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Anesthesia Provider Education to Increase the Use of Apneic Oxygenation in the Difficult Airway Patient

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**Anesthesia Provider Education to Increase the Use of Apneic Oxygenation in the Difficult
Airway Patient**

A DNP Project Presented to the Faculty of the
Nicole Wertheim College of Nursing & Health Sciences
Florida International University

In partial fulfillment of the requirements
For the Degree of Doctor of Nursing Practice

By

Ian Diaz MSN, BSN, RN

Supervised By

Dr. Arturo Gonzalez DNP, APRN, ANP-BC, CWCN-AP

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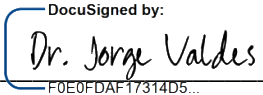
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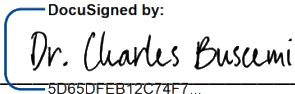
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Abstract

Background: Apneic Oxygenation (AO) is proven to limit the occurrence of hypoxemic episodes in difficult airway patients. However, this approach to care is often overlooked when providing care for these patients.

Objective: The objective of this quality improvement project was to increase provider knowledge of AO and its use in managing the difficult airway patient.

Methods: A quasi-experimental study examining the knowledge of providers regarding the use of AO was conducted. Provider knowledge of AO was assessed before and following an educational intervention to increase knowledge. Comparisons of baseline and post-education knowledge were conducted and the implications of the findings are discussed.

Results: In total, five certified registered nurse anesthetists (CRNAs) were enrolled in the project. Although the sample was too small to inferentially compare pre- and post-intervention results, the data indicated a mean score increase from 65% on the pre-test to 100% in the post-test, suggesting that knowledge scores for providers did increase following the educational program.

Conclusion: The results do indicate that in CRNAs working at the practice site, knowledge of AO increased following education. When paired with the evidence base on this topic, there is strong evidence to support provider education to increase the use of AO in practice.

Keywords: Apneic oxygenation, AO, difficult airway, CRNA, education

Anesthesia Provider Education to Increase the Use of Apneic Oxygenation in the Difficult Airway Patient

Introduction

Problem Statement

Current evidence indicates that when intubating a patient, preoxygenation is typically used to increase safe apnea time for the patient and to reduce hypoxemia.¹⁻³ While preoxygenation has become a standard element of patient care, in recent years the extension of the benefits of preoxygenation has been shown to be possible with the application of apneic oxygenation.⁴ Apneic oxygenation has been shown to extend the safe apnea period while also reducing the incidents of rapid oxygen desaturation and acute hypoxemia.⁴ Additionally, the use of this technique serves to increase anesthesia provider first pass rate⁶ while also reducing patient morbidity and mortality associated with intubation.⁷ However, AO is not as widely used as preoxygenation in treating patients.⁵ This is distressing, especially in light of the fact that the technique is easy to employ and has few adverse implications for the health outcomes that result for the patient.⁸ With these issues in mind, it becomes evident that to improve care for patients and enhance provider competence in managing difficult airway patients, anesthesia providers need to use AO more frequently and integrate the practice as part of standard patient care.

Significance

The incidence of difficult airway management has been reported to occur in as many as 10% of patients requiring intubation.⁹ Failure to adequately intubate the patient adequately typically occurs in 65% of difficult airway patients.⁹ When patients with difficult airways are not properly intubated and ventilated, this can result in an accelerated rate of oxygen desaturation and higher rates of acute hypoxemia.¹⁰ Further, evidence suggests that when rapid oxygen

desaturation occurs, patient rescue becomes more difficult, increasing the rates of patient morbidity and mortality.¹⁰ Apneic oxygenation provided as an extension of preoxygenation has been shown to reduce sudden oxygen desaturation and incidence of acute hypoxemia.^{1,4} Because the evidence to support the use of AO in practice is so robust, failure on the part of advanced practice nurses to ignore the evidence could be viewed as being tantamount to patient negligence.

Improving outcomes for the difficult airway patient has been shown in the literature to have systemic benefits for healthcare providers and the healthcare system. For anesthesia providers that are responsible for managing the airway of the patient, intubating the difficult patient can result in increased stress and failure to adequately manage the airway.¹¹ If severe complications for the patient result, anesthesia providers may find themselves subjected to claims of negligence or malpractice.¹² In the context of the healthcare system, current evidence¹³ does indicate that care costs for the difficult airway patient are significantly higher than for patients that require uncomplicated intubations. Specifically, evidence¹³ indicates that average care costs for the critically ill patient requiring intubation are typically \$4,029 higher than for critically ill patients that do not require intubation. When the intubation is performed on difficult airway patients the average costs of care increase by an average of \$14,468 due, in large part, to the complications associated with intubation and resultant hypoxemia.¹³

Based on this assessment the significance of the problem becomes quite evident. Difficult intubations will be a part of employment for most anesthesia providers. Therefore, finding effective methods to improve these types of intubations will be imperative. Failure to address this issue, especially in light of evidence supporting the use of AO for difficult airway patients^{1,4} could have systemic consequences for patient health outcomes as well as provider performance

and the entire healthcare system. Given the significance of the issue and the availability of an evidence-based solution to the problem, there is an impetus to make change such that more anesthesia providers utilize evidence-based practice to deliver the best possible patient care.

Background

Difficult intubation poses a significant challenge for anesthesia providers. The scope of the challenge is reviewed by Pratt and Miller who note that difficult intubations result in 27% of all adverse respiratory events.¹ Further, these authors report that 93% of these events are unanticipated.¹ When these events occur, patients are at increased risk of acute hypoxemia.¹ This can be exacerbated by specific patient characteristics including underlying lung pathology, obesity, increased metabolic demands, or age (i.e., pediatric patients).² To improve outcomes for the difficult airway patient, preoxygenation techniques or the administration of oxygen prior to intubation, are commonly used.³ Preoxygenation serves to increase oxygen stores in the body to help delay the development of desaturation during apnea.³ Although preoxygenation is typically used in the difficult airway patient to delay the onset of apnea, emerging evidence suggest that there are additional actions that can be taken to help reduce desaturation and the onset of acute hypoxemia.^{1,4} In particular, current evidence supports the use of preoxygenation followed by apneic oxygenation (AO) to reduce hypoxemia and adverse respiratory outcomes in the difficult airway patient.^{1,4}

Despite the fact that AO has been extensively supported in the literature, current evidence does indicate that many anesthesia providers do not utilize this technique during patient care.⁵ In particular, scholars note that over the course of the last two decades, marked advances in airway management have emerged; however training for anesthesia providers continues to lag, resulting in ongoing challenges for improving care of the patient.⁵ With these issues in mind, the focus of

this quality improvement project is to furnish education to anesthesia providers regarding the use of AO to improve airway management in patients undergoing difficult intubation. To undertake this quality improvement project, a proposal for each element of the project is reviewed in this document. In particular, this proposal includes a review of the following issues as they relate to the proposed project: problem statement, significance, summary of the literature, purpose, the clinical question, objectives, definition of terms relevant to the project, the theoretical model to guide the project, the methodology, and timeline for completing the project.

Literature Review

Overview of Apneic Oxygenation

As reported in the literature, apneic oxygenation involves the administration of oxygen to the respiratory tract to increase the period of safe apnea time for the patient beyond the preoxygenation period⁶. Safe apnea time is defined as the duration of time between the cessation of breathing/ventilation and critical arterial decompensation.^{14,15,16} Critical arterial decompensation of the patient following breathing cessation typically occurs when oxygenation saturation (SaO₂) rates fall between 88% and 90%.^{14,16} Once the patient reaches this threshold, rapid decompensation typically occurs with additional declines in the partial pressure of oxygen (PaO₂) leading to an average of a 30% decline in SaO₂ every minute.¹⁶ Safe apnea time for an otherwise healthy preoxygenated patient can last between 8 and 9 minutes.^{14,15} However, the average safe apnea time can be reduced in certain patient groups including those who are young (pediatric patients) overweight/obese, pregnant, critically ill, have severe lung disease, or are experiencing airway occlusion.¹⁷

Apneic oxygenation has been shown in various studies to increase the amount of safe apnea time while reducing the incidence of acute hypoxemia for the patient including those that

are critically ill or require emergency intubation.^{18,19} Theoretical evaluations of safe apnea times when using AO indicate that PaO₂ can be stabilized for up to 100 minutes without the patient taking a single breath.²⁰ Even though this does highlight the efficacy of AO in extending safe apnea time, scholars do note that maintaining PaO₂ at this level without ventilation of the patient will result in significant hypercapnia and acidosis.²⁰ In various studies examining AO for specific patient populations,^{1,14,14,18,19} evidence has consistently demonstrated that this approach can extend safe apnea time for the patient by several minutes. This extra time can be essential for preventing oxygen desaturation in critically ill patients.^{1,18,19} Once oxygen desaturation for the patient begins it can be difficult to reverse without complications for the patient.^{1,14,17} A closer look at AO provides a more complete understanding of the advantages that the technique can offer for both patients and providers.

The primary health advantage of AO for the patient stems from the technique's ability to extend safe apnea time, prevent oxygen desaturation, and limit episodes of acute hypoxemia.^{1,14,17,18,19} Apneic oxygen increases the oxygen concentration available throughout the respiratory system, facilitating effective gas exchange when the patient is not breathing.²¹ If proper gas exchange is not maintained, hypoxemia can result in reduced tissue oxygenation or hypoxia throughout the body.²¹ These conditions are life threatening and if left untreated can result in respiratory failure, cardiac arrhythmia, damage to the brain and nervous system, coma, cardiac arrest, and death.²¹ In addition to the fact that AO has been shown to prevent desaturation and the onset of acute hypoxemia in various patient groups, the technique has also been shown to improve patient outcomes such as reducing hospital length of stay, morbidity and mortality.^{6,7,22,23} What this evidence demonstrates is that AO as an adjunct to preoxygenation in patients can have systemic implications for patient health in both the short- and long-term.

The advantages of AO extend beyond the patient to the provider as well. Scholars reviewing the technique assert that AO is easy to administer via nasal canula and can be applied in difficult or challenging care situations: i.e., if the patient is lying on their side or actively vomiting.²⁴ Further, AO can seamlessly be combined with preoxygenation to ensure that oxygen flow to the upper airway of the patient occurs uninterrupted.^{1,14,24} The use of AO has also been shown to provide anesthesia practitioners with additional time to determine a more definitive airway management plan in critically ill patients.²⁵ Additionally, AO has been shown to improve first pass success without hypoxemia for critically ill patients requiring intubation in the emergency room.^{6,7} This data demonstrates that providers will be able to enhance patient care through the use of apneic oxygenation.

The advantages of AO should be juxtaposed against the disadvantages of using this technique in practice. Evidence indicates that the nasal canula may be uncomfortable for some patients including those with nasal obstructions.^{24,25} The nasal canula flow rate required is typically delivered without heating or humidification which can be uncomfortable for some patients.²⁴ In critically ill patients that are experiencing a decline in oxygenation, altered mental status can exacerbate this situation.²⁵ Additionally, there are reports that there is a potential risk for barotrauma.²⁶ However this evidence indicates that barotrauma is more likely when cannula air flow rates are above 70 L/min.²⁶ Air flow rates between 30 and 45 L/min have been shown to have an excellent safety profile.²⁶ When the advantages of AO are compared with concerns over the use of the technique, it is possible to see that the advantages for the patient and provider far exceed the disadvantages.

Evidence Supporting the Use of AO

With a general review of apneic oxygenation provided, it is now possible to consider the results that have been reported regarding patient outcomes when using this technique. A cursory review of the literature does indicate that AO has been used in various patient groups to extend the safe apnea period and to reduce episodes of acute hypoxemia.^{1,7,18,19} This includes patients requiring emergency and critical care.^{6,27,28,29} Evidence has also demonstrated secondary benefits of AO for patients beyond increasing safe apnea time including reducing patient length of stay, morbidity, and mortality.^{6,7,22,23} A review of this evidence to support the use of AO in practice is provided here.

AO in Surgical Patients

A review of the use of AO in general surgical patients indicates that this technique does have marked benefits for increasing safe apnea time as well as for reducing acute hypoxemia. Rajan et al,¹⁸ for instance, note the use of a controlled trial in which 20 surgical patients were allocated to one of two groups: those receiving preoxygenation and those receiving preoxygenation followed by AO. When compared with the preoxygenation group only, the preoxygenation/AO group had significantly longer apnea time: 816.00 ± 30.98 vs. 348.00 ± 122.64 s, respectively. Further, Rajan et al report that no one in the AO group desaturated until 12 minutes of apnea compared with an average of 6 minutes in the preoxygenation group. Similar outcomes were reported by Wong et al¹⁹ who compared safe apnea times for AO in 40 bariatric surgical patients assigned to receive either preoxygenation or preoxygenation followed by AO. Overall, the results presented by Wong and coauthors indicated that safe apnea time was extended by 76 seconds or 40% for the AO group: 261.4 ± 77.7 vs 185.5 ± 52.9 seconds; [95% CI], 75.9 [33.3–118.5]; $P = .001$, respectively.

Other studies regarding the use of AO to extend safe apnea time and reduce acute hypoxemia have further confirmed the efficacy of this technique. In particular, Pratt and Miller¹ completed a systematic review of the literature to evaluate the impact of AO on patient outcomes. In this review a total of 9 studies were examined including randomized controlled trials reviewing multiple approaches to AO. The results of the analysis indicated notable consistency across all studies with the addition of AO significantly increasing the safe apnea period while also reducing hypoxemia during this time. Similarly a systematic review and meta-analysis completed by Silva et al⁷ further demonstrates the efficacy of AO in improving safe apnea times. In this research, the authors reviewed 8 quantitative studies involving 1837 patients. The authors found that in surgical patients, apneic oxygenation was associated with a decreased risk of hypoxemia: odds ratio [OR] 0.66; 95% CI 0.52 to 0.84.

AO in Emergency Care

Not surprisingly, similar results have been noted when AO is utilized for the emergency care of critically ill patients. For example, Binks et al⁶ completed a systematic review and meta-analysis of 6 trials involving 1822 patients requiring intubation in the emergency room. The authors found that when apneic oxygenation was applied there was not only a significant reduction in oxygen desaturation (relative risk [RR] = 0.76, p = 0.002) but also critical desaturation (RR = 0.51, p = 0.01). In a similar vein of inquiry Tan et al²⁷ also completed a systematic review and meta-analysis in which 10 studies involving 2322 patients requiring emergency intubation was needed. In patients that were provided with AO, the relative risk of oxygenation saturation was markedly reduced when compared with patients that received only preoxygenation (RR = 0.76; 95% CI, 0.61 to 0.95; P = 0.02). However, no statistically significant difference in severe oxygen desaturation was noted.

Additional data provided from empirical trials have also supported the use of AO in reducing hypoxemia in the critically ill patient. Sakles et al,²⁸ for instance, utilized a prospective controlled trial to evaluate outcomes for 127 patients seen in an emergency department with intercranial hemorrhage. Among these patients 72 received AO with the remainder receiving preoxygenation only. When AO was provided, oxygen desaturation occurred in 7% of patients compared with 29% in the preoxygenation group only. Additionally, Doyle et al²⁹ completed a prospective observational study in which 71 sequential patients requiring intubation in the emergency room were treated using either preoxygenation alone or preoxygenation with AO. In patients provided with AO compared with preoxygenation only, safe apnea time was higher, 60 versus 125 seconds and decreases in SpO₂ were lower, 1% versus 3%. Further the authors reported that there were no complications or adverse events associated with using AO in conjunction with preoxygenation.

Additional Benefits of AO

While the primary benefits of using AO for extending safe apnea time and reducing incidents of acute hypoxemia have clearly been demonstrated in the literature, it is also helpful to note the secondary benefits reported from using this technique. Binks et al⁶ and Silva et al⁷ both report significantly higher first pass success rates when using AO. More specifically, Binks and coauthors⁶ reported that first pass intubation success rate was higher when AO was used: RR = 1.09, p = 0.004. Silva and coauthors⁷ noted similar results: OR 1.59; 95% CI 1.04 to 2.44. Success on this measure is important as it helps to reduce the risk of adverse airway events^{6,7}. Consequently this outcome has clinical importance for the health and well-being of the patient both in the short- and long-term.

Additional benefits associated with the use of apneic oxygenation have also been reported in the literature. For instance, Holyoak et al²² and Russotto et al²³ reported decreases in patient length of stay, morbidity, and mortality for patients receiving AO. These studies included patients seeking emergency care, pediatric patients, and patients undergoing various types of surgical procedures. More specifically, Holyoak et al²² reported a significant difference in mortality for patients provided with AO during intubation (RR = 0.61, p = 0.002) as well as a 30% reduction morbidity. Russotto et al²³ reported a 25% reduction in patient length of stay following AO use during intubation. Synthesis of this data does indicate that while AO can improve short-term outcomes for airway management in the patient, this technique can also enhance long-term outcomes for the patient including reducing disability and death. Although these benefits are not the focus of the proposed quality improvement project, these outcomes further highlight the systemic benefits that can be achieved through the use of apneic oxygenation.

Education of Anesthesia Providers

Despite the myriad benefits of using AO in practice, many anesthesia providers fail to utilize this technique as part of standard care for the patient.⁵ Education and training to help improve this situation has been extensively supported in the literature.^{2,30,31,32} Pek et al,³⁰ for example, consider the use of anesthesia provider training delivered via classroom education and simulation to improve the use of AO in the care of pediatric patients undergoing surgery. Pek and coauthors report that use of AO following the training program resulted in a 76% increase in use of the technique. Although this study utilized a quality improvement framework that was specific to a single site, the authors do assert that the program can be applied to any healthcare facility where anesthesia providers work. Karlik and Aziz³¹ further support the need for

anesthesia providers to acquire additional training for effective airway management including the use of AO. As noted by these authors, training should include provider education regarding core clinical skills as well as hands-on education to familiarize patients with the technique and the anticipated patient response.

Additional research provided by McKown et al² indicates that lower levels of provider training have been implicated in increased rates of hypoxemia during tracheal intubation of critically ill patients. In this investigation, McKown and coauthors evaluated data from 433 intubations that were reported in 2 separate randomized controlled trials. The authors found that when anesthesia providers—including those from nursing and medical backgrounds—received additional training for using AO and evidence-based airway management, episodes of acute hypoxemia were reduced. Finally, Sohn et al³² note that there is currently a significant gap between evidence-based practice for effective airway management including the use of AO. These authors contend that training of providers has consistently been shown in the literature as one of the most effective methods for addressing this gap.

Limitations of the Research

Although the evidence presented here provides a robust foundation upon which to undertake practice change, there are some limitations that are noted when reviewing the research. In particular evidence supporting the use of AO indicates that there are few high-quality randomized controlled trials reviewing the topic. While there are systematic reviews and meta-analyses that provide quantification for the benefits of using AO in practice, there are few current randomized controlled trials that demonstrate definitive cause-effect relationships for using AO in practice. Many of the studies conducted on this topic involve prospective or retrospective designs that were not initially implemented for the purposes of identifying causality in the

findings. Consequently, there is a need to consider this issue when evaluating the strength of the literature to support practice change.

Also of concern when reviewing the literature regarding the education or training of anesthesia providers is a lack of clear consensus regarding what specific educational approaches should be used to increase provider knowledge and use of the approach in practice. In addition to the fact that the literature on this topic is relatively scant, the specific methods that can be used to optimize learning for anesthesia providers is not clearly delineated. While some studies support the use of classroom education combined with hands-on education,^{30,31} other scholars report that the use of classroom instruction alone may be useful for improving the provider awareness and use of the technique.^{2,32} These issues are important to consider from a quality improvement standpoint as an effort should be made to utilize optimal instructional strategies for building provider knowledge regarding apneic oxygenation.

Additional limitations from the research include the lack of generalizability in the empirical studies that were conducted to evaluate outcomes from the use of AO and for providing training to use AO in practice. Many of the studies included single sites in which quality improvement projects were implemented.^{6,7,18,19,20,21} Even though the results of this research does support the use of AO in practice and further the use of anesthesia provider training, the methodologies employed limit the generalizability of the results to other practice settings. This is an important consideration for the translation of evidence into practice and may impact the outcomes of any quality improvement project aimed at improving provider education and use of AO in practice.

Summary of the Literature

A synthesis of the literature reviewed in this document does demonstrate that apneic oxygenation when used in myriad patient populations including critically ill patients with difficult airways can increase safe apnea time while also reducing the incidence of acute hypoxemia. Further, the literature demonstrates that there are notable gaps in the use of AO among anesthesia providers. This gap is significant and has the potential to prevent providers from delivering the best possible care for the patient. Gaps in knowledge and use of AO for providers can be addressed through the use of education and training. Based on this evidence, there appears to be ample support for implementing a practice change aimed at providing education to increase anesthesia provider knowledge and use of apneic oxygenation in all patients including those with difficult airways.

Purpose/PICO Clinical Question/Objectives

To operationalize the literature and to address the issue of poor anesthesia provider uptake of OA in practice, the purpose, PICO (population, intervention, comparison, outcome) clinical question, and objectives for the project must be delineated. The purpose of this quality improvement project is to increase anesthesia provider uptake of apneic oxygenation through provider training. The PICO clinical question formulated to guide this project is as follows:

- In anesthesia providers who are working in an acute care facility (**P**) who are provided with an educational module regarding the use of apneic oxygenation for the difficult airway patient (**I**) does knowledge of AO increase (**O**) as compared with knowledge before the educational module (**C**)?

Breaking this question down by respective P, I, C, and O elements, the following is observed:

- P: Anesthesia practitioners working in an acute care facility.

- I: Educational module regarding AO for the difficult airway patient.
- C: Knowledge before the educational intervention.
- O: Knowledge increase following the educational module.

While the primary goal of the project is to increase anesthesia provider use of AO in the difficult airway patient, achieving this goal will require a consideration of what SMART (specific, measurable, achievable, relevant, and time-bound) objectives must be implemented in order to ensure that the primary goal is met. A review of the literature regarding the use of apneic oxygenation does indicate that provider education to understand the importance and methods used in applying this support in clinical practice can be helpful.³⁰ Providing education will require organizational support as well as the development of an educational module that can be provided to anesthesia practitioners to learn new information about the use of AO in providing patient care. Additionally, an evaluation of education and its implications for provider knowledge must be assessed to determine if there is a foundation upon which to expect a change in behavior that will lead to an increased use of AO in practice. Based on this assessment, four SMART objectives were identified that should serve as the basis for structuring and guiding the DNP project.

- **Objective 1:** Within a one-month period, secure organizational leadership approval to undertake an educational program to increase provider knowledge of AO in the difficult airway patient.
- **Objective 2:** Within one month of acquiring leadership approval create an educational module focused on providing anesthesia providers with knowledge to use AO as part of standard care for the difficult airway patient.

- **Objective 3:** Offer anesthesia providers at the practice site with education to increase their knowledge of AO and its use in the difficult airway patient.
- **Objective 4:** Assess anesthesia provider learning from the educational module to ensure that all providers are able to score at least 90% on a test of AO knowledge.

While these SMART objectives do not specifically address the primary goal to increase anesthesia provider use of AO in practice, these goals should serve as the basis for providers to change their behavior. Current evidence provided in the literature does indicate that education when delivered to healthcare providers often serves to raise awareness of key challenges while also providing practical knowledge needed to foster practice change.³⁰ In short, increased awareness and knowledge of the topic should lead to a change in behavior in which education leads to an increased use of apneic oxygenation. Therefore, the primary outcome that can be measured for this project is focused on knowledge acquisition by anesthesia providers to increase their use of AO in the management of the difficult airway patient.

Definition of Terms

Terms specific to this proposed DNP project are defined here to provide additional clarity regarding the scope of the proposed practice change. In particular, the following terms were noted to need clarification:

- **Preoxygenation:** The administration of oxygen prior to the administration of anesthesia.³ This process increases oxygen reserves in the body to prevent adverse outcomes including hypoxemia for the patient.³
- **Hypoxemia:** A biological state in which the oxygen levels in the body are below normal levels.¹ This can have a systemic impact on tissue and organ function.¹

- Apneic oxygenation: The passive flow of oxygen into the lungs during apnea.⁴ AO can be applied following preoxygenation to extend safe apnea time and prevent hypoxemia.⁴
- Safe apnea time: Duration of time between the cessation of breathing or ventilation for the patient and when oxygen saturation rates fall between 88% and 90%.¹⁴ When the oxygenation rate for the patient reaches this level, oxygen desaturation and hypoxemia are likely to occur.¹⁴
- Oxygen saturation/desaturation: Oxygen saturation indicates that the levels of oxygen in the blood are normal.³ Oxygen desaturation indicates that the levels of oxygen in the blood are below normal and can result in hypoxemia.³

Theoretical Model

The theoretical framework selected to guide the development of this project was a translational science model for evidence-based practice known as the Stetler Model. A review of the model indicates that it includes 5 specific stages that are designed to help nurses effectively translate evidence into practice.³³ These 5 stages include the following: preparation, validation, comparative evaluation/decision making, translation/application, and evaluation.³³ Preparation involves identification of the problem both in terms of the organization and the scholarly literature.³³ Validation involves a critical evaluation of the literature to substantiate the scope of the problem and to identify solutions that may be useful for addressing the problem in the practice setting.³³ Comparative evaluation and decision making requires a thorough assessment of the literature to ensure the credibility of the evidence as well as to determine the fit of the solution in the context of the organization.³³ Once these issues have been evaluated, a decision can be made regarding what action to take in terms of making practice change.³³

The decision for action made during the third stage of the Stetler Model will result in building the change that will be translated and applied in practice during the fourth step of the model.³³ Translation and application focus on the actual implementation of change.³³ The final step in the model focuses on an evaluation of what occurred as a result of the change.³³ Evaluation can include various actions such as comparing project outcomes to organizational performance before the change and/or comparing the results to the literature to see if the evidence used to build the project is supported.³³ This model can help guide the translation of evidence into practice by providing an organized framework upon which to create successful change.

Through an application of this translational science model to the proposed DNP project, it should be possible to structure the change to ensure the best possible outcomes. A consideration of how each step of the Stetler Model can be applied to the proposed project is reviewed here:

- **Stage 1, Preparation:** This has been completed to some extent through an identification of the problem (lack of use of AO in anesthesia providers) at both the facility and through the literature.
- **Stage 2, Validation:** The problem of lack of AO use among providers has been validated through a review of the literature and critique of an evidence-based solution for change: i.e., provider education.
- **Stage 3, Comparative Evaluation/Decision Making:** The evidence from the literature has been considered in the context of the organization through the SWOT analysis included in this document. Further a decision has been made to use provider education as the primary means to increase anesthesia provider use of AO in the difficult airway patient.

- **Stage IV, Translation/Application:** This will occur through approval of the DNP project via Institutional Review Board (IRB) approval and providing direct education for providers.
- **Stage V, Evaluation:** This will occur after the educational program and will involve an assessment of provider knowledge to determine if providers have acquired the requisite knowledge needed to use AO in practice.

Methodology

To implement this quality improvement project in practice a methodology is needed. For the purposes of this proposed project, the goal is to increase provider knowledge of AO with the idea that this increase in knowledge will lead to a change in behavior that will increase anesthesia provider use of AO in the difficult airway patient. To achieve this goal an intervention—i.e., provider education—will be utilized. This implies that the methodology being employed will involve an experimental approach. The outcome measure being assessed is provider knowledge and this will be compared with provider knowledge before the educational program. Consequently, this implies that the methodology will involve a pre- and post-intervention framework to evaluate outcomes.

Studies that employ an experimental framework in which a control or comparison group are used typically fall into one of two categories: randomized controlled trials or quasi-experimental studies.³⁴ Randomized controlled trials employ a control group and randomization of subject participants to control and experimental groups while quasi-experimental studies may lack a control group, randomization, or both.³⁴ In this project, a control group (pre-intervention knowledge scores) will be employed; however, randomization will not. Thus, the methodology employed for this project will be a quasi-experimental approach. To provide a more detailed

review of how this methodology will be applied, this section includes a review of the setting and participants for the project, the procedures proposed for use, steps that will be taken to protect human subjects, methods for data collection, methods for data analysis and management, and a discussion of the potential results and their implications for advanced practice nursing.

Setting and Participants

The setting for this project will be a large suburban/urban acute care facility operating in South Florida. The organization is part of a larger nonprofit healthcare system that currently operates various types of healthcare facilities across the United States. The facility provides a wide range of inpatient and outpatient services including those that require the support of anesthesia providers. Presently there more than 50 anesthesiology providers associated with the facility in a full- or part-time capacity including 12 certified registered nurse anesthetists (CRNAs) and 7 physician assistants (PAs). Although the project is aimed at anesthesiology providers, the participants sought for this project would include non-physician providers who may benefit more from continuing education regarding AO including CRNAs and PAs. Consequently, while an effort will be made to recruit all anesthesia providers currently working in the organization, an emphasis will be placed on specifically recruiting CRNAs and PAs for the project.

Approach and Procedures

To begin the project, leaders at the facility will be approached about supporting a practice change to deliver education regarding the use of AO for the difficult airway patient to anesthesia providers working at the facility. Once approval from organizational leaders has been acquired, Institutional Review Board Approval (IRB) from Florida International University (FIU) will be sought to ensure that the proposed project is ethically sound. Following IRB approval,

recruitment of anesthesia providers working in the facility will begin. Using an internal email directory for the healthcare facility, all anesthesia providers currently employed at the practice site will be sent an educational flyer about the study. Anesthesia providers who are interested in acquiring education about AO for the difficult airway patient will be asked to respond to the email indicating their interest such that the principal investigator will be able to contact providers regarding informed consent and scheduling for the educational module. All interested participants will have two weeks to respond to the invitation for participation in the project.

Concurrent with the recruitment of anesthesia providers at the site will be the creation of an educational program regarding AO and its use in the difficult airway patient. The educational module will be created by the principal investigator and will be evaluated and approved by the site preceptor. Evidence-based materials and educational methods will be used to develop the module and the contents of the module will be based on a review of AO including the techniques used for providing patient care, a review of the evidence to support the use of AO in practice, and information regarding how AO improves the care of the difficult airway patient. Once the educational module is approved by the site preceptor, anesthesia providers initially expressing interest in participating in the project will be contacted via email with instructions regarding completing informed consent to participate in the project. The email will include a written informed consent form that interested participants will need to sign and return before being formally invited to attend the educational module. Anesthesia providers wishing to participate in the project will have two weeks to sign the informed consent form and return it via email. The forms can be printed, manually signed, and scanned or they can be digitally signed by the provider before being returned.

After all providers interested in participating in the project have returned their informed consent forms via email, a Doodle poll to gauge availability of providers to attend the educational session will be sent via email. Providers wishing to participate in the project will have two weeks to respond. After the data is collected from the Doodle poll, a day and time that is convenient for all or most participants will be selected to present the educational module in a face-to-face environment. This information will be shared with participants via email. For providers that want to attend but cannot, the educational module will be digitally recorded and placed online for review.

Conference space at the facility large enough to accommodate interested participants will be reserved for the date and time selected and all participants returning informed consent forms will be provided with the date, time, and location of the presentation via email. For providers that cannot attend, information about the digitization of the module will be sent via email to inform them that they can still participate if they are interested. Providers who cannot attend the live module but wish to review the digital video will be provided with follow-up instructions following the completion of the live module. On the day scheduled for the live presentation, anesthesia providers attending in person will be asked to complete a demographic questionnaire and a pre-test of their knowledge regarding AO. Because extensive research regarding educational modules for AO is not currently available, the pre- and post-intervention knowledge assessments will be created by the principal investigator and will include questions directly related to the module. The educational module will include an interactive PowerPoint presentation and a case study to facilitate provider knowledge. Following the completion of the module, providers will again be asked to complete a knowledge assessment. This assessment will

include the same questions from the pre-intervention knowledge assessment with the questions rearranged to help reduce test bias.

Following the completion of the live session, an email will be sent to providers that completed informed consent but could not attend. The email will include the same demographic questionnaire and pre-intervention assessment given to anesthesia providers attending the live session. Providers will be asked to return the completed assessment within two weeks. After providers return their completed assessments, they will be provided with a link to the digital educational module and the post-intervention assessment. The post-intervention assessment will be the same as the one provided to practitioners who attended the live session. Anesthesia providers will be given two weeks to watch the educational session and then to return the completed post-intervention assessment. After all of the assessments have been collected from both the live and digital educational module, the pre- and post-intervention assessments will be evaluated with scores recorded in an Excel spreadsheet.

Protection of Human Subjects

The protection of human subjects in the proposed project will be addressed in several ways. First, IRB approval for the study will be acquired from FIU to ensure that the study does not violate any ethical principles including causing harm for participants. Second, all anesthesia providers wishing to participate in the project will be required to complete a written informed consent form. This will ensure that providers are aware of the harms and benefits of the project as well as their rights in participating the project. Third, no personal identifying information for the participants will be collected. While those attending the educational module in person or virtually will be asked to provide demographic data, this data will not include names, addresses, phone numbers, etc. that would make it possible to identify the participant outside of the project.

Finally, no personal identifying information about participants will be published or attached to any project documents created for disseminating project results.

Data Collection

A review of the procedures provided above does indicate that a demographic survey and a pre-/post-intervention knowledge assessment will be used to gauge the effectiveness of the educational module in increasing anesthesia provider knowledge of AO. The demographic survey will consist of general questions regarding the provider's age, gender, race, and current level of education: MD, DO, CRNA, PA, etc. As noted, there are no standardized or validated knowledge assessments for AO in the literature. Consequently, the principal investigator will be responsible for creating these materials based on the educational module. Content validity of the assessment tool will be confirmed through consultation with two anesthesia providers working outside of the clinical setting and a nurse educator. Anesthesia providers will be asked to review question content and to make suggestions for improvement where possible. The nurse educator will be asked to review the assessment tool for question bias and clarity. Demographic questionnaires and pre-intervention knowledge assessments will be conducted before the educational module and post-intervention knowledge assessments will be conducted following the completion of the educational module.

Data Analysis and Management

Data analysis for the project will include the use of descriptive statistics to describe the characteristics of the participants. More specifically, mean and frequency as well as standard deviation will be applied to the collected demographic data to provide an overview of who participated in the project. Knowledge assessments from the pre- and post-intervention phases of the project will also be scored and descriptive statistics including mean and standard deviation of

scores will also be completed. Inferential statistics, including the use of a paired t-test will be used to compare pre- and post-intervention knowledge scores. It is anticipated that scores will change as a result of the educational intervention. By utilizing a t-test to compare pre- and post-intervention scores it will be possible to determine if the change in scores is statistically significant, implying a cause-effect relationship. An alpha value of 0.05 will be used to delineate statistical significance in the project.

Data management for the project will include several steps to ensure that the integrity of the data is maintained throughout. All email communication with potential and actual participants will be stored on a password protected laptop that will only be accessible to the principal investigator. Further, all electronic data captured for this project including demographic forms, informed consent, knowledge assessments and Excel spreadsheets used to evaluate the data will be stored on the same password protected laptop. Hardcopy forms including demographic questionnaires and knowledge assessments collected during the live educational session will be kept in a locked filing cabinet that can only be accessed by the principal investigator. The data for this project will be destroyed 5 years following the completion of the project. This includes professional shredding of all hardcopy documents and professional removal of data from the hard drive of the laptop.

Discussion of the Results

It is anticipated that a positive change or increase in anesthesia provider knowledge will result from providing education to use apneic oxygenation for the difficult airway patient. Over time, increases in knowledge for providers should result in behavioral changes in practice to increase anesthesia provider use of OA in practice. Evidence supporting the use of AO in practice does indicate that this intervention improves outcomes for patients^{1,4} and providers^{6,7}

with the potential to reduce care costs for the difficult airway patient.¹³ The application of evidence to practice is noted by the American Association of Colleges of Nursing's (AACN) Essentials for Doctoral Education for Advanced Nursing Practice to be one of the nine fundamental skills that advanced practice nurses should possess. By completing this project, this element of the AACN's essentials will be met.³⁵

Additionally, scholars³⁶ reviewing the role of the advanced practice nurse argue that those in these roles must serve as leaders and must work to improve the healthcare system. Given the tangible benefits that can be achieved through the use of AO in practice, it would seem that by completing this project, the advanced practice nurse would be able to fulfill these vital roles in healthcare and the nursing profession. Advanced practice nurses are also expected to contribute to the improvement and betterment of the profession.³⁷ Completion of the project will augment the field of advanced nursing practice, and dissemination of the results both internally and externally should lead to the improvement of nursing practice not just at the practice site where the change was implemented but all across the healthcare system where anesthesia providers work and must provide care for difficult airway patients.

Timeline

To further foster concrete operationalization of the proposed DNP project a timeline for the completion of key activities related to the project is included below. Table 1 provides an overview of the key activities germane to the completion of this project along with the time frame in which a specific activity will be completed. All project components in the table will be completed over the next 12 months starting in January 2022 with a target completion date of December 2022.

Table 1*Timeline: Key Activities and Timeframe*

Key Activities	Timeframe for Completion
Acquire organizational approval.	January-February, 2022
Acquire IRB approval from FIU.	January-May, 2022
Create educational module.	June-July, 2022
Recruit anesthesia providers from the facility.	August, 2022
Provide education in person and virtually.	September, 2022
Collect and record data.	September, 2022
Analyze data.	September, 2022
Write final report.	October-November, 2022
Disseminate results.	December, 2022

Results

A total of five certified registered nurse anesthetists working at the practice site agreed to participate in the project. A summary of the demographic information from the sample is provided in Table 2. The sample included $n = 3$ females (60%) and $n = 2$ males (50%) with an age range between 25 and 55 years of age. The sample included $n = 3$ Caucasian (60%), $n = 1$ Hispanic (20%) and $n = 1$ nurse of mixed ethnicity. Of those participating in the study, $n = 1$ held a masters degree and the remainder held a doctorate ($n = 4$; 80%). A majority of the project participants had been in their roles for 1-2 years ($n = 4$; 80%).

Table 2*Demographic Data for Project Participants*

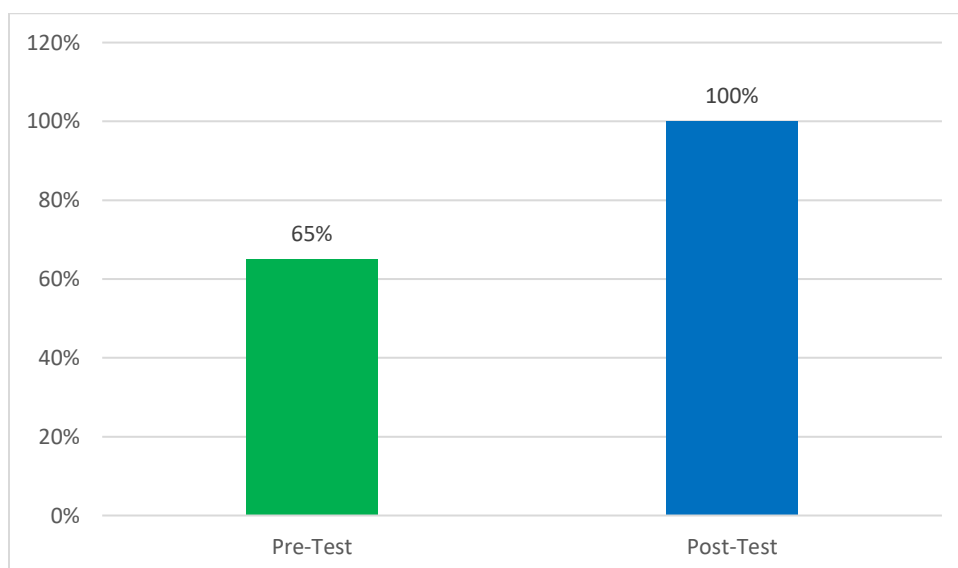
Variable	Response (n, %)
Age	22-55 Years
Gender	
Male	2 (40%)
Female	3 (60%)
Ethnicity	
Caucasian	3 (60%)
Hispanic	1 (20%)
Mixed Race	1 (20%)
Level of Education	
Masters	1 (20%)
Doctorate	4 (80%)

Years in Current Role	
1-2 Years	4 (80%)
10+ Years	1 (10%)

Data collected from this project also included knowledge scores that were obtained from a pre- and post-intervention assessment of knowledge. Specifically, all participants were asked to complete a 15-item knowledge test before and following the educational intervention. Each of the assessments were scored and the average (M) was assessed. Figure 1 provides a visual representation of the mean scores before and after the educational program. The data indicate that before the educational intervention, mean knowledge scores were 65%, suggesting that most participants did not possess adequate knowledge of apneic oxygenation before the educational program. Following the program, however, mean scores increased to 100%, suggesting that knowledge levels of providers completing the project had increased. Due to the small size of the sample, it was not feasible to inferentially evaluate differences in pre- and post-test knowledge scores.

Figure 1

Change in Mean Knowledge Scores from Pre- and Post-Test



Discussion

The results of this quality improvement project did indicate that the use of an educational program facilitated an increase knowledge among anesthesia providers regarding the use of apneic oxygenation in the difficult airway patient. Evidence provided in the literature consistently demonstrates that most anesthesia providers lack the knowledge and skills needed to utilize apneic oxygenation as a standard part of routine care in difficult airway patients.⁵ The use of apneic oxygenation has been shown to be effective and to have myriad benefits for providers—increasing first pass rate⁶—and for patients—reducing morbidity and mortality associated with intubation.⁷ Given these benefits and the fact that there are no significant adverse events associated with the use of apneic oxygenation, integrating this practice as part of standard care for the difficult airway patient was viewed as being an important improvement for current clinical practice. Although the results of this study are not indicative of an increase in the use of the technique among anesthesia providers, the results indicate that providers involved with the project now have the knowledge to utilize AO in practice.

A comparison of the results from this quality improvement project to the current literature on provider education to increase the use of AO suggest that because provider knowledge of the technique has increased significantly, this should result in changes in practice. For instance, McKown et al² noted that when anesthesia practitioners were provided with education for the use of AO, use of this technique increased, resulting in a decline in hypoxemia for patients. This was confirmed through 2 separate randomized controlled trials. Further, Pek et al,³⁰ found that following the use of a provider education program for AO, there was a 76% increase in the use of this approach in practice. Thus, while it is not possible to state for certain that the results of this quality improvement project will lead to an increase in the use of AO and a

reduction in hypoxemia for patients, there is clearly evidence indicating that patient care will improve as a result of this intervention.

Limitations

Even though the results from this quality improvement project demonstrate positive gains in provider knowledge that are aligned with the current literature on the topic, it is important to note that there were some notable limitations to the project. In particular, the project was undertaken at a single site and utilized a small number of providers ($n = 5$). The use of a single site coupled with utilizing a small sample will impact the generalizability of the results. Similar outcomes utilizing the same educational program may not be achievable at other facilities or with other anesthesia providers. However, when the results of this quality improvement project are juxtaposed with the current literature on the topic, it becomes evident that there is a formidable and expanding evidence base upon which to utilize provider education in practice. For instance, Karlik and Aziz³¹ were able to demonstrate the efficacy of using classroom and experiential learning to improve provider knowledge and use of AO. Sohn et al³² reported that any type of provider training should be effective for increasing knowledge of AO to increase its use in practice. Consequently, the results, when combined do suggest that the educational tools used in this quality improvement project should lead to provider adoption of AO in the difficult airway patient.

Also of concern in this quality improvement project is the fact that provider use of AO in practice was not directly measured. As noted from reviewing the literature on provider education, there is evidence indicating that this intervention does work to directly increase provider use of the technique in practice.^{2,30,31,32} However, due to the short duration of this project, it was not possible to measure provider change in practice. Given that provider

knowledge levels did increase significantly, it is hypothesized that this will have a concomitant impact on the use of AO in practice. As a follow-up to the current project, it would be useful to survey providers in 3 to 6 months to determine if AO use has increased. Further, a review of patient records for this time period could be undertaken to assess the number of difficult airway patients, the use of AO, and the number of hypoxemic events that occurred. By reviewing this data, it would be possible to demonstrate the implications of the educational intervention on actual practice and patient outcomes.

Plan for Next Steps

Next steps for this quality improvement project would be to expand its use at the practice site and to measure long-term outcomes in terms of the use of AO in clinical practice. Although the focus of this quality improvement project was to increase provider knowledge, this increase in knowledge is being sought in an effort to increase use of AO in practice. Consequently, implementing an evaluation program to assess the use of AO in practice and to determine if provider use of AO increases following education would provide important insight into the efficacy of the educational program for improving patient care. While evaluating the long-term application of this educational program in the practice setting would be useful, expanding the educational module to include more nurse anesthetists would also be useful in ensuring that staff at the practice site are able to benefit fully from the educational program. Consequently, increasing the number of providers who have access to the training program at the practice site while also expanding project evaluation criteria would be a viable next step for expanding the project.

While optimizing the quality improvement project at the practice site would be a useful method for expanding the benefits of this intervention, expanding the project beyond the practice

site while also disseminating the results of the project will also be important next steps in the project. Ideally, the project should be expanded to other practice sites in the community where registered nurse anesthetists are currently employed. Including multiple sites within the community would strengthen the generalizability of the findings to all anesthesia providers. Program evaluations undertaken at different sites could pool the results to provide a generalizable foundation for making evidence-based practice change to integrate provider education to increase the use of AO in practice.

Dissemination of the results must also be considered both internally and externally. At the practice site a final executive summary will be emailed to all staff to review the findings from the project. Additionally, a poster presentation will be scheduled at the practice site to present the findings from the project. The poster will remain on display in one of the common areas at the facility such that providers can reference the project if needed. Publication of the work in a peer-reviewed scholarly journal would also be considered to expand the reach of the results and to influence evidence-based practice change in other healthcare facilities. Presentation of the work at a national conference would also be sought. Providing a poster presentation for nurses from other facilities and areas of the country would further help to expand practice change to integrate AO as part of patient care.

Plans for Sustaining Change

The plans for sustaining change will be based on efforts to extend the quality improvement project at the practice site. To ensure that the educational program is provided to all staff administering anesthesia an effort would be made to change policy at the facility to ensure that education is included as part of new staff orientation to the facility. In addition, policy would be sought to include the AO training program as part of staff annual training and

development. This will promote reinforcement of the material among current staff at the facility to help ensure that this information is integrated as part of providing patient care at the facility.

While reinforcing training for staff and for new hires will be important for sustaining the change over the long-term, the to sustain the change over the long-term, specific resources and supports must be dedicated to change. In particular, efforts will be needed to establish resources for ongoing monitoring of the project. This would include dedicated resources for monitoring the project and its results. Although consistent assessment of staff training would be helpful, to sustain the change over the long-term, an effort would be needed to identify specific patient metrics that could be tracked via the electronic health record to determine if AO techniques are being used in practice. Electronic medical records could be mined to determine the use of AO and outcomes for patients. This data must be aggregated and disseminated to promote ongoing facility support for the project. Securing this support would help to extend the project and ensure that providers are able to benefit from education over the long-term.

Implications for Advanced Practice Nursing

The advanced practice nursing role is one that is notably dynamic and complex. Advanced practice nurses are responsible for overseeing the holistic care of the patient while also working within their roles to enhance the delivery of care.³⁸ Although the current quality improvement project should lead to improvements in patient care, the project also clearly demonstrates the role of the advanced practice nurse as a leader in promulgating change within the healthcare system. While it is reasonable to believe that the educational program provided through this project will enhance the care of patients within the facility, through additional effort, including the dissemination of the results, it should be possible to make a significant change within the healthcare system.

What is evident from the literature is that AO can have a significant and profound impact on health outcomes for the difficult airway patient. Further, as demonstrated by this project, anesthesia provider education works to increase knowledge of AO and based on the current literature on the topic, to expand provider use of the technique in practice. Through a dissemination of the results from this project, it should be possible to not only improve patient care at the bedside but also to lead a change in the way that care is provided throughout the entire healthcare system. The current American Association of Colleges of Nursing (AACN) essentials for doctoral education in nursing³⁵ promotes the use of eight foundational competencies that should be achieved by each advanced practice nurse in entering the DNP role. A review of these essentials demonstrates that each has been achieved through the completion of this quality improvement project.

Essential I requires nurses to use a scientific underpinning for practice.³⁵ This was accomplished through the use of the literature to guide the current quality improvement project. Essential II from the AACN focuses on building organizational and systems leadership for quality improvement and systems thinking.³⁵ By tailoring the project to the specific needs of the organization and further by recognizing the need for disseminating the findings, it is possible to see that this essential has been met. The third essential from the AACN involves the use of clinical scholarship and analytical methods for evidence-based practice.³⁵ This project not only served to build provider knowledge in the clinical setting but also to measure and quantify the outcomes of this process. Essential IV involves information systems/technology and patient care technology for the improvement and transformation of healthcare.³⁵ Various technologies including those used for acquiring evidence (electronic journal databases) and those for

evaluating and collecting data were used as part of this project, enabling the project implementor to achieve this essential.

The remaining four essentials from the AACN have also been met through the completion of this project. Essential V focuses on healthcare policy for advocacy in healthcare.³⁵ Through the successful implementation of this project in practice, it should be possible to lobby for policy change within the facility to utilize AO in practice. Further, dissemination of the results should provide a foundation upon which to change the standards of care used by anesthesia providers in all care settings. Essential VI involves interprofessional collaboration for improving patient and population health outcomes.³⁵ To bring this project to fruition, expertise from nurses, physicians, librarians, and academicians was combined to build the evidence base and to implement the project in practice, suggesting that this essential has been met. Essential VII addresses clinical prevention and population health for improving the nation's health.³⁵ This project should increase provider use of AO to reduce hypoxemia resulting in better patient outcomes including lower morbidity and mortality. This will mean better outcomes for individual patients and for population health. The final essential involves achieving advanced nursing practice in which specialization in knowledge is built as a foundation for enhancing the foundation of nursing.³⁵ The specific focus on anesthesia providers through targeted education indicates specialization in this area of practice to demonstrate that advanced nursing practice has been achieved.

Conclusions

Synthesis of the findings from this quality improvement project do demonstrate considerable benefit for both providers and patients. Provider education regarding apneic oxygenation did increase knowledge of the technique and based on the current literature, does

suggest that this should have a positive impact on both increased use of the approach in practice as well as lowering the risk of hypoxemia in the difficult airway patient. The latter should translate into reductions in morbidity and mortality for this patient group. Also highlighted in this project is the fact that critical aspects of the advanced practice role have been effectively mastered. Through the completion of this project and a dissemination of the results, it should be possible to foster improvements in direct care practice while also fostering change regarding the standards of care for the difficult airway patient.

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Appendix A




Office of Research Integrity
Research Compliance, MARC 414

MEMORANDUM

To: Dr. Arturo Gonzalez

CC: Ian Diaz

From: Elizabeth Juhasz, Ph.D., IRB Coordinator 

Date: April 7, 2022

Protocol Title: "Anesthesia Provider Education to Increase the Use of Apneic Oxygenation in the Difficult Airway Patient: A Quality Improvement"

The Florida International University Office of Research Integrity has reviewed your research study for the use of human subjects and deemed it Exempt via the **Exempt Review** process.

IRB Protocol Exemption #: IRB-22-0141 **IRB Exemption Date:** 04/01/22
TOPAZ Reference #: 111553

As a requirement of IRB Exemption, you are required to:

- 1) Submit an IRB Exempt Amendment Form for all proposed additions or changes in the procedures involving human subjects. All additions and changes must be reviewed and approved prior to implementation.
- 2) Promptly submit an IRB Exempt Event Report Form for every serious or unusual or unanticipated adverse event, problems with the rights or welfare of the human subjects, and/or deviations from the approved protocol.
- 3) Submit an IRB Exempt Project Completion Report Form when the study is finished or discontinued.

Special Conditions: N/A

For further information, you may visit the IRB website at <http://research.fiu.edu/irb>.

EJ

Survey: Opening Statement

Dear Anesthesia providers:

My name is Ian Diaz, I am an SRNA conducting a DNP project on **Anesthesia Provider Education to Increase the Use of Apneic Oxygenation in the Difficult Airway Patient**. You are invited to participate in a survey regarding your current knowledge on the use of apneic oxygenation with the difficult airway patient via the Qualtrics platform. The survey is expected to take you approximately 10 – 15 minutes. You will not be asked to reveal any personal identifying information. The results will be reported in aggregate and may be presented in advocacy communications, journal articles, poster presentation, and/or as lectures. Short narrative quotes may also be included, but no identifying information will be revealed during the reporting of the results. We ask that you also forward this survey request to all your anesthesia colleagues. This will help us obtain the most comprehensive and robust data on this topic.

Purpose: Educational module to improve provider knowledge on the use of apneic oxygenation with the difficult airway patient.

Participation: You are being invited to participate in this study because you are an anesthesia provider. Participation is voluntary and if you choose to participate, you may stop at any time without any penalty. You may also choose not to answer questions that are asked in the survey.

Risks and discomforts: Any risks related to participation in this study are minimal. You may opt to skip any questions and you may stop the survey at any time. Best practices will be utilized to protect the confidentiality of survey data.

Benefits to you and others: The following benefits may be associated with your participation in this project: An increased understanding on use apneic oxygenation with the difficult airway patient. The overall objective of the project is to increase the quality of healthcare delivery and improve healthcare outcomes for our patients.

We thank you for your continued dedication to the anesthesia profession. If you would like to participate in the survey, please click on the following links:

Survey link_____

This project was approved by the Florida International University's IRB – If you would like to talk with someone about your rights pertaining to being a subject in this project or about ethical issues with this project, you may contact the FIU Office of Research Integrity by phone at 305348-2494 or by email at ori@fiu.edu. If you have any questions about the purpose, procedure, or any other issues related to this research project, you may contact Ian Diaz at 305-588-3799 or idiuz063@fiu.edu and Dr. Arturo Gonzalez at artgonza@fiu.edu.

Appendix B



February 1, 2022

Arturo Gonzalez, DNP, APRN, ANP-BC, CWCN-AP
 Clinical Assistant Professor,
 Florida International University

Dr. Gonzalez,

Thank you for inviting Memorial Regional Hospital to participate in the Doctor of Nursing Practice (DNP) project conducted by Ian Diaz entitled "Anesthesia Provider Education to Increase the Use of Apneic Oxygenation in the Difficult Airway Patient" in the Nicole Wertheim College of Nursing and Health Sciences, Department of Nurse Anesthetist Practice at Florida International University. I have warranted his permission to conduct the project using our providers.

Evidence-based practice's primary aim is to yield the best outcomes for patients by selecting interventions supported by the evidence. This project intends to evaluate if a structured education targeting providers will increase knowledge on the use of applying apneic oxygen techniques to reduce hypoxemia in difficult airway patients.

We understand that participation in the study is voluntary and carries no overt risk. All Anesthesiology providers are free to participate or withdraw from the study at any time. The educational intervention will be conveyed by a 15-minute virtual PowerPoint presentation, with a pretest and posttest questionnaire delivered by a URL link electronically via Qualtrics, an online survey product. Responses to pretest and posttest surveys are not linked to any participant. The collected information is reported as an aggregate, and there is no monetary compensation for participation. All collected material will be kept confidential, stored in a password-encrypted digital cloud, and only be accessible to the investigators of this study: Ian Diaz and Dr. Gonzalez. We expect that Ian Diaz will not interfere with normal hospital performance, behave in a professional manner and follow standards of care.

Prior to the implementation of this educational project, the Florida International University Institutional Review Board will evaluate and approve the procedures to conduct this project. Once the Institutional Review Board's approval is achieved, this scholarly project's execution will occur over two weeks. We support the participation of our Anesthesiology providers in this project and look forward to working with you.

A handwritten signature in blue ink that reads "Suzanne Hale".

Suzanne Hale, MSN, CRNA, ARNP
 Advanced Practice Provider Director, Broward and Dade
 Chief, Memorial Regional Hospital
 Envision Physician Services
 954-265-2044

Appendix C



CONSENT TO PARTICIPATE IN A QUALITY IMPROVEMENT PROJECT

Anesthesia Provider Education to Increase the Use of Apneic Oxygenation in the Difficult Airway Patient: A Quality Improvement Project

SUMMARY INFORMATION

Things you should know about this study:

- **Purpose:** Provide an educational module on the use of apneic oxygenation
- **Procedures:** Participate in a pre-test view and an Educational Module via voice over PowerPoint then participate in a post test
- **Duration:** This will take about a total of 20 minutes total.
- **Risks:** The main risk or discomfort from this research is minimal
- **Benefits:** The main benefit from this module is to increase the participant's knowledge on the benefits of apneic oxygenation
- **Alternatives:** There are no known alternatives available to you other than not taking part in this study.
- **Participation:** Taking part in this research project is solely voluntary.

Please carefully read the entire document before agreeing to participate.

PURPOSE OF THE PROJECT

The goal of this project is to enhance providers knowledge about the use of apneic oxygenation. You are being asked to participate in this quality improvement project.

DURATION OF THE PROJECT

Your participation will require about 20 minutes of your time, you will be one of 15 people in this study.

PROCEDURES

If you agree to be in the project, we will ask you to do the following things: Participate in a pre-test, view an Educational Module via voice over PowerPoint then take a post test.

RISKS AND/OR DISCOMFORTS

Minimal risk, risk not greater than if participant was conducting similar activity. Physical, psychological, social, legal, and economic risks minimal and no greater than if a participant was participating in a similar activity. Similar activity such as filling out an online survey and watching voice over PowerPoint.

BENEFITS

The following benefits with your participation in this project: Increased knowledge regarding the use and benefits of apneic oxygenation.

ALTERNATIVES

There are no known alternatives available to you other than not taking part in this project. However, if you would like to receive the educational material given to the participants in this project, it will be provided to you at no cost.

CONFIDENTIALITY

The records of this project will be kept private and will be protected to the fullest extent provided by law. If, in any sort of report, we might publish, we will not include any information that will make it possible to identify you as a participant. Records will be stored securely, and only the project team will have access to the records.

PARTICIPATION: Taking part in this research project is voluntary.

COMPENSATION & COSTS

There is no cost or payment to you for receiving the health education and/or for participating in this project.

RIGHT TO DECLINE OR WITHDRAW

Your participation in this project is voluntary. You are free to participate in the project or withdraw your consent at any time during the project. Your withdrawal or lack of participation will not affect any benefits to which you are otherwise entitled. The investigator reserves the right to remove you without your consent at such time that they feel it is in the best interest.

RESEARCHER CONTACT INFORMATION

If you have any questions about the purpose, procedures, or any other issues relating to this research project, you may contact Ian Diaz at (305)588.3799, email: idi063@fiu.edu, or Dr. Arturo Gonzalez artgonza@fiu.edu.

IRB CONTACT INFORMATION

If you would like to talk with someone about your rights pertaining to being a subject in this project or about ethical issues with this project, you may contact the FIU Office of Research Integrity by phone at 305-348-2494 or by email at ori@fiu.edu.

PARTICIPANT AGREEMENT

I have read the information in this consent form and agree to participate in this study. I have had a chance to ask any questions I have about this study, and they have been answered for me. By clicking on the “consent to participate” button below I am providing my informed consent.

Appendix D**Pre-/Post-Test Questionnaire**

Multiple Choice Instructions: Select and circle the best answer for the question. Where noted, check all correct answers that apply.

1. In the clinical setting safe apneic with preoxygenation can last _____.
 - A. 8 minutes
 - B. 3-5 minutes
 - C. 1 minute
 - D. 45 minutes

2. What is the purpose of apneic oxygen (select all that apply):
 - A. Flush dead space
 - B. Generate positive airway pressure
 - C. Clear carbon dioxide from the lungs
 - D. Reduce inflammation in the lungs

3. How long can apneic oxygen extend safe apnea time without serious complications for the patient?
 - A. 100 minutes
 - B. 45 minutes
 - C. 8 minutes
 - D. 2-3 minutes

4. When does safe apnea time end?
 - A. When SpO₂ declines to 95%
 - B. When SpO₂ declines to 90%
 - C. When SpO₂ declines to 85%
 - D. After 20 minutes
5. If safe apnea time is extended to 100 minutes through AO what complications can occur:
 - A. Hypoxemia and acidosis
 - B. Hypercapnia and acidosis
 - C. Hypoxemia and hypercapnia
 - D. None of the above.
6. What is required to apply and maintain apneic oxygen (check all that apply):
 - A. A patent airway
 - B. Hemodynamically stable patient
 - C. Preoxygenation
 - D. All of the above
7. All of the following are considered to be benefits of apneic oxygenation for patients
EXCEPT:
 - A. Reduced patient morbidity.
 - B. Reduced patient mortality.
 - C. Reduced patient length of stay.
 - D. Reduced blood pressure.
8. All of the following are considered to be benefits of apneic oxygenation for providers
EXCEPT:

- A. Improved first pass rate
 - B. Increased patient volume
 - C. Low costs
 - D. No additional training required
9. Bag-valve masks are often used to perform AO. What other tool can be used:
- A. Nasopharyngeal catheters
 - B. Nasal prongs
 - C. Endotracheal tubes
 - D. All of the above
10. When administering AO, if O₂ saturation dips below 95%, what should be considered:
- A. Stop administering AO.
 - B. Increase nasal cannula flow rate.
 - C. Provide positive pressure.
 - D. Decrease nasal cannula flow rate.

True or False Directions: Circle the correct answer (true or false) for the following statements.

11. Apneic oxygenation can be used as a substitute for preoxygenation.

True

False

12. When providing apneic oxygenation, oxygen flow rates should be maintained above 70 mL/min.

True

False

13. Barotrauma is more likely to occur when AO is administered with a nasal cannula flow rate between 15 and 30 mL/min.

True

False

14. Apneic oxygen can be used with little training, costs, and harm to the patient.

True

False

15. In an overweight patient, it is reasonable to assume that AO will increase safe apnea time by 45 minutes.

True

False