AN EDUCATIONAL-BASED APPROACH TO PREVENT CORNEAL ABRASIONS AT A COMMUNITY HOSPITAL

by

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ABSTRACT

MEGAN FROWINE. An Educational-Based Approach to Prevent Corneal Abrasions at a Community Hospital. (Under the direction of DR. LUFEI YOUNG)

Corneal abrasions (CA) are one of the most common anesthesia-related adverse events. There is limited evidence about the effect of virtual education on providers' knowledge regarding CA prevention. The purpose of this project was to assess if a web-based educational module effectively improved anesthesia providers' awareness of evidence-based preventative measures of CA. This project had a quasi-experimental, pretest-posttest design. All participants completed a questionnaire regarding the knowledge on CA prevention before and after the educational module. A student T-test was used to compare the differences in pre- and post-education knowledge scores. Among 25 participants, 12.0% were anesthesiologists and 88.0% were certified registered nurse anesthetists. There was a significant pretest-posttest difference on the total knowledge score (6.88 ± 1.59 vs. 8.29 ± 1.31, $p < .001$). Overall, the average number of correct answers increased from 6.88 ($SD = 1.59$) to 8.29 ($SD = 1.31$), $t = 4.22$, $p < .001$. The web-based educational module effectively enhanced anesthesia providers' knowledge in preventing surgical induced CA. The finding may add evidence when developing guidelines and standardizing provider education in CA prevention.

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DEDICATION

I dedicate my work to those that have supported me throughout the past three years and beyond. Firstly, I would like to dedicate this project to my husband, Andrew, who always believed in me and never had any doubts about my potential. I would also like to dedicate this project to my parents, Chris and Kathy, who provided me with the support to make it to this point in my career. Finally, I would like to dedicate this project to my Golden Retriever, Bentley, for his unconditional love and emotional support. Thank you all!

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LIST OF ABBREVIATIONS

CA	Corneal abrasions
CRNA	Certified Registered Nurse Anesthetist
EHR	Electronic health record
ENT	Ear/nose/throat
F2F	Face-to-face
GYN	Gynecologic
HIPAA	Health Insurance Portability and Accountability Act of 1996
ID	unique study code
IRB	Institutional Review Board
MDA	Anesthesiologist
NORA	Non-operating room anesthesia
NSAIDs	non-steroidal anti-inflammatory drugs
ORs	operating rooms
PACU RN	Post Anesthesia Care Unit Registered Nurse
PDCA	Plan-Do-Check-Act
QI	Quality improvement
SD	standard deviation
SPO	Structure, process, outcome
SRNA	Student nurse anesthetists
STP	Steep Trendelenburg position
WBL	Web-based learning

CHAPTER 1: INTRODUCTION

Background

Corneal abrasions (CA) are one of the most common ocular adverse events after surgery with an incidence rate between 1.4 to 15.1 per 10,000 procedures (Barash, 2017, p. 292). They are associated with significant pain, stress, and heightened anxiety for the patient in the postoperative setting. Furthermore, CA can lead to negative ocular sequelae such as corneal ulcer formation and bacterial infections (Porter, 2022). Consequently, these sequelae can increase the patient's length of hospital stay and warrant an ophthalmology consultation (Segal, 2014). This leads to an additional cost for the hospital with the median amount of compensation for this preventable injury being $12,000 (Posner & Lee, 2014). Overall, the significance of this incident results in a reduction in quality patient care and dissatisfaction in the surgery's outcome.

Problem Statement

The increased risk for CA related to positioning, provider awareness, and the surgical environment has been well documented. With the increasing use of robotic surgery, which requires the patient in steep Trendelenburg position (STP), the need to continue to promote providers' awareness on corneal abrasions is paramount. One study which reviewed the incidence of CA in robotic-assisted laparoscopic hysterectomies showed that "compared with open hysterectomy, risk of corneal abrasion was increased nearly four-fold with the laparoscopic technique and nearly 6.5-fold with the robotic technique" (Sampat, 2015, p. 994). Another reported risk of CA is inappropriate eye protection during surgeries. According to McKevitt et al. (2022), most of the corneal injuries that occur under anesthesia are from incomplete eye closure. To avoid CA, the eyelids must be covering the eye (Nagelhout, 2018, p. 245). In the prone or Trendelenburg positions, venous congestion of the conjunctiva may occur which inhibits full

closure of the eye (McKevitt et al., 2022, p. 1). Other risk factors of CA include advanced age, the use of general anesthesia, length of the procedure, direct trauma, corneal exposure, dehydration and associated keratitis, or chemical injury (Porter, 2022; Papp, 2019; Nagelhout, 2018, p. 944-945; Barash, 2017, p. 1272-3484). The implementation of standardized CA prevention, early recognition and treatment has contributed to the reduction of CA; however, this adverse event remains a significant problem seen in the peri anesthesia period (Porter, 2022). One of the reasons is the lack of awareness of methods used to prevent and alleviate CA.

Purpose of the Project

To address this clinical issue, a quality improvement (QI) project was proposed. Its goal was to increase providers' awareness on current evidence-based practice to reduce CA occurrence in perioperative patients. The purpose of this project was to study the effect of a web-based educational module provided to anesthesia providers and its influence on providers' awareness of corneal abrasions. An investigation was performed to assess providers' awareness regarding current literature recommendations on effective methods used to prevent and reduce CA and CA risks. An educational module was provided, and providers were given a pre-assessment and post-assessment. Current literature identifies the effectiveness of educational modules on the awareness regarding up-to-date clinical practice among healthcare professionals.

Clinical Question

After a thorough review of the literature and feasibility assessment, the overarching clinical question was the following: Does a web-based educational module (I) provided to anesthesia providers (P) at a community hospital increase the awareness of evidence-based corneal abrasion prevention measures (O) during the perioperative period (T)?

Stakeholders

During the investigation of this problem, identified stakeholders were Certified Registered Nurse Anesthetist (CRNA), Anesthesiologist (MDA), Post Anesthesia Care Unit Registered Nurse (PACU RN), Ophthalmologist, Risk Management Leader, Surgeon, and the patients. According to Sipes (2020), stakeholders are individuals who share common interest in the project and serve as valuable critics (p. 66). Although CAs are classified as an anesthesia-related adverse event, collaboration with other individuals actively involved in patient care is optimal. The anesthesia providers serve as critical stakeholders as this investigation directly impacts their practice of care. During surgical procedures, several instruments and devices are used to ensure patient safety. Ophthalmology consultations may be warranted dependent on facility protocol for CA, so ophthalmologist involvement is necessary. Lastly, when adverse events are documented, the risk management leader investigates the occurrence.

CHAPTER 2: LITERATURE REVIEW

Database Search

In determining the effectiveness of an educational module provided to anesthesia providers, a literature review was conducted within the following databases: CINAHL Complete, PubMed, Web of Science, Science Direct, and Medline between January 2005 to February 2023. The keywords used were corneal abrasions, corneal injuries, general anesthesia, prevention, surgery, web-based learning, anesthesia, anesthesia providers, and healthcare providers.

Background and Significance

CAs are one of the most common ocular adverse events in patients undergoing general anesthesia. Morris et al. (2018) defines corneal abrasion as a defect on the cornea's epithelial surface. Patients undergoing general anesthesia are at greater risk due to the loss of natural corneal protective reflexes, reduced tear production, and incomplete eye closure. Documented trends in perioperative CA prevalence reveal a varying incidence rate dependent on the study being conducted, preventative measures being implemented, patient population inclusion criteria, patient position, comorbidities, and the overall objective of the study. However, Morris et al. (2018) mentions the marked increase from 0% to 44% when eye protective measures are not utilized. According to Barash (2017), CA incidence rate ranges between 1.4 to 15.1 per 10,000 procedures. Overall, CA raises significant concerns for patients during the perioperative period. They are associated with significant pain, stress, and heightened anxiety during the postoperative period.

In addition, Porter et al. (2022) mentions numerous associated negative sequelae, such as corneal ulcer formation and bacterial infection. If left untreated, recurrent corneal erosion can occur months to years after the CA. Researchers express the rarity of long-term sequelae

occurring, due to the rapid self-regeneration of the corneal epithelium. However, as stated by Segal et al. (2014), this unforeseen event can lengthen hospital stay as the patient awaits an ophthalmology consult for definitive treatment. Despite the implementation of preventive measures in the operative setting, the occurrence of CA leads to additional costs for the patient and hospital. Morris et al. (2018) explains the varying cost of treatment for CA, including topical antibiotics and oral non-steroidal anti-inflammatory drugs (NSAIDs) that contribute to the additional cost for the hospital encounter. According to the closed claims analysis study, eye injuries accounted for 3% of total claims against anesthesia providers, of which CA occurred in 35% of those cases (Aitkenhead, 2005). Furthermore, perioperative CAs yield a median payout of $3,000 per incident, accounting for 3% to 8% of anesthetic malpractice claims (Porter et al., 2022). It has been postulated that sustained practice change supporting recommendations from current literature can save $637 per corneal injury prevented (Vetter et al., 2012). Overall, the significance of this incident results in reduced patient satisfaction in surgical outcomes, provider liability, and additional cost for the healthcare facility.

The impact that CAs can have on the patient, anesthesia provider, and healthcare facility is consistently stated in the literature. Many researchers commonly expressed the need for a universal protocol to promote appropriate implementation of preventative measures. Porter et al. (2022) presented an online learning module to anesthesia providers, which supported the change in practice, reducing the occurrence by 12-13%. In addition, Vetter et al. (2012) conducted a case-control study that introduced a reiterative approach to anesthesia providers, incorporating the Plan-Do-Check-Act (PDCA) cycle. The intervention increased provider awareness and expanded on an already established knowledge base with current evidence-based practice. Utilization of techniques such as these should contribute to the overall reduction of CA incidence

while increasing provider awareness.

CA Prevention and Control

An important facet when dealing with CA prevention is awareness of patient risk factors. Studies have differed slightly in identified risk factors that are the greatest perpetrators for increased frequencies of CA. Segal et al. (2014) determined significant risk factors to be age, the use of general anesthesia, increased blood loss, Trendelenburg position, and supplemental oxygen during transfer. Conversely, Carniciu et al. (2017) found the main risk factors to be surgery length greater than 3 hours and pre-existing ocular disease. This study showed no association of body positioning causing increased CA risk. Overall, in one systematic review, Papp et al. (2019) established the most common risk factors throughout various studies to be longer surgeries, advanced age, Trendelenburg positioning, robotic cases, and general anesthesia. Among studies found in the literature, it can be determined that there is not one list of confirmed risk factors for CA that is currently agreed upon.

Evidence-based guidelines and protocols have differed slightly amongst the literature as there are various methods for CA prevention that have been determined. Best practice guidelines described by Segal et al. (2014) and Porter et al. (2022) included applying either eye drops or ointment prior to taping the eye. Another study adopted a guideline that included complete closure of the eyelids with tape during general anesthesia, taping once the eyelash reflex was lost, and the utilization of aqueous gel as a protection method (Domino, 2017). Vetter et al. (2012) implemented a standardized CA prevention program that included a certain way of taping the eyes, the timing of taping the eyes, and a consistent method of eye protection documentation. After the rollout of the new protocol, results showed a marked reduction in CA. Porter et al. (2022) also achieved a noticeable reduction in CA through a similar manner of standardizing CA

prevention. Their intervention included educating providers on causes, risk factors, and prevention measures throughout the perioperative period. Like Vetter et al.'s study (2012), they also created an intraoperative protocol aimed at standardizing eye care for all patients receiving general anesthesia which included taping the eyes prior to securing the airway, using a particular tape, and documenting eye checks hourly. The study showed an absolute reduction of 13% and 12% over two separate years.

Dixon et al. (2019) described a guideline adopted specifically for decreasing CA risks among patients undergoing endoscopic procedures – where sedation or monitored anesthesia care were used rather than general anesthesia. In procedures that do not require general anesthesia, taping of the eyes is generally not recommended. Instead, Dixon et al. (2019) adopted the practices of making sure patients' eyes were completely closed peri-procedurally and ensuring proper fit of ancillary oxygenation devices on patients' faces (such as, nasal cannulas). They also made sure patients' eyes avoided contact with the bed while in lateral position, which was the position required for the endoscopic procedures. Douthit et al. (2022) adopted a similar guideline, where it became a new standard to position patients from lateral to supine when traveling from endoscopic procedures to the post-anesthesia care unit to avoid CA. The intervention was based on the belief that patients would rub their eyes on their pillows and sheets, potentially harming their dependent eye. Conversely, Haghighat et al. (2021) employed a practice of bilaterally taping both eyelids during endoscopic procedures. Their study took place after the COVID-19 pandemic when patients were required to wear masks. Therefore, they also standardized taping the mask to the bridge of the nose of these patients to prevent the mask moving toward the eyes and scratching the cornea. In this study, there were zero incidences of CA among 2,149 endoscopic procedures after the implementation of the practice change.

In summary, there are many different CA prevention measures that can be adopted and there are various guidelines that support these interventions. These studies highlight the need of educating providers on up-to-date information regarding prevention of CA, certainly when it comes to the importance of eye care during the intraoperative period.

Effectiveness of Current Education

As previously mentioned, education models focused on improving anesthesia providers' knowledge of CA prevention are discussed in the literature. To assess the need for education regarding best practice measures against CA, one case-control study began by observing anesthesia providers' eye protection practices (Vetter et al., 2012). It was found that providers had various timing on when eyes were protected with tape and/or lubricant – either occurring before or after confirmation of mask ventilation of the airway during induction of anesthesia. After observing CRNAs, student nurse anesthetists (SRNA), anesthesiology residents, and attendings over a seven-day period, it was found that there was no standard practice for eye protection. Post observation, educational presentations were provided to all anesthesia providers to implement a standard of practice for eye protection and documentation in the electronic health record (EHR) regarding CA. Vetter et al. (2012) and Martin et al. (2009) also studied the effects of education provided in-person via lectures, grand rounds presentations, or quality improvement conferences. Martin et al. (2009) employed a unique method of dividing anesthesiologists and CRNAs/SRNAs into separate sessions of educational lectures. However, each group received the same education on CA prevention. In a more recent study by Douthit et al. (2022), researchers worked directly with anesthesia providers and hospital administrators to develop an evidence-based practice change to prevent CA. To implement change, anesthesia providers were educated via in-services and were provided hard copy summaries for review.

In more recent years, educational interventions have begun to shift to an online or digital platform. Porter et al.'s (2022) quality improvement study involved the creation of an online module to expand provider knowledge of CA. The module consisted of a digital presentation that informed providers of proposed causes, risks, and prevention measures against CA. The preventive measures were separated into three categories – preoperative, intraoperative, and postoperative. After viewing the module, providers completed a series of questions to assess their knowledge gain.

In other studies, there is a combination of in-person as well as electronic strategies to expand provider knowledge of CA. In Martin et al.'s (2009) case-control study, e-mail technology was used to initially notify providers of CA occurrence among patients in their care. This was then followed up with formal teaching on effective preventive measures. This included an in-person lecture series that focused on CA awareness, risk factors, and prevention methods. Vetter et al. (2012) employed a similar intervention. Providers that were involved in cases of CA were informed of the incidents and re-educated about the facility's new standardized eye protection protocol. Re-education was provided by a representative from the hospital's quality department.

Another element of CA education found in the literature includes instruction on incident reporting and intraoperative eye protection documentation in the EHR. In one study, presentations as well as audiovisuals were created to inform anesthesia providers of the correct CA documentation process (Vetter et al., 2012). To further increase documentation compliance, researchers in this study were able to add a reminder button to the EHR. This would alert the provider to document eye protection measures given to the patient. Prior to this addition,

providers would have to rely on their own intuition to ensure they completed eye protection documentation.

Based on the review of the literature, it can be concluded that education regarding CA prevention has been provided to anesthesia providers in various ways. Several strategies have been employed and no single method has proven to be more advantageous than others. Of note, there has been a shift to the incorporation of online learning in recent years. Porter et al. (2022) is the only study found that used an online module for its primary education method.

Overall, the desired effect of CA education is a reduction in CA incidence. In Martin et al.'s (2009) case-control study, rates of CA were followed throughout the education initiative and fell substantially compared to the beginning phases (Papp et al., 2019). Vetter et al. (2012) found similar results and revealed that rates of CA fell from 1.20 per 1000 to 0.09 per 1000 after institution of a standardized eye protection protocol (Papp et al., 2019). Additionally, in one quality improvement project, the creation of an educational module reduced CA incidence from 0.22% to 0.09% over a two-year study period (Porter et al., 2022). Vetter et al. (2012) also reported a sustained reduction in CA incidence over a three-year period. The sustained reduction in CA after implementation of the education programs in these studies is a testament to their overall effectiveness.

As previously discussed, there were a few studies that aimed to increase provider compliance to CA reporting and eye protection documentation in the EHR. Therefore, this was another outcome measure that was used to assess education effectiveness. The efforts of one study increased provider documentation of eye protection from 3.4% during the beginning of education to 74.9% (Vetter et al., 2012, p. 494). Improved electronic documentation of CA in one study flagged the patients which led to ophthalmology consults. Patients being flagged led to

faster treatment overall to reduce the risk of further, more complex complications (Martin et al., 2009, p. 322).

Effects of Web-Based Education on Practice

As previously mentioned, there has been a shift to providing education via electronic and web-based platforms. The COVID-19 pandemic proved that education programs can be administered through an online platform. Prior to the COVID-19 pandemic, many educational programs for healthcare providers were completed using a face-to-face (F2F) platform. However, the pandemic forced educational programs to shift more to a web-based delivery system. The use of web-based educational programs has the advantages of providing access to time sensitive information and accommodating learners' varying schedules. Abbas et al. (2020) conducted a comparative study to investigate the effectiveness of a web-based module on preventative measures presented to 401 healthcare workers. Statistical analysis revealed a significant increase in hand hygiene completion when comparing the pre-intervention percentage and the post-intervention percentage. Researchers concluded that a concise web-based educational module is an effective tool to educate healthcare workers and promote practice change.

Multimedia advancement offers the potential to expand the competencies of nurses in clinical practice. Sixty-seven nurses participated in a randomized control study, where web-based learning (WBL) was provided to simulate a clinical setting. The clinical performance of the participants in the experimental group improved significantly compared to the control. Based on their results, Liaw et al. (2015) concluded that web-based simulations provide an educational tool where large groups require training, and grant accessibility to repetitive training to promote retention of clinical competency. In addition, participants of WBL perceived the platform as being more suited to meeting the needs of their demanding work schedules.

Additionally, socio-cognitive factors have the potential to predict provider adherence to updated clinical guidelines and completion of web-based modules. Depending on self-efficacy, some providers are less likely to adhere to guidelines during difficult clinical situations (Ruijter et al., 2018). The evaluation of nurses' adherence to patient smoking cessation guidelines was studied using a randomized controlled trial, which utilized an e-learning program to promote provider adherence. Their results found that the e-learning program resulted in better smoking cessation guideline adherence, which led to greater patient outcomes (Ruijter et al., 2018). Furthermore, patient safety and satisfactory outcomes are always the core of delivering optimal patient care. It is vital to ensure a sufficient level of knowledge in healthcare professionals built on evidence-based practice (Van de Steeg et al., 2015). E-learning allows for self-paced learning and quality assurance. However, barriers to e-learning such as the level of computer literacy must be considered.

Prior to beginning an online educational course, a baseline knowledge exam is often provided. The score is compared to a post-education test score to determine intervention effectiveness. Van de Steeg et al. (2015) expressed that a post-exam score of 80% or higher demonstrated successful completion of an online program for healthcare providers.

Maloney et al. (2012) concluded that WBL and F2F platforms produced comparable outcomes, such as satisfaction, participation, and knowledge acquisition. In a comparison of the two platforms' effects on fall prevention education, the researchers concluded that WBL was more cost-effective for educational providers and opened opportunities to overcome barriers, such as time and cost. They also determined that WBL can provide better maintenance of knowledge that is frequently lost with short-term courses (Maloney et al., 2012). WBL produces

positive effects on the retention of current evidence-based practice, quality improvement, as well as patient outcomes.

Gaps in Literature

After a review of the literature, there are several gaps that remain in CA research as it pertains to anesthesia. A major gap includes the lack of studies providing online educational modules addressing CA prevention. Much of the literature found pertains to F2F education provided to anesthesia providers. Porter et al. (2022) is one of the only studies that discussed a positive outcome from an online educational module with a significant reduction in CA incidence. Since Porter et al.'s (2022) education initiative led to a substantial decrease in CA incidence, it is worth investigating this strategy further.

Another gap in the literature is coverage of CA occurrence during moderate sedation cases. Dixon et al. (2019) and Douthit et al. (2022) are two studies that discuss CA occurring after endoscopic procedures where general anesthesia is not utilized. Porter et al. (2022) shared that 14 out of 23 CA cases that occurred in the facility of interest occurred in patients under deep sedation and not general anesthetics. Considering much of the literature discusses the pathophysiology of CA due to general anesthesia's effects on the body, this topic needs to be investigated further. There may be an even higher rate of CA among patients where general anesthesia is not utilized. In moderate sedation procedures, it is typical to leave the eyelids without tape. However, when the eye is unprotected in this fashion, constant monitoring by the CRNA would be required throughout the procedure to prevent eyelid opening (Grixti et al., 2013, p. 115). The theory of higher incidence of CA during moderate sedation procedures is largely unknown due to the lack of research studies covering this phenomenon.

As discussed previously, another gap in the literature is the inconsistency of a standardized way of preventing CA. The overall patient risk factors vary slightly with some agreed upon throughout studies and some risk factors being contested. One comprehensive review by Kaye et al. (2019) indicated that positioning (i.e., lateral, prone, and Trendelenburg) and higher estimated blood loss have not been consistently found to cause an increased risk of CA. This review also included several methods of preventing corneal injuries such as manual closure of eyelids, use of eye ointment, and bio-occlusive dressing. However, researchers also agreed that none of these methods have been shown to be completely effective (Kaye et al., 2019). There are many mechanisms of injury for CA, and studies differ slightly on best practice recommendations for CA prevention. More research involving large randomized controlled trials is needed to evaluate prevention measures against CA in patients undergoing anesthesia (Grixti et al., 2013, p. 117).

Review of Findings

In summary, CA remains as one of the most common ocular injuries in non-ocular surgery requiring general anesthesia. Despite preventative measures in place, CA remains a significant issue. Although there are many preventative measures that can be implemented, a universal protocol has not been established. Researchers have revealed that one intervention is not superior to the next in the prevention of CA. It is evident that implementation of CA prevention reduces the risk of occurrence. However, studies vary on the most effective tape to use for eye protection and the advantage of utilizing eye drops/ointment. It has been consistently determined that the establishment of a CA protocol and provider education have successfully reduced the risk. In addition, CA protocols and provider education have improved anesthesia

provider awareness and knowledge acquisition as studied by Vetter et al. (2012) and Porter et al. (2022).

As previously mentioned, WBL offers the potential to expand the competencies of nurses in clinical practice. Implementation of a web-based module provided to anesthesia providers on CA prevention has produced practice change. The literature reveals that WBL yields positive effects on the retention of current evidence-based practice, quality improvement, as well as patient outcomes. The literature has made it evident that CA is consistently reduced after providers are introduced to an educational program, reflecting the program's overall effectiveness.

Conceptual/Theoretical Framework

This quality improvement project followed the structure, process, outcome (SPO) model. The structure part of the SPO model refers to the environment where care is provided. The structure was the facility where CA education was distributed. The process referred to the actions performed to affect care delivery. The process is to provide education to anesthesia providers regarding CA best practice prevention measures with a web-based method. Finally, the outcome refers to the end results of the QI project. The outcome is increasing provider awareness of CA prevention.

CHAPTER 3: METHODOLOGY

Study Design

This project followed a quantitative, quasi-experimental design and used a pretest posttest format. The sample was collected from one healthcare facility. The goal of this quality improvement project was to assess the effectiveness of an educational module on the awareness of CA prevention strategies among anesthesia providers. The project investigated the following PICOT question: Does a web-based educational module (I) provided to anesthesia providers (P) at a community hospital increase the awareness of evidence-based corneal abrasion prevention measures (O) during the perioperative period (T)? A pretest was utilized to assess general knowledge of CA best prevention practices at baseline and followed with a short educational module. To assess knowledge gain, a posttest was completed thereafter, and the score used for comparison to pretest score. SQUIRE 2.0 guidelines were followed when reporting this scholarly project (Ogrinc et al., 2016). Both the clinical site and the university's Institutional Review Board approvals were obtained prior to the implementation of the project (refer to Appendix A and B).

Setting

The selected project site opened in 1987. It is associated with a comprehensive healthcare system situated in the southeastern region of the U.S. There are 12 ORs and several NORA suites, including two labor and delivery ORs, heart catheterization labs, endoscopy rooms, and interventional radiology suites. The facility started out as a small entity but has evolved into a major medical center. There is a wide array of procedures that can be done at this location, including robotic surgery, neurosurgery, pediatric urology, and open-heart surgery.

Population

The sample population for this project consisted of anesthesia providers, including MDAs and CRNAs, working at the community hospital. Convenience sampling was used to obtain subjects. The potential sample consisted of 71 CRNAs and 7 MDAs. In the pretest portion of the project intervention, participants were asked what their professional role is and how long they have been practicing. The purpose was to investigate whether this information altered pre and posttest results.

Intervention

The educational module utilized an infographic to encourage participant engagement while learning about CAs. An infographic maximizes understanding and information is more likely to be retained via this method (Murray et al., 2017). An infographic is defined as a visual presentation of information, minimizing the amount of text, and utilizing pictures, charts, and graphs. It also ensures that the education provided will be concise and easy to follow, which may potentially increase the number of participants willing to complete the module. The educational module consisted of a one-time session, with all parts included to allow the participant to complete it in one sitting. The time to review the infographic depended on the participant with an average time frame of around 10 minutes. The infographic included a discussion on the pathogenesis of CAs, prevention method strategies, and treatment measures supported by the literature. Easelly was the platform used to create the infographic which was converted into a PDF. The Easelly platform has signed an agreement with the Student Privacy Pledge, which manages how educational technology companies handle student data (Easelly, 2023). This platform allows straightforward navigation to build visual aid that includes pictures, graphs, and text. The infographic was included in the main educational portion of the module. Refer to

Appendix D for the infographic layout. This, along with the pretest and posttest questions, were examined by the CRNA experts of the project to ensure validity.

The following strategies were used to enhance and maintain the intervention fidelity. For study design, clear and detailed intervention protocols were developed that outlined specific education components and expected outcomes. Standardized education materials were provided that align with the intervention protocol. To improve the intervention fidelity, the project developer was trained to develop online surveys and web-based educational modules. To ensure the delivery and receipt, the average time spent on completing education modules was monitored and team meetings were scheduled to identify and troubleshoot any challenges encountered by participants in completing the online learning module. Also, regular emails were sent to encourage active participation and completion, providing guidance on how to access the web-based learning module, and identified areas that needed more clarification. For enactment, handouts were included to encourage participants to apply the knowledge and skills gained from the intervention. By addressing each of these components in the design, training, delivery, receipt, and enactment stages of the educational intervention, efforts were made to improve intervention fidelity, ensuring that the intervention was implemented as intended and produced meaningful outcomes.

Procedures

Data Collection

SurveyMonkey was utilized to create a one-link, self-reported module that provided the pre-evaluation, infographic, and post-evaluation. SurveyMonkey measured the pre and posttest scores of participants. This measurement was used to determine if there were any change in baseline knowledge of CA prevention methods after educational module completion. The

SurveyMonkey link was initially sent out via secure email to CRNAs and MDAs on July 31, 2023. Reminder emails were sent August 14, August 21, and September 5. Also, the anesthesia management team was reminded by the Nurse Anesthesia Program director on August 25 to encourage staff participation. In addition to emails, a QR code for the SurveyMonkey link was made available for easy access and distributed in areas that are frequently used by MDAs and CRNAs (including the breakroom and office areas).

Method of Data Collection

In both the pre- and post-evaluations on SurveyMonkey, clear questions were asked to identify knowledge regarding the prevention of CAs. Similar questions were used between the pre- and post-evaluation to determine module completion and whether learning occurred from the infographic. According to Bellg et al. (2004), measuring provider knowledge during and after training is essential to assess education effectiveness.

In the pretest, additional questions were asked to quantify anesthesia providers: the title of the anesthesia provider taking the module (CRNA or MDA) and the number of years of anesthesia experience. This helped determine which subset of providers were taking the module and would have no impact on the overall score of the pre- and post-evaluation. The rest of the questions asked were closed-ended and based on education provided in the module. The platform that was utilized kept track of the number of participants completing the module and stored the results from the evaluations.

Inclusion and Exclusion Criteria

Inclusion criteria for participation included any provider that currently provided anesthesia care to surgical patients. Exclusion criteria included non-anesthesia providers in the surgical arena – such as circulating nurses, surgical scrub technicians, and anesthesia technicians.

Additional exclusion criteria included CRNAs or MDAs that did not work at the community hospital. The reason for exclusion of these participants was to limit the project sample to the facility of interest.

Data Management and Security

Completion of the module remained confidential, only identifying the participants by the IP address provided upon completion of the module. Each participant was assigned a unique study code (ID), which was used for data entry, tracking, and analysis. All questionnaires were identifiable; however, each participant was assigned a unique ID. Each participants' ID was stored in a secured, Institutional Review Board (IRB) approved web-based folder. This web-based folder was password protected and only accessible by the project personnel. A consent form was provided to participants prior to completing the module. This consent informed participants that their years of experience and provider role would be used for study purposes. Participants were reassured that their identity remained confidential and secure. In addition, the participant ID number was associated with the pre and posttest for tracking purposes.

Furthermore, REDCAP is an online password protected data storage site utilized by project personnel to access all stored data. REDCAP is only accessible to the project personnel, the sponsor of the project, IRB, and any other persons required by law. UNCC and the participating healthcare facilities share a uniform policy on the protection of patient privacy that satisfies all the requirements of the Health Insurance Portability and Accountability Act of 1996 (HIPAA). The project and personnel abided by both organizations' policies, and strictly adhered to the detailed human subject protection regarding data analysis. This was utilized during this project intervention period to preserve participants' privacy and security. Participants were provided the option to opt out of participating in the project.

Data Analysis and Evaluation

All statistical analyses were performed using R (version 4.0.2, R Foundation for Statistical Computing, Vienna, Austria) with a significance level of 0.05 (de Micheaux et al., 2013). Pre-analysis data screening was performed prior to statistical analysis to examine coding errors, outliers, and data skewness to determine if any data cleaning procedures were needed. Coding errors often occur when the questionnaires are used as assessment tools. To reduce coding errors, the statistician was consulted, and statistical procedures were used to recode the study questionnaires. Additionally, the missing data caused by unanswered questions was reviewed for patterns that would introduce bias in the result. Participants were asked to go back and fill out the questionnaires completely. If some data items remained missing, these issues were resolved via consultation with the statistician and major advisor.

Descriptive statistics (means, standard deviations, or median, interquartile range, or number, percentages, and frequencies) were calculated for all variables. Demographic characteristics of the study population were analyzed as means and standard deviations (SD) for continuous variables and as frequencies and percentages for categorical variables. All statistical tests were 2-tailed. The variables were checked for normality and the mean and standard deviation was used as a measure of central tendency since the data were normally distributed.

The $\chi 2$ test was performed to describe and compare frequencies. The student t-test was utilized to test for significant differences between pre and posttest scores. Pearson's correlation coefficients were used to determine the relationships between key concepts. Univariate and multivariate logistic regression or linear regression analyses were performed to determine the relationships between the pretest and posttest.

Timeline

The project topic was finalized in December 2022. A literature review was conducted in March 2023. The proposal defense was successfully completed in April 2023. Following the proposal defense, approvals from both the clinical site and the university IRBs were obtained in July 2023. Data collection and intervention took place in August and the first part of September 2023. Data analysis and report generation were finished at the end of September 2023 (Appendix C).

CHAPTER 4: RESULTS

Sample Characteristics

A total of twenty-five individuals participated in the educational module. This corresponded to a 32% participation rate among 78 eligible participants. Among the participants, 12.0% were anesthesiologists and 88.0% were CRNAs (see Figure 1). In terms of years of experience, 20.0% had less than 5 years of experience, 20.0% had 6 to 10 years of experience, 16.0% had 11 to 15 years of experience, and 44.0% had 16 or more years of experience (see Figure 2).

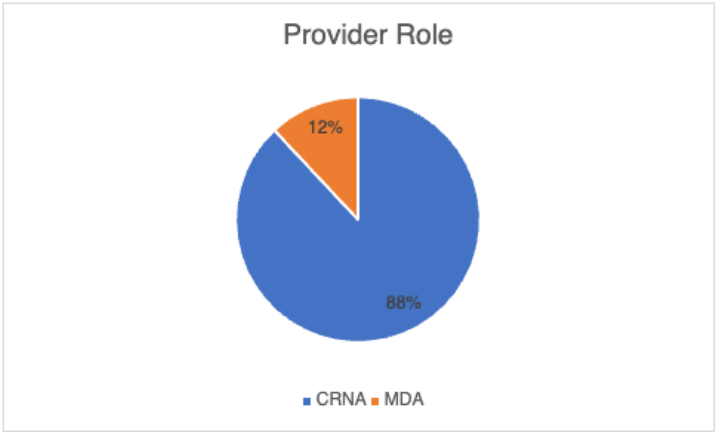

Figure 1: Provider role among participating anesthesia providers

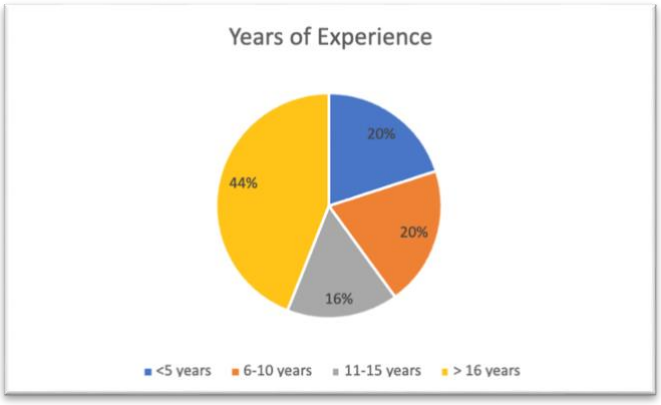

Figure 2: *Years of experience among participating anesthesia providers*

Project Findings

Before the data collection period could commence, IRB approvals were obtained from both healthcare system and university (Appendix A and B). The project results are described following the Standards for Quality Improvement Reporting Excellence (SQUIRE) 2.0 guidelines (Ogrinc et al., 2016).

Table 1: Pretest and posttest comparison for each question and total score

	Pretest (n = 25) % correct	Posttest (n = 21) % correct	p-value
1. What is the most common ocular adverse event related to anesthesia?	100	100	1.00
2. In the preoperative area, which finger is optimal for pulse oximeter probe placement?	76.0	90.5	.368
3. All of the following are common offenders of corneal abrasion EXCEPT:	80.0	95.2	.276
4. When is the optimal time to tape the eyes closed during induction?	80.0	47.6	.047
5. Which statement is TRUE:	44.0	71.4	.116
6. What is the proper method to remove protective eye tape prior to patient emergence?	48.0	76.2	.099
7. Which is NOT a risk factor for corneal abrasions:	56.0	66.7	.663
8. According to the American Society of Anesthesiologists Closed Claims analysis, the mechanism of injury was identified in what percentage of corneal abrasion claims?	36.0	100	< .001
9. All of the following heightens the risk for corneal abrasions during general surgery, EXCEPT:	88.0	90.5	1.00
10. All of the following agents have been used for CA treatment EXCEPT:	80.0	90.5	.566
Total score	6.88 (1.59)	8.29 (1.31)	< .001

Note. p-values for the individual questions were based on chi-squared tests. The p-value for testing total score difference was based on paired t-test.

Table 1 displays the percentage of correct answers for each of the questions. The only question answered 100 percent correctly on both the pretest and posttest evaluations was Question 1, which asked what the most common ocular adverse event related to anesthesia was. The correct answer was corneal abrasion. Additionally, there was a significant pretest posttest difference on Question 4 ($\chi^2(1) = 3.94$, $p = .047$); and Question 8 ($\chi^2(1) = 17.90$, $p < .001$).

Question 4 addressed the timing of eye taping during induction of general anesthesia. The percentage of individuals who got this question correct on the posttest decreased compared to the pretest, from 80% to 46%. Conversely, with Question 8, the percentage of participants who answered correctly increased from 36% to 100% during the posttest evaluation. This question asked how often the mechanism of injury could be identified among CA cases in closed claims. Overall, the average number of correct answers increased from 6.88 (*SD* = 1.59) to 8.29 (*SD* = 1.31), $t = 4.22$, $p < .001$ (see Figure 3).

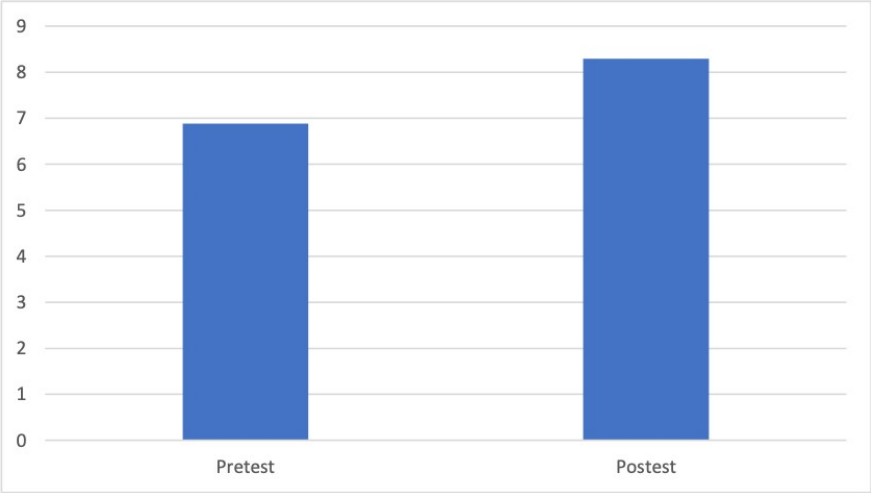

Figure 3: *Average number of correct answers in pretest vs posttest*

During the statistical analysis of results, demographic variables were assessed for association between pretest and posttest scores. Consequently, the demographic variables investigated did not relate to either pretest or posttest scores (*p*s >.138). This suggests that the role of anesthesiologist versus nurse anesthetist did not have an apparent effect on pretest or posttest performance. In addition, years of experience did not prove to be an advantage.

CHAPTER 5: DISCUSSION

Summary

This QI project was the first reported project that examined the effect of a web-based education module on anesthesia providers' knowledge of CA prevention. This ocular injury remains a significant problem faced by anesthesia providers and their patients. CA leads to many problems for surgical patients, including severe pain, infection, scarring, and loss of vision (Grixti et al., 2013). The issue remains prominent among all healthcare facilities, with an incidence rate ranging from 1.4 to 15.1 per 10,000 procedures (Barash, 2017). This can be attributed to a lack of education and adherence to evidence-based prevention protocols. This project aimed to provide up-to-date education to anesthesia providers regarding CA prevention measures and best practices supported by current literature. The findings were that a web-based educational module improved provider awareness regarding CA prevention.

Interpretation

The results of this project align with evidence found in the literature. Several studies have shown that web-based learning is an effective teaching method. It has been found particularly effective in the education of healthcare providers (Abbas et al., 2020). The use of a pretest posttest model in this project allowed for assessment of increased provider knowledge. A post evaluation score of 80% demonstrates successful online education completion (Van de Steeg et al., 2015). Overall, studies in literature support that web-based learning is a useful method to educate healthcare providers.

Furthermore, a recently performed study distributed an online education module to promote a new CA prevention protocol at one facility (Porter et al., 2022). However, to assess the effectiveness of education, CA incidence rates were measured instead of following a pretest

posttest assessment model. With the presentation of the online learning module, CA incidence decreased by 12-13% (Porter et al., 2022). Another study offered repeated education to anesthesia providers after the main education was presented, which helped the facility maintain low CA rates (Martin et al., 2009). Due to the lack of time allotted for the project discussed in this paper, CA incidence rates could not be assessed. The only method of assessment was pretest versus posttest evaluation scores of participants.

Unlike other studies found in the literature, a CA prevention protocol was not developed within this QI project. Rather, education regarding best prevention practices was distributed. Porter et al. (2022) and Vetter et al. (2012), for instance, developed intraoperative protocols and practice standards aimed at standardizing eye care for patients receiving general anesthesia. The project discussed in this paper, however, focused on providing up-to-date education to anesthesia providers to impact their current practice.

As previously mentioned, Question 4 (refer to Appendix E) on the project's pretest and posttest addressed the correct time to tape the eyes during induction of general anesthesia. The question had an 80% correct rate on the pretest and only 46% on the posttest evaluation. This aligns with literature findings that discuss various eye taping preferences among providers, either before or after confirmation of mask ventilation (Vetter et al., 2012). The variety of preference regarding CA prevention may have played a role in the way questions were answered.

Limitations and Challenges

There are several limitations in this project. A pretest posttest design was employed. The most significant limitation of this type of design is the lack of a control group, potentially introducing bias and threats from confounding factors. Also, a convenient sample was utilized with a small size, which could have affected the validity of results. Additionally, the study is

limited by measuring the short-term effect of the online education program. Due to feasibility and time constraints, the long-term effects of the online education program were unable to be assessed.

As discussed previously, the project had a small sample size. Only 25 subjects participated in the educational module. Weekly reminder emails as well as QR code access to the module were strategies used to combat this issue. However, even after 5 weeks of data collection, the participation rate concluded at 32 percent of providers. Participation was entirely voluntary, so it was challenging to recruit subjects. In addition, the facility's anesthesia department had a significant amount of staff turnover during the period of project implementation. On that note, another limitation is the lack of time for project completion. Unlike other studies found in the literature, this QI project had a short data collection period. If more time was allotted for data collection, there may have been a larger sample size.

Another limitation was a lack of anesthesiologist participation. Only 12 percent of the 25 participants (n = 3) were anesthesiologists. This limited the assessment of knowledge difference among anesthesiologists versus nurse anesthetists. In fact, these demographic variables were not significant when analyzing the data. Additionally, a limitation to this project was lack of SRNA participation. An independent CA risk factor found in one study was anesthesia provided by SRNAs, which could have been assessed in this project (Martin et al., 2009).

Another limitation was the presence of incomplete posttest evaluations. As depicted by Table 1, n = 25 for the pretest and n = 21 for the posttest. Therefore, assessment of knowledge gained could not be adequately assessed with these subjects. Participants were allowed to opt out of the module at any point which was the likely cause of incomplete posttest evaluations.

Required resources for the project included SurveyMonkey and the website Easelly. SurveyMonkey was utilized as a tool to present the education module to the desired population as well as evaluate the results of the pretest and posttest. It is a platform that shares online surveys and tracks results in real-time. It allows for a module that is easily accessible, as it permits completion with use of a mobile device, tablet, or computer. The website Easelly was used to generate the infographic that was presented to anesthesia providers. Easelly offers a variety of templates that were beneficial to the development of the web-based module. It allowed the opportunity to visualize information and transform it into an easy-to-read format. Expenses for SurveyMonkey and Easelly were 400 dollars. This was a financial limitation presented by the project. The cost for the programs was paid independently by the project developer. Free versions of the platforms utilized did not offer all the tools needed to carry out the project as desired.

Recommendations

For future studies, the first recommendation would be utilization of a larger sample size. As previously discussed, participation was a challenge in this QI project. The potential sample belonged to one facility, which belongs to a conglomerate of other healthcare facilities belonging to one parent healthcare system. Targeting a larger sample of interest could have increased module participation and more results could have been obtained among anesthesia providers. In addition, a longer period of data collection is also recommended. Separate studies found in the literature where online education interventions were performed lasted several months. Having more allotted time for project completion may have benefited participation rates.

Another important recommendation is to avoid distributing education when other education and surveys are being requested for completion. This project was conducted at the

same time other colleagues were completing their projects. This could have limited participation due to the many surveys being distributed at once.

Implications for Practice

Due to the results of this project, future studies could be performed where online education is distributed regarding CA best practice prevention measures. The study could be completed over a longer period to assess pretest vs posttest evaluation scores in combination with CA incidence rates at the healthcare facility of interest. Additionally, this education could be distributed annually to target all anesthesia providers, as a part of annual compliance education. This would require providers to at least view the education as a part of employment compliance.

Overall, the results from this QI project support the use of web-based learning, especially regarding CA. Anesthesia providers need to be regularly updated on evidence-based practices supported by the literature regarding CA prevention; this could be accomplished via an electronic platform. As noted by several authors in the literature, educating providers and standardizing care are key to mitigating the issue of CA in modern day hospital systems.

Conclusion

To conclude, the project found that a web-based educational module is an effective method to increasing provider knowledge of CA prevention, as evidenced by increased posttest evaluation scores. This finding could lead to expanded use and successful implementation of web-based education in future QI projects. In addition, the results from this project could assist in the development of CA prevention protocols.

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APPENDIX A: WAKE FOREST UNIVERSITY HEALTH SCIENCES IRB APPROVAL

WAKE FOREST
UNIVERSITY
HEALTH SCIENCES

Office of Research
INSTITUTIONAL REVIEW BOARD

MEMORANDUM

To: Karen Lucisano
Clinical and Translational Science Institute {CTSI}

From: Jeannie Sekits, Senior Protocol Analyst
Institutional Review Board

Date: 6/23/2023

Subject: Exempt Protocol: IRB00097733
Corneal Abrasions: An Educational-Based Prevention Approach

No protected health information will be used or disclosed in this research proposal; therefore the requirement for individual Authorization does not apply.

This research meets the criteria for a waiver of HIPAA authorization according to 45 CFR 164.512.

Based on the information provided, the IRB has determined that HIPAA does not apply to this study.

Note that only the Wake Forest University School of Medicine IRB can make the determination for its investigators that a research study is exempt. Investigators do not have the authority to make an independent determination that research involving human subjects is exempt. Each project requires a separate review and approval or exemption. The Board must be informed of any changes to this project, so that the Board can determine whether it continues to meet the requirements for exemption.

The Wake Forest School of Medicine IRB is duly constituted, has written procedures for initial and continuing review of clinical trials; prepares written minutes of convened meetings, and retains records pertaining to the review and approval process; all in compliance with requirements of FDA regulations 21 CFR Parts 50 and 56, HHS regulations 45 CFR 46, and International Conference on Harmonisation (ICH) E6, Good Clinical Practice (GCP), as applicable. WFSM IRB is registered with OHRP/FDA; our IRB registration numbers are IRB00000212, IRB00002432, IRB00002433, IRB00002434, IRB00008492, IRB00008493, IRB00008494, and IRB00008495.
WFSM IRB has been continually fully accredited by the Association for the Accreditation of Human Research Protection Programs (AAHRPP) since 2011.

Medical Center Boulevard, Winston-Salem, NC 27157-1023 (336) 716-4542 / fax (336) 716-4480

APPENDIX B: UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE IRB APPROVAL

CHARLOTTE
DIVISION OF RESEARCH

To:	Megan Frowine University of North Carolina at Charlotte
From:	Office of Research Protections and Integrity
Approval Date:	28-Jul-2023
RE:	Notice of Determination of Exemption
Exemption Category:	1
Study #:	IRB-24-0007
Study Title:	An Educational-Based Approach to Prevent Corneal Abrasions

This submission has been reviewed by the Office of Research Protections and Integrity (ORPI) and was determined to meet the Exempt category cited above under 45 CFR 46.104(d). This determination has no expiration or end date and is not subject to an annual continuing review. However, you are required to obtain approval for all changes to any aspect of this study before they can be implemented and to comply with the Investigator Responsibilities detailed below.

Your approved consent forms (if applicable) and other documents are available online at Submission Page.

Investigator's Responsibilities:

1. Amendments **must** be submitted for review and the amendment approved before implementing the amendment. This includes changes to study procedures, study materials, personnel, etc.
2. Researchers must adhere to all site-specific requirements mandated by the study site (e.g., face mask, access requirements and/or restrictions, etc.).
3. Data security procedures must follow procedures as described in the protocol and in accordance with OneIT Guidelines for Data Handling.
4. Promptly notify the IRB office (uncc-irb@charlotte.edu) of any adverse events or unanticipated risks to participants or others.
5. Five years (5) following this approval/determination, you must complete the Admin-Check In form via Niner Research to provide a study status update.
6. Be aware that this study is included in the Office of Research Protections and Integrity (ORPI) Post-Approval Monitoring program and may be selected for post-review monitoring at some point in the future.
7. Reply to the ORPI post-review monitoring and administrative check-ins that will be conducted periodically to update ORPI as to the status of the study.
8. Complete the Closure eform via Niner Research once the study is complete.

APPENDIX C: GANTT CHART

GANTT CHART

A Gantt Chart provides an visualization of project deliverables that includes start and end dates for each task

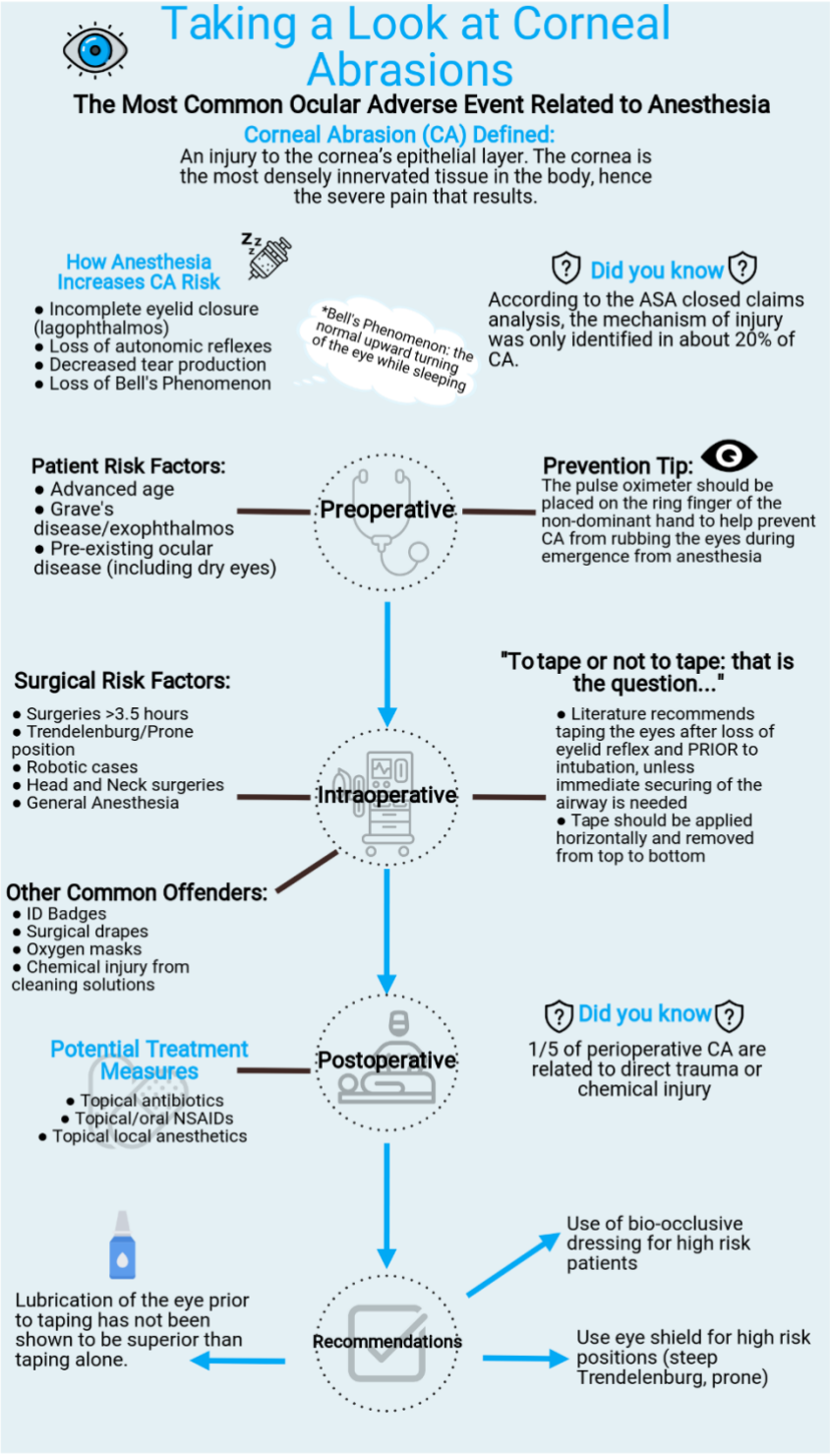
Corneal Abrasions: An Educational-Based Prevention Approach

Project Start: Mon, 8/15/2022

PHASE ONE | PHASE TWO | PHASE THREE | PHASE FOUR

TASK	ASSIGNED TO	PROGRESS	START	END
PROJECT DEVELOPMENT I				
Need Assessment	Name	100%	8/15/22	10/17/22
TOPIC APPROVAL		100%	10/17/22	11/30/22
TOPIC APPROVAL PRESENTATION		100%	11/30/22	12/5/22
PROJECT DEVELOPMENT II				
REVIEW OF LITERATURE		100%	1/9/23	2/15/23
MAPPING OF THE PROJECT		50%	2/15/23	3/15/23
DRAFT OF SCHOLARLY PAPER		0%	4/3/23	4/11/23
ORAL PROJECT DEFENSE		0%	4/18/23	4/18/23
SECTIONS I & II OF SCHOLARLY PAPER WITH REVISIONS		40%	4/19/23	4/26/23
SUBMISSION OF IRB TO ATRIUM HEALTH, WAKE FOREST,&UNCC				7/28/23
PROJECT DEVELOPMENT III				
Development of Educational Module			4/26/23	5/22/23
Introduction of Web-Based Module to Anesthesia Providers			7/31/23	9/5/23
Evaluate Participants Results			9/5/23	9/15/23
Project Development IV				
Statistical Data Analysis			9/15/23	10/6/23
Discussion of Findings and Implications			10/6/23	10/27/23
Final Draft of Scholarly Paper to Committee			11/3/23	11/17/23
Final Defense Presentation			12/1/23	12/8/23

APPENDIX D: EASELLY INFOGRAPHIC



APPENDIX E: PRE-TEST EVALUATION

What is your role with Atrium Health anesthesia?

a. Anesthesiologist (MDA)
b. Certified Registered Nurse Anesthetist (CRNA)

If you are a licensed anesthesia provider, how long have you been practicing?

c. <5 years
d. 6–10 years
e. 11-15 years
f. 16+ years

1What is the most common ocular adverse event related to anesthesia?

a. Postoperative vision loss

b. Corneal abrasions

c. Increased intraocular pressure

d. Conjunctivitis

2. In the preoperative area, which finger is optimal for pulse oximeter probe placement?

a. Index finger of non-dominant hand
b. Middle finger of non-dominant hand
c. Ring finger of dominant hand
d. Ring finger of non-dominant hand

3. All of the following are common offenders of corneal abrasion except:

a. ID badges
b. Surgical drapes
c. Tegaderm dressing
d. Oxygen masks

4. What is the optimal time to tape the eyes closed during induction?

a. Before confirming mask ventilation
b. After confirming mask ventilation
c. Just before intubation
d. Just after intubation

5. Which statement is true:

a. Tegaderm/biooclusive dressing has been found to be the best prevention intervention with lower rates of ocular injuries
b. Studies have shown no significant improvement in corneal abrasion prevention by applying lubricating eye ointment prior to taping eyelids
c. All perioperative CA are related to direct trauma or chemical injury
d. Intra-operative CA can be attributed to the enhancement of Bell's phenomenon

6. What is the proper method to remove protective eye tape prior to patient emergence?

a. Bottom to top
b. Top to bottom
c. Horizontally
d. The literature says it shouldn't matter

7. Which is NOT a risk factor for corneal abrasions:

a. Surgeries lasting longer than 3.5 hours
b. Obesity
c. Supplemental oxygen en route to the Post-Anesthesia Care Units
d. Trendelenburg position

8. According to the American Society of Anesthesiologists Closed Claims analysis, the mechanism of injury was identified in what percentage of corneal abrasion claims?

a. 10%
b. 15%
c. 20%
d. 25%

9. All of the following heightens the risk for corneal abrasions during general surgery, except:

a. Loss of autonomic reflexes
b. Decreased tear production
c. Absence of the blink reflex
d. Complete closure of the eyelids (lagophthalmos)

10. All of the following agents have been used for CA treatment except:
a. Topical antibiotic ointments/drops
b. Topical or oral NSAIDs
c. Topical anesthetics
d. Antihistamine drops

APPENDIX F: POST-TEST EVALUATION

1. What is the most common ocular adverse event related to anesthesia?

    a. Postoperative vision loss

    b. Corneal abrasions

    c. Increases intraocular pressure

    d. Conjunctivitis

2. In the preoperative area, which finger is optimal for pulse oximeter probe placement?

    a. Index finger of non-dominant hand

    b. Middle finger of non-dominant hand

    c. Ring finger of dominant hand

    d. Ring finger of non-dominant hand

3. All of the following are common offenders of corneal abrasion except:

    a. ID badges
    b. Surgical drapes
    c. Tegaderm dressing
    d. Oxygen masks

4. What is the optimal time to tape the eyes closed during induction?

    a. Before confirming mask ventilation
    b. After confirming mask ventilation
    c. Just before intubation
    d. Just after intubation

5. Which statement is true:

    a. Tegaderm/biooclusive dressing has been determined to be the best prevention intervention with lower rates of ocular injuries
    b. Studies have shown no significant improvement in corneal abrasion prevention by applying lubricating eye ointment prior to taping eyelids
    c. All perioperative CA are related to direct trauma or chemical injury
    d. Intra-operative CA can be attributed to the enhancement of Bell's phenomenon

6. What is the proper method to remove protective eye tape prior to patient emergence?

    a. Bottom to top
    b. Top to bottom
    c. Horizontally
    d. The literature says it shouldn't matter

7. Which is NOT a risk factor for corneal abrasions:

a. Surgeries lasting longer than 3.5 hours
b. Obesity
c. Supplemental oxygen en route to the Post-Anesthesia Care Units
d. Trendelenburg position

8. According to the American Society of Anesthesiologists Closed Claims analysis, the mechanism of injury was identified in what percentage of corneal abrasion claims?

e. 10%
f. 15%
g. 20%
h. 25%

9. Patients are at an increased risk for corneal abrasions during general anesthesia except for:

a. Loss of autonomic reflexes
b. Decreased tear production
c. Absence of the blink reflex
d. Complete closure of the eyelids (lagophthalmos)

10. All of the following agents have been used for CA treatment except:
e. Topical antibiotic ointments/drops
f. Topical or oral NSAIDs
g. Topical anesthetics
h. Antihistamine drops