knowledge question was: "Do you implement eye protection to patient's corneas' prior to or post mask ventilation and/or laryngoscopy?" On the pre-test, 15 (62.5%) participants answered the question incorrectly, while nine (37.5%) answered the question correctly. On the posttest, the participants were asked, "Based on the simulation, when is the best time to initiate eye protection?" Two (8.3%) participants answered the question incorrectly, and 22 (91.67%) answered correctly After conducting a descriptive and McNemar analysis, statistically significant difference can be found between the pretest ($n = 24$, $x = 0.6250$, $\sigma = 0.49454$, $p = 0.307$) and posttest ($n = 24$, $x = 0.9167$, $\sigma = 0.28233$, $p < 0.001$). (See Appendix G).

The second knowledge-based question asked: “Which of the following is not a risk factor for corneal abrasions?” On the pretest, eight (33.3%) participants answered the question incorrectly, while 16 (66.7%) answered the question correctly. On the posttest, two (8.3%) participants answered the question incorrectly and 22 (91.67%) answered correctly. After conducting a descriptive and McNemar test analysis, a statistically significant difference can be found between the pretest ($n = 24$, $x = 0.6667$, $\sigma = 0.48154$, $p = 0.152$) and posttest ($n = 24$, $x = 0.9583$, $\sigma = 0.20412$, $p < 0.001$) (See Appendix H).

To achieve a deeper understanding of the DNP results, statistical inferences were conducted on all knowledge-based questions to assess the module's efficacy. A total of 6 questions were determined to be knowledge-based questions from the combined modules of anesthesia patient safety: corneal abrasion prevention, timing and dosing of reversal agents, quantitative neuromuscular monitoring, and intraoperative lidocaine infusions. There was a total of 90 (62.5%) correct answers and 54 (37.5%) incorrect answers on the pre-survey. There was a total of 128 (88.9%) correct answers and 16 (11.1%) incorrect answers on the post-survey. Odds ratios were computed to determine relative risk estimates. The odds ratio is usually employed when one or two possible outcomes are evaluated in response to intervention (Hart & Little, 2017). It is the ratio of the odds of success to the odds of failure. After the intervention, there was a 4.8-fold (380%) increase in odds of answering the questions correctly per participants during the post-test compared to the pre-test questions (odds ratio = 4.8; 95% confidence interval = 2.583 to 8.919). This means that the quadruple increase in odds of answering the question correctly after watching the module increased providers' knowledge of anesthesia patient safety topics.

Willingness

Based on the pre-test results extrapolated from SPSSS, nine (37.5%) were already adhering to the best practice methods to prevent corneal abrasion. Interestingly, following the educational module's completion, the willingness rate to adhere to best practices presented in the post-survey educational module was 100 percent (Appendix J). This data proves that educating anesthesia providers on current best practice methods is vital in preventing corneal abrasion.

Discussion

Corneal abrasion is a severe and unpleasant harmful occurrence for surgical patient, both from a patient's standpoint and from a medical-legal point of view. The use of e-learning, such as simulation-based educational modules, has steadily increased among providers and offers a unique opportunity to deliver educational initiatives and enhance knowledge (Rouleau et al., 2019). Studies have shown that implementing an educational initiative can significantly improve patient care (Martin et al., 2008). The average mean scores on each posttest knowledge question were higher than the pre-test's average mean scores (Appendix G). The significant change in test scores confirmed that anesthesia providers' knowledge on cornea abrasion increased after participating in the educational module.

The average score of correct answers on the pre-survey knowledge-based questions for all anesthesia patient safety topics was 62.5% when looking at the comprehensive data. On the post-survey, the average score of correct answers was 88.9% for all knowledge-based questions. One hundred percent (100%) of participants reported a willingness to institute a practice change for all the patient safety topics. This was also indicative that the module successfully provided education and instituted practice changes for the combined anesthesia patient safety topics.

SPSS v.17 provided inferential analysis or statistically significant ($p < 0.001.$) results, which imply a chance of 5% that the result was not caused by a probability and a 95% certainty that there exists an actual relationship between the variables analyzed in the project. Although the project yielded statistically significant results, this project's intent was not to prove statistical significance but rather to prove the clinical significance and to be able to change current practice based on the best available evidence. Clinical significance was possible with the conclusion from

the data that providers were able to increase knowledge and exhibited a willingness to make a practice change.

Furthermore, the participant pool was diverse and broad across various hospitals and specialties. The participant pool's makeup (MDAs, CRNAs, and SRNAs) allowed for diverse representation of anesthesia providers. This project's outcome has shown that when anesthesia providers are provided with the most up-to-date evidence, providers are willing to adhere to evidence-based practice. When anesthesia providers are educated and utilized evidence-based corneal prevention methods, prevention is optimized. Therefore, providers can effectively eradicate perioperative corneal abrasion by simply imparting proven knowledge (Martin et al., 2008). The knowledge that providers acquired from the simulation-based educational module will ultimately reduce financial strain, liability, corneal abrasions, length of stay, and patient dissatisfaction. Clinical significance is crucial within anesthesia and healthcare since evidence-based recommendations can be inferred to increase positive patient outcomes (Polit & Beck, 2017). This project demonstrated a clinical significance and positive impact on anesthesia professionals who participated in the project.

Chapter Seven

Implication for Practice

The Institute of Medicine (IOM) set a goal that by 2020, 90% of all clinical decisions must be supported by accurate and timely evidence-based research (Lehane et al., 2019). E-learning is an efficient way of translating evidence-based practice (EBP) findings into current viable practice (Elkman, 2018). Healthcare providers are pleased with virtual learning and find it an effective means of education (Rouleau et al., 2019). The DNP project's primary aim was to (a) improve anesthesia providers' knowledge on perioperative corneal abrasion and (b) create a willingness to change providers' clinical practice based on EBP recommendations. The project findings suggested that providers are willing to change practice when anesthesia providers are provided with current evidence-based recommendations. Knowledge acquired from the educational module may reduce the incidence of corneal abrasion, patient dissatisfaction, ophthalmology consult, length of stay, and anesthesia-malpractice claims.

Strengths of the Project

The first strength of this project was the convenience and accessibility of the simulation-based education module. During the COVID-19 pandemic, providers faced incredible stress and busy schedules. Face-to-face learning was limited, restricted, or impossible. The simulation-based educational module provided an alternative avenue to educate anesthesia providers during this unprecedented time. Another major strength of the project was the catering of different learning preferences. All learners acquire knowledge in different ways. The WIX website provided verbal instruction, a realistic simulation scenario, and a one-page summary of anesthesia patient safety topics. The WIX website also allows for topic information to be stored and disseminated to providers in the future. Since anesthesia patient safety is important, it is

crucial to reach anesthesia providers of all types and experience. The DNP project was able to reach a diverse group of anesthesia providers. Every provider (anesthesiologist, CRNA, and SRNA) and experience level (0 – 15 years) participated in the educational module. The module created a robust platform that instilled a practice change for all providers and levels of experience.

Limitations

The small sample size and the use of convenience sampling method were the two main drawbacks of the project. Since the module was virtual and recorded, participants were unable to ask questions in real-time. Although none of the DNP authors were contacted about questions at any time, participants may have failed to ask questions or raise concerns due to lack of convenience or inaccessibility of the authors. Questions might have been more likely if the instruction was held in-person and authors were readily available. Finally, the implementation period was conducted over a two-week period, resulting in a smaller sample size. The study's findings are constrained in their potential to be generalized due to the study's small sample size, short timeframe for data collection, and the project methodology.

Linkage to DNP Essentials

The American Association of Critical-Care Nurses (AACN) (2006) emphasizes the critical role Advanced nurse practitioners (APN) have in ensuring that patients achieve the highest quality of care. Since APNs are critical in ensuring the highest quality of care, this led to the creation of the “Eight core DNP competencies.” The project used these essentials as a backbone throughout the planning, implementation, and evaluation phase.

Essential I: Scientific underpinnings for practice are the framework for progressing nursing research and improving nursing services to patients (AACN, 2006). Taping the eyelids

horizontally after induction and before mask ventilation is well acknowledged in the literature. However, significant gap in knowledge still exists among anesthesia providers. DNP-prepared nurses can help close the gap between evidence-based knowledge and application in care delivery. Based on current literature, adopting clinically sound evidence is paramount in eradicating corneal abrasion incidence. This project aimed to improve anesthesia providers' knowledge to minimize corneal abrasion during surgery.

***Essential II*:** Organizational and systems leadership for quality improvement and systems thinking drives clinical performance and promote patient welfare (AACN, 2006). The DNP project offered an opportunity to highlight the best corneal abrasion prevention practices for surgical patients. Equipped with the knowledge gathered from the simulation-based educational module, providers will be better prepared to prevent a costly adverse event. Healthcare organizations can assist anesthesia providers with resources to engage in continuing education, research, or policy meetings regarding corneal abrasion prevention. This may influence institutional reform and system-wide practices to decrease the incidence of corneal abrasion.

Essential III: Clinical scholarship and analytical methods for EBP are the cornerstones of doctoral education. It involves translating research into practice and disseminating new knowledge to drive practice change (AACN, 2006). The systematic analysis of the literature in this DNP project satisfies this core competence.

Essential IV: Information systems/technology and patient care technology for the Improvement and Transformation of Health Care. The design and implementation phase of the project was based on several innovations which includes simulation IQ, WIX platform. Simulation IQ was employed to develop the module. The WIX platform was utilized to house the

project and extract data. Finally, the project was disseminated virtually to support the growth of EBP culture, expand nursing knowledge, and encourage EBP changes.

***Essential V*:** Healthcare policy for advocacy in healthcare creates a framework that can impact patient care or clinical practice in several ways (AACN, 2006). DNP nurses are key players in formulating and influencing policy at all levels, including institutional, local, state, regional, and federal. To date, AANA has not yet developed recommendations for eye care of patients undergoing general anesthesia. A nation-wide standardization of eye care based on current evidence by the AANA would be of considerable benefit to patients. The knowledge that providers garnered from this project may create a movement towards increasing positive patient outcomes.

***Essential VI*:** Interprofessional collaboration for improving patient and population health outcomes relies on several providers' efforts from multiple disciplines. DNP-prepared nurses play a "central role in establishing interprofessional teams, participating in the work of the team, and assuming leadership of the team when appropriate (AACN, 2006, P. 14)." Successful prevention of corneal abrasion in the perioperative environment requires the collaboration of CRNAs, Anesthesiologists, and SRNAs. This project was able to educate anesthesia providers on the importance of evidence-based eye protective measures.

***Essential VII*:** Clinical prevention and population health are essential for ensuring patients' welfare. DNP-prepared nurses must demonstrate leadership in integrating evidence-based clinical prevention programs for patients and communities (AACN, 2006). An increase in anesthesia providers' knowledge and willingness to adopt evidence-based practice recommendations would lower the incidence of corneal abrasion, improve public welfare, and boost patient satisfaction.

***Essential VIII*:** Advanced nursing practice is a distinct specialty that requires expertise, advanced knowledge, and mastery in one area of nursing practice. Demonstrating advanced clinical judgment and evaluating therapeutic interventions to improve patient care based on science are core competencies that were demonstrated throughout the project.

Chapter Eight: Summary of the Project

Corneal abrasions (CAs) are the most common visual pathway injury in patients undergoing general anesthesia for non-ocular surgery. Injury to the cornea usually heals within 72 hours. However, during this time, patients experience extreme discomfort, pain, and blurry vision, which has been associated with increase length of stay (Papp et al., 2019). In rare cases, deep corneal abrasions can lead to permanent damage or corneal scarring to the point where a corneal transplant is needed to restore vision (Morris et al., 2018).

As a result of these findings, many institutions are searching for various ways to decrease corneal abrasion. Studies have shown that improving the understanding or reiterating the importance of evidence-based perioperative corneal abrasion prevention practices can reduce the likelihood of corneal injury. Based on current literature, early initiation of ocular protection after induction and educating providers on corneal abrasion risk factors can reduce CA incidence (Grixti et al., 2013; Papp et al., 2019; SFAR et al., 2017). The use of e-learning, such as simulation-based educational modules, has steadily increased among providers and offers a unique opportunity to deliver the educational initiative and enhance providers' knowledge (Rouleau et al., 2019). Simulation-based education is an effective and convenient educational platform to improve providers' knowledge of corneal abrasion and willingness to change clinical practice.

The purpose of this DNP project was aimed to improve providers' knowledge and willingness to implement evidence-based corneal abrasion prevention measures in clinical practice. By integrating existing evidence into the CTML framework, a simulation-based educational module was developed. The CTML framework was used as a heuristic guide to design the module to capture learners' interest and foster new knowledge. This project's goals

were met by demonstrating an increase in knowledge, as evidence by improvement in knowledge-based post-test survey scores and a willingness to implement the knowledge in future practice. The project demonstrated clinical significance based on the 100 percent willingness rate and fourfold increase in odds of answering the questions correctly after watching the module.

Dissemination Plans

This project was presented as a virtual poster at the Eastern Nursing Research Society's (ENRS) 33rd Annual Scientific Sessions conference in March 2021. Presenting at this conference provided an opportunity to disseminate to a broad audience across the eastern United States. This proposal was also disseminated virtually to students and faculty at Cedar Crest College in April 2021.

Future Ideas

It is essential to stay current with current evidence-based practices. Continued education is warranted as the benefits of reduced corneal abrasions, including improved patient comfort, patient satisfaction, and reduced cost to the patient, outweigh the risks. Therefore, a future project idea would be to incorporate continuing education credits to providers for reviewing the educational module. Institutions should be encouraged to implement protocols to standardize intraoperative eye care to reduce corneal abrasions. The initiation of a corneal abrasion prevention protocol that can be used throughout the perioperative period, including PACU would be beneficial. This may improve providers' compliance, patient outcomes and decrease the length of stay.

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Appendix A: Evidence Summary

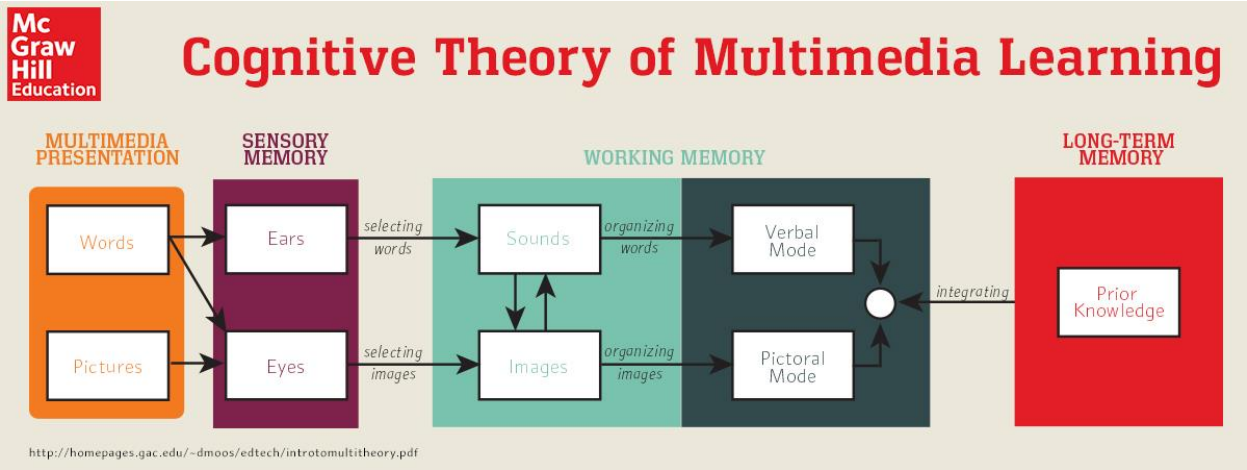
PICO Question: "In anesthesia providers, does a multimedia simulation-based educational intervention increase knowledge about current best practices for patient safety, monitoring, and administering medications in accordance with evidence-based practice guidance?"								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
French Society for Anesthesia and Intensive Care (SFAR), French Ophthalmology Society (SFO), French-speaking Intensive Care Society (SRLF), Keita, H., Devys, J.M., Ripart, J.3., Frost, M., Cochereau, I., Boutin, F., Guérin, C., Fletcher, D., & Compère, V. (2017). *Elsevier*	To provide clinical practice guidelines for Ocular Management During General Anesthesia.	**Sample** Ten studies **Setting** Conducted by the French Society for Anesthesia.	**Design** Meta-Analysis **Instrument:** Delphi and GRADE Grid method	**Measures:** Efficacy of various methods of eye protection **Outcome:** Incidence of corneal injuries	When compared to other methods, Systematic eyelid occlusion using adhesive strips alone was recommended as the ciliary reflex is lost and before tracheal intubation. The development of a prevention protocol and educational program was recommended to decrease the incidence of corneal abrasion.	Lack of recent studies.	**I**	High (A)
Papp, A.M., Justin, G.A., Vernau, C.T., Aden, J.K., Fitzgerald, B.M., Kraus, G.P & Legault, G.L. (2019). Perioperative corneal abrasions after	To perform a systematic review of international literature evaluating the risk factors, preventive steps, and treatments for perioperative corneal injuries for non-ocular surgery.	**Sample** 16 studies. **Setting** Consist of multiple international studies. The review studies consist of epidemiological and trials.	**Design** A Systematic Review and meta-analysis. **Instruments** 2011 Oxford center for EBM levels of evidence. Random effect modeling. Preferred reporting items for systematic review and meta-analysis protocols.	**Independent variable**: Non-ocular surgeries Educational interventions **Dependent variable**:	Eyelid taping or Tegaderm/bio-occlusive dressing were found to be superior in reducing the rates of abrasions. Educational interventions alone, as studied in 2 of the 16 articles, demonstrated a significant decrease in the rate of corneal abrasion.	Lack of consistently reported sample sizes, variable forms of reported corneal abrasion rates, inconsistently reported patient demographics, and limited clinical trial data.	I	High (A)

PICO Question: "In anesthesia providers, does a multimedia simulation-based educational intervention increase knowledge about current best practices for patient safety, monitoring, and administering medications in accordance with evidence-based practice guidance?"								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
non-ocular surgery: A systematic review. *Cornea.*				Incidence of corneal abrasion	The Systematic Review recommended standardized ocular protection, reporting, and education should be implemented among hospitals and medical treatment faculties.			
Grixti, A., Sadri, M., & Watts, M.T. (2013). Corneal protection during general anesthesia for non-ocular surgery. *The Ocular Surface*	To identify the best method of preventing corneal abrasion during GA.	**Sample** An integrated review of eight RCTs and one historical controlled study. The sample sizes varied across studies. **Settings** The studies include RCTs and one historical controlled study.	**Design** Systematic Review. **Instruments**: N/A. **Methods of data collection:** Literature review (CINAHL, MEDLINE, & EMBASE).	**Independent variable:** Methods of ocular surface protection. **Dependent variable:** Incidence of corneal abrasions.	Vertical lid taping is not helpful because the lids may open. Concluded that lid taping is the single best protective measures. The bio-occlusive dressing is recommended for head & neck, prone cases, and prolonged procedures. However, trauma to the eyelid, lashes, or cornea may occur during the application or removal of the bio-occlusive dressing. Eye-Goggles provides extra protection against mechanical trauma and is more effective in facial burn patients that preclude eyelid tape. However, it may be displaced accidentally and may cause pressure on the eye resulting in blindness.	Various methods of ocular protection were implemented, causing heterogeneity (study to study variation) and the inability to perform a meta-analysis of the results.	I	High (A)
Gandhi, S.J., Zavala, A., Williams, U., Van Meter, A., & Hsu, P., (2016). A retrospective review of corneal	To determine the incidence of known and hypothetical risk factors for corneal abrasion in a cohort of cancer patients who had developed corneal abrasion after oncologic surgery.	**Sample** The authors retrospectively queried the chart of cancer patients. The total participants consist of 19 patients. **Settings**	**Design** Retrospective chart review. **Instruments** Descriptive summary statistics. **Methods of Data Collection:**	**Independent Variable:** Non-ocular cancer patients. **Dependent variable:** Corneal abrasion.	Several independent risk factors were noted to increase the incidence of corneal abrasion. This includes the use of preoperative chemotherapy, selected comorbidities, ophthalmic-lubricant, and postoperative supplemental oxygen.	The use of retrospective data, small sample size and lack of rigorous statistical analysis.	III	Good (B)

PICO Question: "In anesthesia providers, does a multimedia simulation-based educational intervention increase knowledge about current best practices for patient safety, monitoring, and administering medications in accordance with evidence-based practice guidance?"								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
abrasions after oncologic surgery in a tertiary cancer center *Int J Anesthetic Anesthesiol*		single medical center.	Electronic medical records Automated electronic notification system, electronic medical record.					
Carniculi, A. L., Fazzari, M. J., Tabibian, P., Batta, P., Gentile, R. C., Grendell, J.H., Brathwaite, C.E., & Barzideh, N. (2017). Corneal abrasion following anesthesia for non-ocular surgical procedures: A case-controlled study. *The Association for Perioperative Practice.*	To identify risk factors associated with perioperative corneal abrasion.	**Sample:** 138 patients. **Settings:** Single hospital in Mineola, New York between June 2011 and November 2013.	**Design** Retrospective chart review. **Instruments** Age-stratified logistic regression model, multivariate models. **Methods of Data Collection:** Electronic medical records review.	**Independent variable:** Non-ocular surgery. **Dependent variable:** Corneal abrasion gender Pre-existing ocular injuries, diabetes.	Corneal abrasions were associated with longer procedures. Pre-existing ocular disease was strongly associated with a corneal abrasion.	Small sample size. Single hospital.	III	Good (B)
Ely, A. L., Goerlitz-Jessen, M., Scott, I.U., Lehman, E., Ali, T., Kerchner, D. & Liang, D. (2019).	To evaluates the effectiveness of an ophthalmology resident-led quality improvement (QI) initiative to decrease the incidence	**Sample:** 19,736 were included in the study. **Settings:**	**Design** Retrospective chart review. **Instruments** Logistic regression model.	**Independent variable:** Ocular surgeries. **Dependent variable:**	The educational initiative to anesthesia providers was associated with a significant decrease in the incidence of perioperative corneal injury.	Retrospective study.	III	Good (B)

PICO Question: "In anesthesia providers, does a multimedia simulation-based educational intervention increase knowledge about current best practices for patient safety, monitoring, and administering medications in accordance with evidence-based practice guidance?"								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
An Ophthalmology Resident-Led Quality Improvement Initiative to Decrease the Incidence of Perioperative Corneal Injury *Journal of Academic Ophthalmology*.	of perioperative corneal injury.	A retrospective chart review was conducted of all surgical cases performed six months prior to, and six months after, implementation of an ophthalmology resident-led QI initiative at Penn State Health Milton S. Hershey.	**Methods of Data Collection:** Electronic health records.	Corneal abrasion incidence rate.				

Appendix B: Theoretical Framework



Appendix C: Recruitment Email

Dear Participant,

On behalf of the Cedar Crest College: School of Nursing and Nurse Anesthesia Program, we are cordially inviting you to participate in a doctoral project proposed by four student registered nurse anesthetists. Unfortunately, our project was transitioned from a clinical setting-based implementation to a virtual platform due to today's unprecedented times amidst the COVID-19 pandemic. We ask that you participate in our project to help continuously advocate for implementing evidence-based practice into the clinical setting to improve upon anesthesia patient safety practices.

If you choose to participate voluntarily, you can follow the link below to our project's custom website. Here, there will be a simple 3-step process to follow for participation. **Step 1** will consist of a brief 10-question pre-survey. After completing the pre-survey, **Step 2** will be to watch our educational module on best practices of anesthesia patient safety. This module consists of four individual topic presentations that are approximately 10 minutes each. After the presentation segment, a robust simulation scenario will be performed. The entire duration of the module is approximately 1 hour. After viewing the module, you can proceed to **Step 3** of participation. Here, a 10-question post-survey will be administered to help us gather pertinent data on this doctoral project. Although this is 100% voluntary, completion and submission of the online survey is an indication of your consent to participate within the project. You can stop participation at any time up until submission of the post-survey during Step 3.

Institutional review board (IRB) approval was obtained prior to the project's implementation. Each DNP student author from the module completed Collaborative Institutional Training Initiative (CITI) training. It is anticipated that participants will be at no physical, psychological, or emotional risk at any time during this research. We assure you that all survey data is anonymous and will be collected and stored on an encrypted and password-protected electronic device.

Your participation is crucial to the implementation of this project and would be greatly appreciated! Provided below is a link to the website. We hope that you are as interested as we are in advocating for the improvement of evidence-based practices on anesthesia patient safety.

Please feel free to contact any of us with any questions, comments, or concerns regarding this project.

WEBSITE LINK:

https://athernan2.wixsite.com/website

Sincerely,

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Appendix D: Pre-Survey Tool

Pre-Survey Questions

1. What is your primary role?
- a. Anesthesiologist
- b. Certified Registered Nurse Anesthetist
- c. Student Registered Nurse Anesthetist

2. How many years have you been practicing?
- a. 0 - 5 years
- b. 6 – 10 years
- c. 11 – 15 years
- d. 16 – 20 years
- e. ≥ 21 years

3. What is your current methodology to assess neuromuscular paralysis? (select all that apply)
- a. Qualitative techniques (i.e., PNS)
- b. Quantitative techniques (i.e., AMG, EMG, KMG)
- c. Physical Assessment
- d. No monitoring

4. What degree of paralysis is present when 4/4 twitches are elicited with a peripheral nerve stimulator?
- a. 90%
- b. 70%
- c. 50%
- d. 30%

5. Do you implement eye protection to patient's corneal prior to or post mask ventilation/laryngoscopy?
- a. Prior to mask ventilation
- b. Post mask ventilation

6. What is the appropriate dose of Neostigmine to reverse a TOFr of 0.5 in a patient who weighs TBW:100kg and IBW:70kg?
- a. 20mcg/TBW
- b. 20mcg/IBW
- c. 40mcg/TBW
- d. 40mcg/IBW

7. What is the ideal TOFr to achieve prior to extubation?
- a. TOFr 0.1
- b. TOFr 0.9
- c. TOFr 0.8
- d. TOFr 0.7

8. What is the recommended infusion rate for multimodal intraoperative lidocaine infusions?
- a. 0 – 1 mg/kg/hr IBW
- b. 1 – 2 mg/kg/hr IBW
- c. 2 – 3 mg/kg/hr IBW

d. Not sure

9. Do you currently use multimodal intraoperative lidocaine infusions in your practice?

a. Yes
b. No

10. Which of the following is not a risk factor for corneal abrasion?

a. Dangling ID badge
b. Pulse oximeter on the index finger
c. Incomplete eyelid closure
d. Taping the eyelid after intubation.

Appendix D Post-Survey Tool

Post-Survey Questions

1. Are you willing to change your practice based on the information you were presented about corneal abrasion prevention?

a. Yes, I will make changes based on the highlighted evidence-based recommendations.
b. No, I will not make any changes.

2. Based on the simulation, when is the best time to initiate eye protection?

a. Prior to intubation
b. After induction

3. What is the recommended infusion rate for multimodal intraoperative lidocaine infusions?

a. 0 – 1 mg/kg/hr IBW
b. 1 – 2 mg/kg/hr IBW
c. 2 – 3 mg/kg/hr IBW
d. Not sure

4. Are you willing to change your practice based on the information you were presented about multimodal intraoperative lidocaine infusions?

a. Yes
b. No

5. What is the appropriate dose of Neostigmine to reverse a TOFr of 0.5 in a patient who weighs TBW:100kg and IBW:70kg?

a. 20mcg/TBW
b. 20mcg/IBW
c. 40mcg/TBW
d. 40mcg/IBW

6. What is the ideal TOFr to achieve prior to extubation?

a. TOFr 0.1
b. TOFr 0.9
c. TOFr 0.8
d. TOFr 0.7

7. Are you willing to make a change in your practice based on the information you were presented about timing and dosing of reversal agents?

a. Yes
b. No

8. What degree of paralysis is present when 4/4 twitches are elicited with a peripheral nerve stimulator?

a. 90%
b. 70%
c. 50%
d. 30%

9. What modality is the MOST accurate at depicting the depth of neuromuscular paralysis?

a. Qualitative techniques (i.e., PNS)
b. Quantitative techniques (i.e., AMG, EMG, KMG)

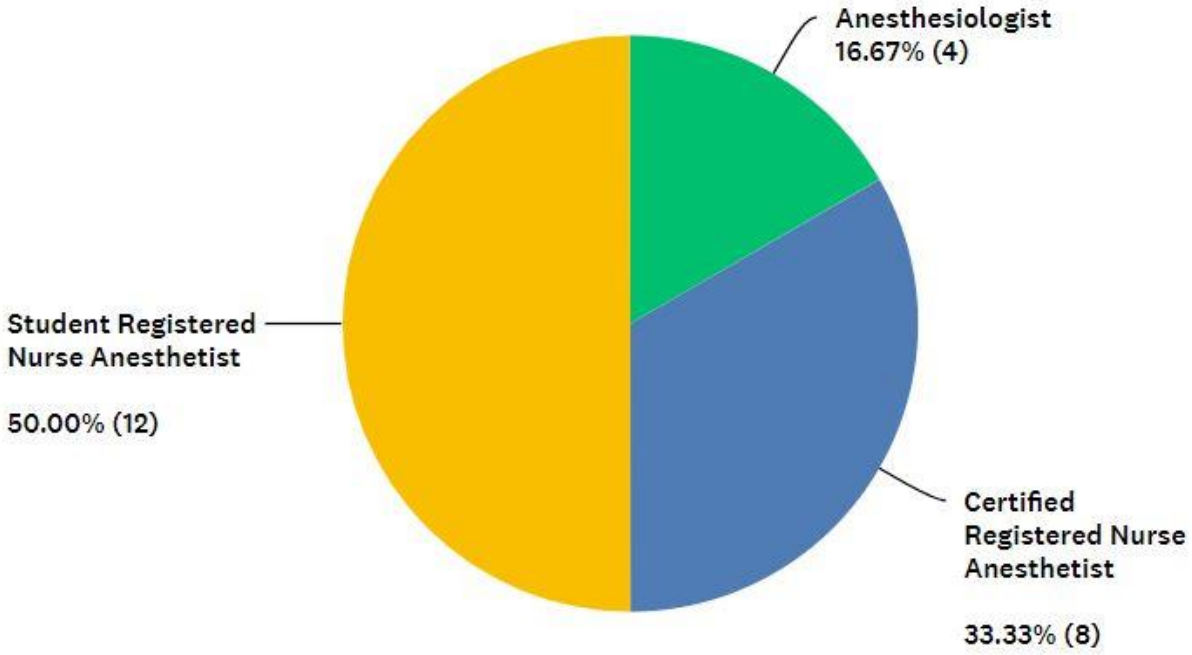
c. Physical Assessment (i.e., HR, Vt, RR, etc.)
d. Sustained head lift for 5 seconds

10. Which of the following is not a risk factor for corneal abrasion?

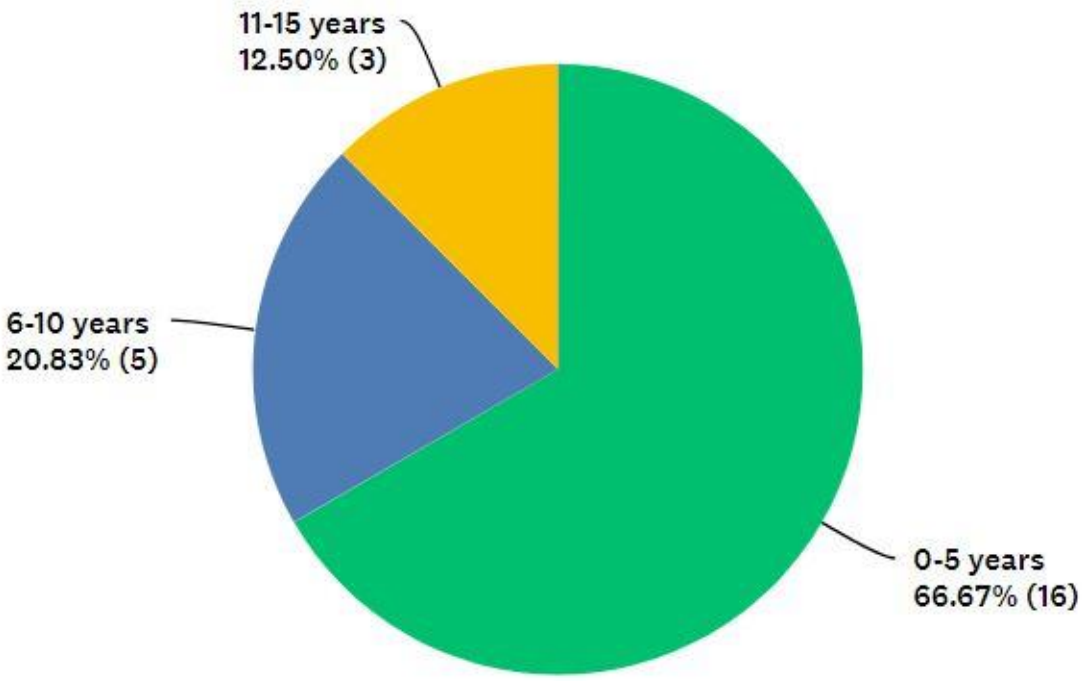
a. Dangling ID badge
b. Pulse oximeter on the ring finger
c. Incomplete eyelid closure
d. Taping the eyelid after intubation.

Appendix E: Demographic

Project Participant Position



Appendix F: Experience Level of Project Participants



Appendix G: SPSS v.17 of knowledge-based cornea abrasion question: McNemar's test.

Pretest: Do you implement eye protection to patient's corneas prior to or post mask ventilation and/or laryngoscopy?

Posttest: Based on the simulation, when is the best time to initiate eye protection?

	PretestQ5	PosttestQ2
1	1.00	.00
2	1.00	.00
3	.00	1.00
4	1.00	1.00
5	.00	1.00
6	1.00	1.00
7	.00	1.00
8	1.00	1.00
9	.00	1.00
10	.00	1.00
11	.00	1.00
12	.00	1.00
13	1.00	1.00
14	.00	1.00
15	1.00	1.00
16	.00	1.00
17	.00	1.00
18	.00	1.00
19	.00	1.00
20	.00	1.00
21	.00	1.00
22	1.00	1.00
23	1.00	1.00
24	.00	1.00

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
PretestQ5 * PosttestQ2	24	92.3%	2	7.7%	26	100.0%

PretestQ5 * PosttestQ2 Crosstabulation

			PosttestQ2		
			Incorrect	Correct	Total
PretestQ5	Incorrect	Count	0	15	15
		% within PretestQ5	0.0%	100.0%	100.0%
		% within PosttestQ2	0.0%	68.2%	62.5%
	Correct	Count	2	7	9
		% within PretestQ5	22.2%	77.8%	100.0%
		% within PosttestQ2	100.0%	31.8%	37.5%
Total		Count	2	22	24
		% within PretestQ5	8.3%	91.7%	100.0%
		% within PosttestQ2	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	Exact Sig. (2-sided)
McNemar Test		.002[a]
N of Valid Cases	24	

a. Binomial distribution used.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
For cohort PosttestQ2 = Correct	1.286	.907	1.823
N of Valid Cases	24		

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
PretestQ2	24	.6250	.49454	.00	1.00
PosttestQ2	24	.9167	.28233	.00	1.00

Appendix H: SPSS v.17 of knowledge-based question on cornea risk factors: McNemar's test.

Pre/Post-test Q10: Which of the following in NOT a risk factor for corneal abrasions?

	PretestQ10	PosttestQ10
1	.00	.00
2	.00	.00
3	.00	1.00
4	1.00	1.00
5	.00	1.00
6	1.00	1.00
7	1.00	1.00
8	1.00	1.00
9	.00	1.00
10	1.00	1.00
11	.00	1.00
12	1.00	1.00
13	1.00	1.00
14	.00	1.00
15	1.00	1.00
16	1.00	1.00
17	1.00	1.00
18	.00	1.00
19	1.00	1.00
20	1.00	1.00
21	.00	1.00
22	1.00	1.00
23	1.00	1.00
24	1.00	1.00

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
PretestQ10 * PosttestQ10	24	92.3%	2	7.7%	26	100.0%

PretestQ10 * PosttestQ10 Crosstabulation

			PosttestQ10		
			Incorrect	Correct	Total
PretestQ10	Incorrect	Count	2	7	9
		% within PretestQ10	22.2%	77.8%	100.0%
		% within PosttestQ10	100.0%	31.8%	37.5%
	Correct	Count	0	15	15
		% within PretestQ10	0.0%	100.0%	100.0%
		% within PosttestQ10	0.0%	68.2%	62.5%
Total		Count	2	22	24
		% within PretestQ10	8.3%	91.7%	100.0%
		% within PosttestQ10	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	Exact Sig. (2-sided)
McNemar Test		.016[a]
N of Valid Cases	24	

a. Binomial distribution used.

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
PretestQ6	24	.6667	.48154	.00	1.00
PosttestQ6	24	.9583	.20412	.00	1.00

Risk Estimate

	Value	95% Confidence Interval Lower	Upper
For cohort PosttestQ10 = Correct	.778	.549	1.103
N of Valid Cases	24		

Appendix I: Comprehensive analysis of the combined anesthesia safety data.

	Pretest	Posttest
1	.7083	.7500
2	.6250	.9167
3	.3333	.7917
4	.9167	.9583
5	.5000	1.0000
6	.6667	.9583

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	.625000	6	.1972210	.0805151
	Posttest	.895833	6	.1011943	.0413124

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pretest & Posttest	6	.261	.618

Paired Samples Test

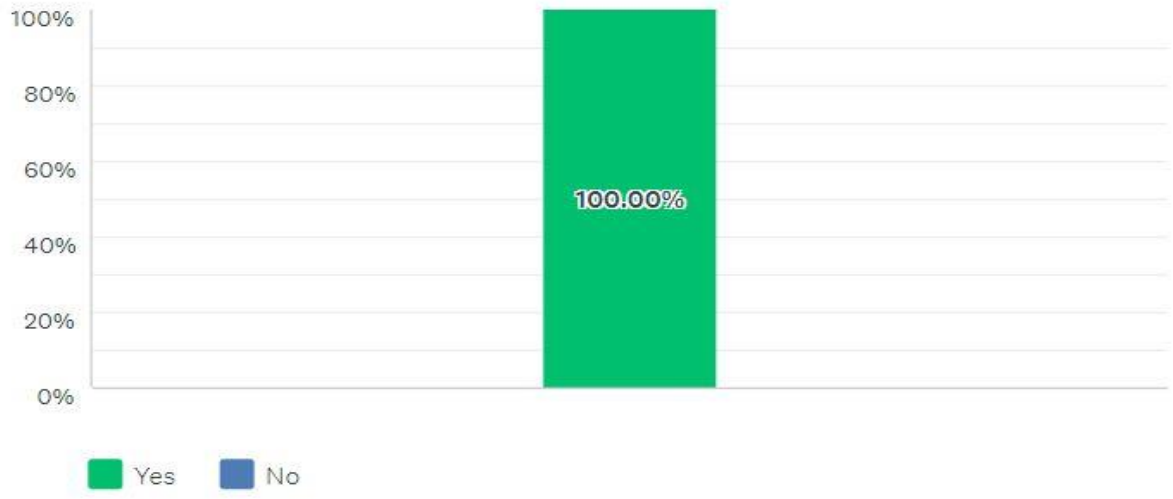
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pretest - Posttest	-.2708333	.1967818	.0803358	-.4773431	-.0643235	-3.371	5	.020

Paired Samples Effect Sizes

			Standardizer[a]	Point Estimate	95% Confidence Interval Lower	Upper
Pair 1	Pretest - Posttest	Cohen's d	.1967818	-1.376	-2.498	-.196
		Hedges' correction	.2132568	-1.270	-2.305	-.180

Appendix J: Willingness rate

Anesthesia providers who reported a willingness to make a practice change based on information received from the module on corneal abrasion prevention methods.



Number of anesthesia providers who implement eye protection prior to or after mask ventilation.